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The Turkish Online Journal of New Horizons in Education, AECT, Governors State University, Sakarya University, Ohio University and other international universities will organize International New Horizons in Education Conference (INTE-2015) between June 10-12, 2015 in Barcelona, Spain (www.int-e.net). INTE series is an international educational activity for academics, teachers and educators. This conference is now a well-known education science event. It promotes the development and dissemination of theoretical knowledge, conceptual research, and professional knowledge through conference activities. Its focus is to create and disseminate knowledge about education science and teacher education.

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I am always honored to be the editor in chief of TOJNED. Many persons gave their valuable contributions for this issue.

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January 01, 2015

Editor-in-Chief,
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AN EVALUATION OF TWO ESP COURSEBOOKS USING REVISED BLOOM TAXONOMY

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ABSTRACT

The choice of teaching materials and a coursebook that will be used in a language classroom is one of the crucial factors that may create significant differences in teaching and learning process. Hence, the teacher should pay thorough attention to determine the most appropriate teaching materials and coursebook for the particular classroom. This paper reports an analysis of two English for Specific Purposes (ESP) coursebooks in terms of language skills and subskills as a cognitive ability to choose the most appropriate coursebook between two for the specific teaching context. The criterion in the evaluation of the coursebooks will be based on four knowledge dimensions (factual, conceptual, procedural and meta-cognitive knowledge) which overlap the cognitive processes (remembering, understanding, applying, analysing, evaluating and creating) of the Revised Bloom Taxonomy. The evaluation will be quasi systematic; however, it will also be influenced by non-systematic qualitative judgments made by the teacher. These are based on the knowledge and understanding of the teacher who knows the requirements of students in this course. The study would provide some implications based on the findings to teachers and/or material designers for effective teaching, material development and production.

Keywords: English for Specific Purposes (ESP), coursebook evaluation, Revised Bloom Taxonomy

1. INTRODUCTION

We are reminded by Fraidan (2012) that as teachers we are involved on a daily basis with the task of evaluating the materials that are used to teach students. However, he argues, the informal methods that we inevitably employ are not enough if we are to gain the maximum value for the students who we teach. It is therefore necessary to "conduct systematic evaluations." One important point in considering which materials to evaluate is how relevant they are to the specific needs of the students, something it is argued that will be of particular pertinence for an English for Special Purposes (ESP) course. The choice, furthermore, will inevitably be limited because it would not only be impossible to give consideration to every possible book available but it would also not be financially viable. This puts even more pressure on the evaluation process.

However, while it is of necessary interest to justify the evaluation of course material in a systematic manner, it is also important to gain an understanding of how the process may begin. McDonough and Shaw (2003) make some relevant introductory, even basic, points about the initiation of the process. For example, it is pointed out that there are many different settings and motivations which underpin the teaching of English and these have never been as varied and wide-ranging as they now are. However, despite these wide variances, a "common core" can be identified which means that there are some facets to the teaching of English which are universal and McDonough and Shaw (2003) identify two, which are the setting in which the teaching will take place and the pedagogic principles which will guide the construction of the materials which are to be used. These latter principles will include the mother tongue of the students, their educational level and academic achievements and their attitude towards learning English. This is not to suggest that students may be unwilling to learn, or that they will be hostile; however, if the purpose is very specific, they may only be likely to be interested in perceived immediate benefits as related to that specific area; therefore, more abstract areas which may be important in order that they better understand the specifics may be misjudged.

These aspects will also be connected with factors such as "the role of English in the country" from which the students hail as well as the role of English plays within the school – its positioning in the curriculum (McDonough & Shaw, 2003, p. 7), which will be related to its role in the country. Consideration of these points in mind, a teacher can embark on a scanning of the book to see how well it is aligned with the setting and the pedagogic principles involved. The table of contents, for example, would be a good place to start, followed by a consideration of the content, obtained by quickly checking the text under some key headings, which will have been identified from the contents section. This will give the teacher a general feel for the book and can be seen as a screening process – it should enable him or her to establish

whether the book is at all suitable and, if it is not, he or she can reject it without wasting more time in further exploring it. This would then lead to the next stage with the selected book(s) and he or she can then conduct an "in-depth analysis of the materials" (Fraidan, 2012, p. 43). While this may be seen as a universal approach to a textbook evaluation, other methods can be applied but they may have some drawbacks. Nevertheless, they will be given consideration within this study. Having introduced the topic and given a broad indication of the approach(es) that will be taken, the aim of the study and ancillary issues can now be discussed.

2. AIM OF THE STUDY

The teaching context in which the chosen coursebook will be used is comprised of first-year learners of English who are studying in Management Department of a private university in Turkey. The learners are a group of mixed ability who are learning English because they perceive or their parents perceive that they will benefit from following an ESP course that focuses on English for business. However, a considerable amount of learners regards English as a course to pass and there will be no necessity in their future work. This places a number of constraints on the teacher and these include the fact that there are expectations from all of the students that they will pass the course but that this expectation extends, within some of them at least, to an assumption that this will be allowed regardless of their efforts. On the other hand, one strength of the course from a teaching perspective is that there are some very willing learners who have a good aptitude and attitude to the work. Taken as a whole, however, this puts the teacher in a position where a minimum standard must be reached, even by the indifferent learners regardless of their expectations, but at the same time this person feels a vocational compunction to take the others, those who could reach a high level by the end of the course to their full potential.

With regard to the institution, it can be said that it tries to face in two asymmetric directions. This is because there is a 'traditional' expectation that most if not all of the students, as paying customers, should pass their course, but on the other hand there is a realist view that this undermines and potentially de-motivates not only the teachers but is also likely, over the longer term, to undermine the perceived value of the institution as a serious place for learning. With regard to the design of teaching and learning, the institution and owners of it follow the principle that the teachers should design their own curriculum and that this should be tailored by these teachers to the course(s) that they are teaching. The philosophical approach of the institution and its owners towards learning is a little difficult to pin down but it is predominantly based in the fact that the teaching of English here at least is very much based in market economics – in other words in money and takings. This leads to a more refined statement of the problem.

2.1 Problem statement

The institution at which the teacher works is only moderately supportive of educational standards. Alongside this, the students on an ESP course that is focused on teaching Business for English have a wide range of attitudes and application. This means that there is a quandary about what the best methods are and the best materials that will allow those who have the ability and skills to reach the highest possible standard while optimising the limited potential within the less motivated group. It is also necessary that sufficient and proportional attention should be paid to those students who are between these two extremes.

2.2 Research Question

The choice of textbook has been narrowed down to two. This leads to the question that this essay will attempt to address, which is:

> *Given the situation that exists within the institution and the specific course discussed, which of two textbooks is the most suitable for using on a specific ESP course*

3. METHOD

Although this section is described as being that which will introduce and discuss the method(s) that were used to analyse the two textbooks, it is taken in its widest context, which effectively means that the section will include discussions of how the methods were applied. Bearing in mind that the section which follows it is titled 'Findings and Discussions,' this is believed to be the appropriate way of addressing this, the method(s) section. The first part of this section therefore reviews and discusses some literature, paradigms and theories relevant to the evaluation that will subsequently be undertaken.

3.1 Review of literature, theories and paradigms

Littlejohn (2012) makes a number of salient points which can be used to guide the general process for a book evaluation as well provide some useful suggestions – pitfalls that should be avoided if possible. One main concern expressed is

that a scrutiny of texts can effectively mean "general, impressionistic judgments" which may be done at the expense of a more detailed examination, the result being a poor or inappropriate choice (p. 181). He (2012) also argues that typical for the teacher to make implicit judgments about the materials and what they "should look like" (p. 143) focuses to a great extent on the underlying rationale that leads to the creation of materials and how this may align with the needs of students of English. With the fact of the differing needs of students in mind (a very relevant point with regard to the identified needs of the students in question), Tomlinson (2012) suggests that ideally the materials should "aim to provide all these ways of acquiring a language for the learners to experience and sometimes select from". However, asymmetry with these needs may exist in practice because most materials in reality place emphasis on "providing explicit teaching and practice" (p. 143). This reality in turn is based in the fact that "most commercially produced materials focus on informing their users about language features and on guiding them to practise these features" (Tomlinson, 2012, p. 143).

A scrutiny of a range of literature regarding textbook evaluations and those conducted on books that are concerned with the teaching of English brought attention to the fact that one theoretical area that has been often used in evaluations is Bloom's taxonomy as well as, more recently, the revised version of it. A more detailed study of this taxonomy revealed that it is not a theory that is unique to the teaching of English as a second language. Indeed, it has been applied in a number of disciplines. The question is what it is and how it may be useful? Razmjoo and Kazempourfard (2012) explain that the revised version of the taxonomy has a dual aspect to it, something that was lacking in the earlier version. This means, for example, that it is not just concerned with the knowledge learned but also with the kind of learning expected by students. This is, surely, a critical juncture for consideration and one which can only benefit a systematic evaluation of text books and other teaching materials if it is appropriately applied. The structure of the revised Bloom paradigm is that if we take s grid and along the x axis place the cognitive dimensions and along the y axis the knowledge dimensions, the point where they meet will be the area of attention from the perspective of both parameters. Along the cognitive dimension, for example, may be placed 'remembering,' 'understanding,' 'applying,' analysing,' 'evaluating' and 'creating.' Along the y axis may be placed, for example, the areas of knowledge such as factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge as seen in *Figure 1* below (Razmjoo & Kazempourfard, 2012, p. 174). Then the cognitive aspects of each knowledge area can in turn be assessed.

Knowledge dimension	Cognitive Process Dimension					
	Low order thinking skills ⟶ High order thinking skills					
	Remember	*Understand*	*Apply*	*Analyse*	*Evaluate*	*Create*
Factual knowledge						
Conceptual knowledge						
Procedural knowledge						
Meta-cognitive knowledge						

Figure 1. The structure of Bloom's revised taxonomy by Anderson (2001)

A further useful point is made by Razmjoo and Kazempourfard (2012), is the usefulness of a coding scheme for each area, which they utilised for conducting an evaluation of two books within their study. Thus, as each area within the books was considered, a code was assigned which identified the parameter within which the particular aspect of teaching could be positions. Thus, exercises or materials that focus on remembering within the four knowledge areas are respectively assigned A1, A2, A3 and A4. The exercises that focus on understanding within the four knowledge areas would be assigned B1, B2, B3 and B4 etc.

Soleimani and Ghaderi (2013) suggest that textbooks have come to be seen as extremely important in the teaching of English, taking on a status that almost goes beyond their practical use. This importance placed on them as a central part of the teaching and learning arena is despite the fact that, for some authors at least, they should be criticised and have a number of disadvantages as well as some advantages. It is also despite the fact that there is competition from "the

development of new technologies that allow for higher quality teacher-generated materials." The criticisms include the fact that many textbooks are undoubtedly culturally as well as socially biased and, importantly, do not allow students to be a part of the process which designs curricula. By definition, furthermore, they assume to know the needs of every student on every course that is using the textbook when the reality is that this is an impossible task. On the other hand, if the teacher regards the book highly and has a good understanding of its underlying aims with regard to students, in other words is felt by the teacher to be aligned with his or her approach to teaching, a textbook can be seen as a starting point from which to explore with the students. Furthermore, while it may not always follow the requirements for as specific course, and may be seen as being outdated if it does, a textbook will probably be seen as a necessity by at least some students – a fall back for revision or even as a supplement that can be used to fill in gaps that they may have missed or may not fully have understood.

Whether a teacher is on one side of this argument or not, the likelihood is that a text book will be necessary and therefore the evaluation of any that may be used will be important. This importance swells considerably if the teacher believes that text books should be central to any course. For this reason, Soleimani and Ghaderi (2013) contend that a textbook evaluation is a key task that should be undertaken by teachers but the question that is posed is what the best approach to evaluation is? They note the two stage model proposed by McDonough (2003), as has been discussed within this paper as well as the notion of coding in order that the evaluation is appropriately systematic. Indeed, Soleimani and Ghaderi (2013) add to this the notion of a checklist so that aspects within all areas of the book are adequately evaluated.

Keshta and Seif (2013) discuss the existing literature with regard to course material evaluation and decide that a qualitative approach is the most likely to elicit the most accurate results. In order to achieve their goals, they first develop an analysis card which sets some criteria, or subjective opinion, of the material being considered and ask 16 teachers to give their opinion on this material as compared to the yardstick produced. In order to provide some validity to their yardstick, the content analysis card, the researchers asked two experts to provide an opinion on its value. Thus, the important focal point for the structured interviews with the selected respondents was developed and within this the researchers "included the needed items for evaluating the three higher cognitive skills" (Keshta & Seif, 2013, p. 58). Following this, the items were given to the experts for their opinion, as noted above. Interestingly, the materials were taken from a government produced set and thus are those that are commonly used in the education of students in the country in question, Palestine. The materials were split into two areas, Student Book (SB) and Workbook (WB), and each was considered separately by two experts. The results of their expressed opinions were statistically analysed and the results of this analysis showed that there were 66 points of agreement out of 69 from one of the two areas and 28 out of 28 points of agreement for the other. This meant correlation coefficients of 95.6 and 100 respectively. This, the authors posit, provided the required validity for the instrument (Keshta & Seif, 2013, p. 59).

The results of the structured interviews carried out with the teachers showed that "higher order cognitive skills in reading comprehension exercises are not well covered, not well treated nor well distributed. There is a lack of progression from the lower cognitive skills to the higher ones." Furthermore, that while "some skills have a high rate of frequency, others have a very low rate of frequency. e.g., the sub skill 'predicting events or solutions related to the text' takes place 9 times whereas 'discuss to persuade' sub skill takes place only once." This leads the authors to conclude that the "findings do not match the general objectives of teaching reading in English for Palestine stated by the Palestinian Ministry of Higher Education" (Keshta & Seif, 2013, p. 67). Several points can be made about this interesting and illuminating work. The first is that all studies within this area are subjective and must be based, in the final analysis at least, on the perceived value of work. Therefore regardless of how 'structured' or 'systematic' a work may claim to be, it must be based in a qualitative evaluation. It can be argued that the authors take this to its rational end by deepening the approach. This must be one strength and another is the fact that a range of professionals (teachers) were used as key respondents. Hence, the results are subjectively justified by professional opinion, especially as the instrument, the content analysis card, was verified by two experts. However, while the work has this undoubted strength, it relies on the opinion of those who deliver the content rather than those (the students) who were the recipients of it. The question is whether such a reliance on professional infallibility is epistemologically acceptable.

Viswanathan and Murthy (2011) focus their attention on the questions for students in textbooks and argue that these do not sufficiently stretch or even appropriately test the cognitive abilities and potential of the students who are following courses based in these books. In order to substantiate their claims, the authors extend the questions in a text book by supplementing some of their own (Viswanathan & Murthy, 2011, 189). The study thus had three aims, which were to analyse the content and questions within a computer textbook, to then extend these by adding questions developed by the authors and finally to test whether these added and more challenging questions could be adequately answered by students who were using that computer text book. One point that should be made is that in order to maintain some rigour in their study, Viswanathan and Murthy (2011) only exposed the students to questions that were of a higher order and that the questions had not been tackled before (the students had already completed the lower level questions in the book). This meant that the questions in terms of type and content were new challenges for the students. The results of

the study suggest that students are generally able to answer the higher level questions and that in order to answer "questions that involve skills of analysing, evaluating and creating. This alone should encourage teachers and curriculum designers to include questions that target higher cognitive levels in the revised Bloom's taxonomy" (Viswanathan & Murthy, 2011, 193). If these results are accepted, it may have a significant influence on the writer as the evaluation in this study proceeds. We can recall that one problem identified was how the students who were likely to be able to achieve a high level of success on the course could be consistently challenged while at the same time retaining the interest and maximising the potential of more mediocre as well as less motivated students.

The necessary review of existing work, which may have relatively little value for the work in hand, can be seen by the extent to which the final method that will be adopted by the teacher has been guided by some of the work even indirectly. While, for example, the necessity for a systematic approach is acknowledged, it is argued that this should not compromise the subjective opinion of the writer, based in the epistemological stance that this person has. We can recall that epistemology requires at least truth, belief and justification for knowledge to be acceptable as such and therefore the method used must be believed to be true by the teacher. The justification for the approach comes in the methods used but the underlying values are those that are within the mind of the teacher.

4. FINDINGS AND DISCUSSION

The subjective freedom that the teacher has allowed means that a strongly systematic approach is not necessary for the initial review of the contents pages of each of the books that are being evaluated. This is the starting point for this section.

4.1 The contents section

The initial parts of the method that will be used have been discussed above and these can be summarised. The contents page of the first textbook – Business Result Pre-intermediate Student's Book, by Grant, Hudson and McLarty (2009), sets out 16 sections and each has an accompanying video. This suggests a reasonable amount of interactivity, something which is confirmed by a perusal of the sub sections within each chapter. For example, the first part of the first chapter introduces some basic business words, then aspect of language and sentence structure (presumably using these words), followed by practical language (how to make polite requests), then socialising and using language in social situations. This is followed by a case study as well as activities which are centred on the making of contacts. The chapter rounds off a consideration of the outcomes of it – what the students should be able to do etc., effectively a review of the topics covered. A further example of the chapters can be given, this time the last one, which again has a video and, as it is the last chapter, focuses on careers, career paths, making decisions, strengths, weaknesses etc. It then moves on to grammar revision and a presentation by the individual student, how to appropriately say good bye in English, then a case study and activities that revolve around 'ambition.' The chapter and, indeed the book as a whole, draw to an end with a revision session of all of the topics covered in the chapter.

The second book – Market Leader Business English coursebook by Cotton, Falvey and Kent (2007) sets out the 'Map of the Book' and the immediate impression gained is that this book is set out in a different, perhaps more pragmatic and business-like manner, with a total of 12 units and several revision units interspersed within these. The contents of each unit have similar features to those of the book by Grant et al. (2009), for example, the first chapter begins with a discussion about careers and then moves on to a discussion about how a career can be built and includes listening skills in the form of two people having a conversation about how a career can be improved. The next part of the first chapter introduces words associated with careers and this leads to the last but one section, which is about telephoning and making contacts. The chapter comes to a conclusion with a case study of an applicant for a sales management vacancy. The following chapters follow the same format – discussion, texts, language work, skills and a case study and this leads to a focus on the final chapter. This begins by asking the students to have a discussion about their favourite products, followed by an article from the Financial Times about rain forests and listening to five people talking about a topic. Following this, there is a section about adjectives and passives and then the skills section, in which the topic is the presenting of a product. Finally, there is a case study and a report writing exercise.

This initial part of the book evaluation process suggests to the writer that each has its own strengths – the first, by Grant et al (2009), seems that it may have more tools in the form, for example, of a dedicated video that accompanies each chapter and it seems almost as if it is aimed at a moderate, perhaps less serious learner. The book by Cotton et al (2007), on the other hand, gives the appearance of being more serious, more dedicated to a diligent student who is eager to learn, with case studies and reports from the Financial Times etc. The contents of both books have similarities but when the writer pictures the classroom setting and the requirements of the course against the points made, there is a feeling of leaning towards the book by Cotton et al (2007), although there is nothing decisive yet. There is enough, for example, judging by the contents in the book by Grant et al (2009), to suggest that it certainly should not be rejected at this stage. We proceed, therefore, to a more in depth look inside each textbook.

3.3 Factual and conceptual knowledge

The book by Grant et al (2009) has a significant level of factual knowledge content within it – for example, approximately 30 per cent of the first chapter. Of this 30 per cent, much is in terms of applying, for example in choosing companies from a list and inserting them in some given sentences as well as listening to a conversation and then inserting appropriate words from the listening exercise into sentences. Chapter 2 has a lesser percentage of content within this area and it is predominantly understanding, for example in reading three brief job descriptions and being able to categorise the script as a specific occupation from the information given. The third chapter again has less knowledge within this category and that which there is can be considered as being understanding and applying, for example in listening to a recording, a narrative, and from that answering some specific questions. The following 6 chapters (Chapters 4 – 9 inclusive) follow similar patterns although the expectations in terms of interpreting the knowledge become progressively slightly more challenging. For example, Chapter 9 asks the students to match pictures with words that they have to select from a list and they have to identify modal verbs from a script. By the time the students get to the fifteenth chapter, the intervening ones having followed a similar pattern to the earlier chapters described above, the level at which students are expected to gain and demonstrate that they have gained factual knowledge is at a higher level but it is suggested that this is not as high as having worked through so many previous chapters would imply. For example, they are still doing exercises where they choose words from one list to match them with words in another list.

The other book, by Cotton et al (2007), devotes a similar percentage of the first chapter to factual knowledge, although it is spread more around it. It is more about the cognitive area of understanding than in merely inserting names from a list, for example by asking the students to rearrange sentences so that they form a question and modal verbs are introduced earlier in the book than in the one by Grant et al (2009). More consideration is demanded of the students in this area, for example as early as Chapter 2 the students are asked to give opinions about a number of questions and to compare values such as what is advantageous with shopping online and what is advantageous with shopping offline. The narratives and articles that are used are not only more complex and demanding but also more concise, which means that students of different levels of ability would be able to read into each what they were able to understand. For example, in Chapter 2 there is an article taken from the Financial Times about the rise of online shopping and worries about how this may affect traditional ways of going about this activity. The questions asked about this article are for the students to give two reasons:

   i.   why online shopping makes markets very competitive,
   ii. why operating in both markets is difficult for a single retailer,
   iii. why dual pricing is only a short term solution and the ways in which retailers can take advantage of both the online and offline markets.

Although the chapters follow a similar pattern as that which is described above, in this book there is a subjective 'feel' that the topics are more focused and more appealing – they provide relevant and focused attention on what, in the opinion of the researcher, fundamentally more pertinent areas for teaching the subject while retaining interest. For example, in Chapter 5 the theme is that of stress. The case studies are also more comprehensive and detailed, one example being from Unit 12 (products) and the case study is on the German company Minerva. Once the details of the company have been given, the students are asked to consider which of four products based in different technologies the company should buy. The students are asked to work in small groups and to prepare a presentation for one of them. The teacher can picture the groups that the students will self-select themselves into and that there will be varying ranges of interest. However, if this were set as an assignment which would contribute towards their final mark, the students with lower levels of motivation would be likely to see an opportunity for this to contribute towards the passing of the course and would therefore put in a serious effort, as those with higher levels of ability and motivation would also do.

3.4 Procedural and meta-cognitive knowledge

There is less evidence of conceptual knowledge in the book by Grant et al (2009) and that which is given would probably not adequately challenge the most able students. For example, in Unit 2, the students are given the following challenge: "Sang Chun is talking about his job in a software company. Listen and tick (√) the people that he works with and the jobs that he does" (Grant et al 2009, p. 13). Even by Chapter 12, the expected progress of the students cannot be seen as being very high because we still have similar questions being pose, for example: Read about the history of Dubai's economy and answer the questions. 1 What is Dubai trying to do? 2 Has it been successful? How do you know?

This information it to be taken from a mini case study that contains 100 words and where the information that the students are supposed to write down, the answers to the questions, are staring out at them, they are too easy to find. Towards the end of the book, there is a section which contains a 'practice file' and a glance at this brings back to mind the points made by Viswanathan and Murthy (2011) concerning the extent to which questions should challenge students

because they are likely to be able to answer them. One can only guess what these authors would make of questions that are at such a stage in a book which challenge students by asking, for example, that they choose from a list of five words to complete a sentence such as: 'My company *holds* a corporate event every June.'

In view of the point made above concerning the perceived lack of expected progress of students across the textbook by Grant et al (2009), this section can draw to a close by making a direct comparison with the expected progress of students in the other book that is being evaluated, by Cotton et al (2007). The point can be made that it doesn't really matter the level at which each text book is aimed, it is rather the extent to which the authors of the book and the materials in the book are likely to challenge the students and therefore enable them to make good progress. In the first unit of the book by Cotton et al (2007) the following is an example from a task that is given to students and its similarity with that given towards the end of the book by Grant et al (2009) (see above) will be noticed by the reader. The student is again asked to choose a word from a list of five to complete a sentence: 'Employees in large multinationals *have* excellent career opportunities if they are prepared to travel.' However, while this is one of the opening exercises in the book by Cotton et al (2007), by the time the book proceeds to the revision questions towards the end of it, the students are asked to fill missing words into a larger number of more complex sentences without the comfort zone of being given options. Once they have completed this, they must take one shaded letters from each of their answers to complete another sentence. Thus, if they do not have a valid and meaningful word, they have to go back over what they have done until all of the words enable the final word in the final sentence to make sense.

A further aspect of the textbook by Cotton et al (2007) can be brought to attention with regard to the knowledge. This is that rather than have a general revision section, there is a dedicated one for each section of the book and which extends the student beyond the actual knowledge that is contained within it. For example, the seventh unit is concerned with marketing and the unit content is moderately challenging and informative, for example in introducing and using various approaches to learn around this and other themes. The revision section for this unit then extends this and asks the student to develop the themes through the construction of more challenging and complex sentences within the subject of marketing.

Knowledge dimension		Cognitive Process Dimension											
		Low order thinking skills →→→ High order thinking skills											
		Remember		*Understand*		*Apply*		*Analyse*		*Evaluate*		*Create*	
		BR	**ML**	**BR**	**ML**	**BR**	**ML**	**BR**	**ML**	**BR**	**ML**	**BR**	**ML**
Abstract → Concrete	**Factual knowledge**			X	X	X	X				X		X
	Conceptual knowledge	X	X		X								
	Procedural knowledge	X			X	X	X				X		
	Meta-cognitive knowledge								X				X

*Table 1. Short summary of the evaluation of the books *BR- Business Result **ML-Market Leader*

5. CONCLUSION

The approach used for the book evaluation has attempted to take aspects of various studies in order to produce as an accurate evaluation as possible within the inevitable constraints that exist in teaching context. In order to be able to do this, it was necessary to consider and review work that has already been undertaken on the grounds. In the study, the wider consideration of the existing literature is because of avoiding to be seen as a reductionist for coursebook evaluation.

This leads to the books in question and as the evaluation progressed, it became increasingly clear that the book by Grant et al (2009) had a degree of shallowness about it because if followed closely by students, their progress would be slow. While this may be suitable for mediocre students who do not have a deep interest in learning business English, it was not capable of motivating the students who are keen to make progress. The book by Cotton et al (2007), on the other hand, did have the potential to enable such progress by those who were capable and willing to develop themselves and their English abilities. This left the question of whether this textbook could also be used by weaker students so that they would be able to reach their full potential, even if this is at a relatively and comparably low level. The fact that this potential exists was highlighted above (see the previous section) when the example of one case study was brought to attention. In this, students were asked to put themselves into small groups and make presentations based on a specific case study. The point is that exercises such as these allow the most able and motivated students to work towards their potential while at the same time not disenabling more mediocre students to fulfil theirs. It could be argued that one example does not prove the point but the counter argument would be. There are numerous such examples that while it is possible for a teacher to ameliorate the most challenging aspects of a challenging book, it is not so possible to enhance those of one that does not challenge students. Therefore, the book – Market Leader Pre-intermediate (2007) is chosen for the particular teaching context as the teacher believes the students will benefit more from this book for their studies.

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BEST PRACTICES FOR MAINTAINING DISCIPLINE IN SECONDARY SCHOOLS FOR EFFECTIVE CURRICULUM DELIVERY IN NIGERIA

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Abstract

The paper highlights some of the best practices for maintaining discipline in Secondary Schools for effective curriculum delivery in Nigeria. The paper also discusses some disciplinary problems teachers may encounter in their classrooms and possible ways of tackling them. The paper concludes stating emphatically that effective enforcement of classroom discipline is a pre requisite for smooth curriculum delivery in any classroom. The paper recommended among others that teachers should maintain a calm, productive and conducive atmosphere for effective learning. Teachers should also be firm and consistent with their classroom rules and enforcement for effective and meaningful learning.

Introduction

Throughout the history of education in Nigeria and Africa in general, the most common means of maintaining discipline in schools was corporal punishment. While a child was in school, a teacher was expected to act as a substitute parent, with many forms of parental discipline or rewards open to them. This often meant that students were commonly chastised with the cane, paddle, strap or yardstick if they did something wrong. Corporal punishment, often by canning, remains common place in many schools Nigeria and some African countries.

Great teachers first learn how to maintain classroom discipline in their academic preparation rather than dishing out punishments. Educators also learn how to maintain classroom discipline through experience and adapt their basic techniques to the best practices for their current students who might differ substantially from the previous groups. In addition, school teachers usually work in a collaborative environment so they can learn how to maintain classroom discipline and best practices on the job. Disciplinary problems have been listed (Bello, 1981, Arum 2003) as the major concerns for most teachers. A disciplined classroom requires daily maintenance and monthly reflection. This paper provides some hints that teachers can use to maintain discipline to ensure smooth and effective curriculum delivery in secondary schools in Nigeria.

Discipline Defined

It is not easy to define the word discipline because of the fact that the word can be used in a variety of ways. For instance, Arum (2003) Glasser (2001) see discipline as conforming in totality to laid down norms and as complete obedience to orders. Bello (1981), martella, Neslon and Marchand view discipline as a means of imparting knowledge and skills. Latham (1997) and Saich (2003) see discipline as simply punishment and control.

Classroom discipline is more than all of the above. It is more than the power the teacher exercises over his students. It is more than the mere maintenance of law and order in the classroom or the right method of dealing with offenders in schools. It means more than punishment and occasional praises and rewards. It is more than mere stillness and quietness in the classroom. Discipline according to this writer, is the application of all those influences which secure or at least try to secure proper conduct in schools. Classroom discipline is the training which produces in students self restraint, orderliness, good conduct, cooperation and the habit of getting the best out of themselves. It involves intellectual and moral education as opposed to mere order and instruction. Discipline is more than simply getting students to behave the way one expects them to or stopping them from behaving the way one does not want on a specific occasion. Discipline according to this writer is the continuous process of positive instruction and negative correction through which students are taught to act within specified rules and values. Simply stated mathematically: Discipline = Instruction + Correction. i.e Discipline = 90% Instruction + 10% Correction. A child's behavior usually gets worse, not better if this ratio is reversed. Excessive negative responses from parents or teachers tend to encourage more negative responses from the hurt

and angry child. To discipline effectively, negative correction should be used sparingly and positive instruction should be used most of the time.

Types of Discipline

Types of Discipline	Recommendations or Teachers
Preventive Discipline Preventing misbehaviour is obviously preferable to dealing with it after it has occurred. Most experts such as Jones (2001), Greenberg (1987) and Calvin Lazar (1997) contend that the best way to prevent classroom misbehaviour is to provide a stimulating curriculum that involves students so successfully that they spend little time thinking of misbehaving.	• Make curriculum as worthwhile and enjoyable as possible. • Remember that students crave fun, belonging, freedom, power, and dignity. • Involve and empower students by asking them for input and help. • Reach clear understandings with students about appropriate class conduct. • Discuss and practice behaviours jointly agreed. • Continually emphasize good manners, self respect, and respect for others. • Be a role model.
Supportive Discipline All students may become restive and subject to temptation at times, when signs of incipient misbehaviour appear, supportive discipline should be brought into play at such times. This facet of discipline assists students with self-control by helping them get back on task. Often only the student involved knows it has been used.	• Use signals directed to a student needing support. • Learn to catch students' eyes and use head shakes, frowns, and hand signals. • Use physical proximity when signals are ineffective. • Show interest in students' work. Ask cheerful questions or make favourable comments. • Sometimes provide a light challenge: "Can you complete five more before we stop?" • Restructure difficult work by changing the activity or providing help. • Give hints, clues, or suggestions to help students progress. • Inject humor into lessons that have become boring or tiring. Students appreciate it. • Remove distractive objects such as toys, comics, notes, and the like. Return them later. • Acknowledge good behaviour in appropriate ways and at appropriate times. • Use hints and suggestions as students begin to drift toward misbehaviour. • Show that you recognize students' discomfort: ask for a few minutes more of focused work.
Corrective Discipline Even the best efforts in preventive and supportive discipline cannot eliminate all misbehaviour. When students violate rules, teachers deal with the misbehaviour expeditiously. Corrective discipline should neither intimidate students nor prompt power struggles.	• Stop disruptive misbehaviour. It is usually best not to ignore it. • Talk with the offending student or invoke a consequence appropriate to the misbehaviour in accordance with class rules. • Remain calm and speak in a matter-of-fact manner. • Follow through consistently on promised consequences. • Redirect misbehaviour in positive directions. • If necessary, talk with students privately about misbehavior. • Be ready to invoke an insubordination rule for students who refuse to stop misbehaving.

Best Practices for maintaining Discipline in Secondary Schools for Effective Curriculum Delivery in Nigeria

The main purpose of school is to provide students with an educational foundation from which they can build successful independent lives. However, disruptions in the classroom cause roadblocks to students' achievement. Maintaining discipline in schools is essential for effective curriculum delivery. The following are some best practices that can help teachers to achieve this.

1.   Increase Parental Involvement

Parents truly make a difference in student achievement and behaviour. Schools should institute a policy where teachers are required to contact parents periodically through the year. Half-term or end-of-term reports are often not enough. A parent cannot help solve an issue if they do not know one exists. While home calls take time, in the end they can help provide solutions to very difficult classroom problem. This is not to say that all parent involvement will be positive or have a measurable effect on student's behaviour. Nevertheless, this is an area which many successful schools claim make a huge difference.

2.   Create and Enforce a School wide Discipline Plan

Discipline plans are a way to provide students with a consistent and fair plan of what will happen if they misbehave. While some schools have a discipline plan on books, many do not have disciplinary plans on conduct/behaviour. Having it posted in every classroom and in notice boards around the school compound is a good way to start.

3.   Practice Effective Follow Through

While posting the discipline plan is important so that all students are informed of the consequences for misbehaviour, followings through on the discipline plan is the key to truly fostering discipline in schools. In the classroom, if a teacher does not follow through and deal with misbehaviour, it will increase. School-wide, if administrators do not follow the discipline plan and support the teachers, it would easily lose control of the situation.

4.   Foster Discipline in Schools Through Leadership

The principal and vice principal are of major importance in fostering an academically focused school-wide environment. Their actions form a basis of the overall mood for the school. If they are consistent in supporting teachers, implementing the discipline plan, and following through on disciplinary actions, then teachers will follow their lead. On the other hand, if they are lax on discipline, this will become apparent over time and misbehaviour will increase.

5.   Build a Reputation for Fairness

Hand in hand with effective leadership and school-wide consistent follow through is the belief by students that teachers and administrators are fair in their disciplinary actions. While there are sometimes extenuating circumstances that require administrator to make adjustments for individual students, overall students who misbehave should be treated similarly.

Teachers must act fairly for all students if they expect to be respected. If teachers do not treat all students equitably, they will be labelled as unfair. Students will not be keen to follow their rules.

6.   Maintain High Expectations

From administrators to guidance counsellors to teachers, schools must institute high expectations for both achievement and behaviour. These expectations must include messages of encouragement and means of support to help all children succeed. According to Mclntyre (2005) Schools that foster high-esteem and promote social and scholastic success reduce the likelihood of emotional and behavioural disturbance.

Expect that students will behave, not that they will disrupt. Teachers should reinforce this with the way they speak to their students. Teachers should begin the day by telling students their expectations. For example, a teacher might say, "for the duration of this class period, I expect you to raise your hands

and be recognized before you start speaking. I also expect you to respect each other's opinions and listen to what each person has to say."

7.   Deal with Disruptions with as Little Interruption as Possible

When teachers have classroom disruptions, it is imperative that they deal with them immediately and with as little interruption of their class momentum as possible. If students are talking amongst themselves and the teacher is having a classroom discussion, ask one of them a question to try to get them back on track. If the teacher has to stop the flow of his/her lesson to deal with disruption, then he/she is robbing students who want to learn of their precious in-class time. Sometimes all it takes is for everyone to have a good laugh to get things back on track in a classroom. Many times, however, teachers confuse good humour with sarcasm. While humour can quickly diffuse a situation, sarcasm may harm a teacher's relationship with his/her students. Teachers should use their best judgment but realize that what some people think as funny others find to be offensive.

8.   Avoid Confrontations in Front of Students

Whenever there is a confrontation in class there is a winner and a loser. Obviously teachers need to keep order and discipline in their class. However, it is much better to deal with disciplinary issues privately than cause a student to 'lose face' in front of their friends. It is not a good idea to make an example out of a disciplinary issue. Even though other students might get the point, the teacher might have lost any chance of actually teaching that student anything in that specific period in class.

9.   Overplan

Free time is something teachers should avoid. By allowing students time just to talk each day, teachers are setting a precedent about how they view academics and their subjects. To avoid this, teachers should overplan. Write additional activities into their lesson plans just in case main lesson runs short. When teachers have too much to cover, they will never run out of lessons and they will avoid free time. Teachers can also fill up any left over time with mini-lessons.

10.   Be Consistent

One of the worst thing a teacher can do is not to enforce his/her rules consistently. If one day a teacher ignores misbehaviours and the next day he/she jumps on someone for the smallest offence, students will quickly lose respect for the teacher. Students have the right to expect teachers to be basically the same everyday. Moodiness is not allowed. Once a teacher loses students' respect, he/she will also lose their attention and their desire to please him/her.

11.   Make Rules Understandable

Teachers need to be selective in their class rules for instance no one can follow 180 rules consistently. Rules need to be clearly stated. Students should understand what is and what is not acceptable. Furthermore, teachers should make sure that the consequences for breaking rules are also clearly known before hand.

12.   Keep an anecdotal record

Keep an anecdotal record of major issues that arise in your class. This might be necessary if one is asked for a history of classroom disruptions or other documentation.

13.   Use humour

Try to use humour to diffuse situations before things get out of hand. Teachers should Know their students. The following example could be used with students for example, if a teacher tells his students open their books to page 51 and three students are busy talking, do not immediately yell at them. Instead, smile, say their names, and ask them kindly if they could please wait until later to finish their conversation because you would really like to hear how it ends and they have to get this class finished. This will probably get a few laughs but also get the points across.

14.   **Start Fresh Everyday**

Teachers should start teaching their class each day with the expectation that students will behave. Don't assume for instance, that because Adamu has disrupted your class everyday or for a week, he will disrupt it today. By doing this, one will not be treating Adamu any differently and thereby setting him up to disrupt again (like a self-fulfilling prophesy).

Attributes a teacher should possess to maintain good discipline for effective curriculum delivery

A disciplined teacher is one who:

- succeeds in getting children to learn in a meaningful, enjoyable and business like manner. He creates a learning environment that is stimulating and disciplined.
- creates varied opportunities/learning experiences for children to learn.
- always aims at achieving his/her lesson's behavioural objectives.
- encourages his children to ask questions and talk about their experiences as they relate to the lesson.
- holds the philosophy that all children can learn. He does all he can to ensure that each child has sufficient opportunity to learn something.
- is patient with all. He explains the same thing in different ways and exposes children to several modes of learning. They see, hear, touch etc.
- uses class time wisely and efficiently. That is, children are productively involved in learning activities most of the time.
- ensures that learning time is maximized and disruption of class time is reduced to the minimum.
- ensures that a good percentage of the class time is spent doing things that have academic value.
- establishes and enforces routine for time wasting chores such as, change of lesson, submission of assignment, class work etc.
- has a clear purpose or objective for every lesson. He gives children explicit guidelines on how to perform each classroom task. He is goal-oriented. He introduces activities that match his objectives. He never digresses unreasonably from what he has set out to achieve.
- personalises his teaching. He treats learners as individuals and he is sensitive to their needs. He makes provision for individual differences by adjusting the pace of his instruction in such a way that the fast learners are not held back and slow learners are carried along.
- always resourceful. Uses teaching aids to make lessons more meaningful. He/she is willing to go the extra mile to improvise as the need arises.

Disciplinary cases and consequences proposed by this author

Disciplinary Cases	Scenario	Consequences
Bullying	A JS 2 girl has reported that a boy in her class has been verbally bullying her for the past week. He has continuously called her fat, ugly, and other derogatory terms. He also mocks her in coughs, etc. The boy has admitted to this and says he did so because the girl annoyed him.	Start by contacting the boy's parents and asking them to come in for a meeting. Next, require the boy to go through some bullying preventing training with the school counsellor. Finally suspend the boy for three days
Continuous Disrespect/failure to comply	A JS 3 boy argues about everything with a teacher. The teacher has talked to the student, given the student lines to write, and contacted the parents for being disrespectful. This behaviour has not improved and has gotten to the point that the teacher is starting to see it affect other students' behaviour.	Set up a parent meeting and include the teacher. Attempt to get to the root of where the conflict lies. Give the student three days in school punishment within the school.
Continuous failure to complete home work	A Senior Secondary 2 student has turned in eight incomplete assignments and has not turned in another five assignments at all over the past-three weeks. The teacher has contacted the student's parents and they have been cooperative. The teacher has also given the student lines to write each time they have had a	Set up parent meeting and include the teacher. Create an intervention programme to hold the student more accountable. For example, require the student to attend an extra school lesson if they have a combination of five missing or incomplete assignment. Finally, place the student in

	missing or incomplete assignment.	detension during break and after school until he/she catches until up on all work.
Fighting	Two Senior Secondary 1 male students got into a major fight during break over a female student. Both students had injuries on their faces and one student may have a broken nose. One of the students involved has been involved in another fight previously in the year.	Contact both students' parents. Contact the local police asking them to cite both students for public disturbance and possibly assault and/or battery charges. Suspend the student who has had multiple issues with fighting for ten days and suspend the other students for five days.
Possession of alcohol or drugs	A student initially reported that a Senior Secondary student is offering to sell to other students some "weed". The student reported that the student is showing other students the drug and is keeping it in a bag inside their sock. The student is searched and the drug is found. The student informs you that they stole the drugs from their parents and then sold some to another student that morning. The student that bought the drugs is searched and nothing is found. However, when his locker is searched you find the drug wrapped up in a bag and tucked in his backpack.	Both students' parents should be contacted. Contact the local police, advise them of the situation, and turn the drugs over to them. Always make sure that parents are there when police talk to students or they have given permission to the police for them to talk to them.
Possession of a weapon	A JS 2 student took his Dad's pistol and brought it to school because he wanted to show his friends. Luckily it was not loaded and the clip was not brought.	Contact the students' parents. Contact the local police, advise them of the situation and turn the gun over to them. A possible consequence would be to suspend the student for the remainder of the school year. Even though the student had no ill intent with the weapon, the fact remains that it is still an offence and must be dealt with severe consequences in accordance with law.

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CHALLENGES AND SUPPORT FACTORS OF MARRIED EMIRATI STUDENTS IN TEACHER EDUCATION

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ABSTRACT

The United Arab Emirates (UAE) is on the path to becoming a knowledge economy and the role women play as pioneers and innovators, not only in their own society but, also, in the global community is strongly advocated (Al-Qazzat, 2003). Involvement of women in tertiary education and in the work force is promoted despite restrictions as to the kinds of jobs they can take up and difficulties associated with socio-cultural factors. When making career choices, teaching appears to be favored as a respectable, stable job involving limited interaction with the opposite sex. This paper explores the motivational factors, challenges and support strategies of a social group of married female Emirati students undertaking their Bachelor of Education (B. Ed.) teaching degree. Using Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1979) and socio-cultural influences on 'self' among the various nested systems that play a role in their development, data on motivational factors, challenges and support strategies are portrayed in the findings.

Keywords: Emirates, teacher, education, married, challenges

I.　INTRODUCTION

In Abu Dhabi, capital city of the UAE, the drive for growth and future development is inseparably linked to the education reform agenda initiated by the Abu Dhabi Education Council (ADEC) aimed at improving schools through the introduction of a New School Model (NSM) in September, 2010. Reasons for this are clearly stated by Dr. Al Khaili, the Director General of ADEC, who comments, "we don't just want to improve our education system, our schools and the performance of our students…we want to be ranked as one of the best education systems in the world" (ADEC, 2008, p.1). The reforms and a break away from the more traditional methods of teaching where teachers do most of the talking and students listen passively to one where inquiry and active learning is encouraged can be traced to ADEC's Strategic Plan for the 2009-2018 period which focuses on six key priorities: 1) elevate school quality in Abu Dhabi to international standards; 2) improve access to P-12 education; 3) provide students with affordable options of high quality private education; 4) preserve UAE culture and heritage and develop successful careers; 5) build ADEC capabilities; and 6) actively engage the stakeholders (ADEC, 2009).

As part of the reforms to initiate change in Abu Dhabi, ADEC's New School Model is claimed as, "a new approach to teaching and learning…to improve student learning experiences and to raise academic outcomes of Abu Dhabi students to the internationally competitive level necessary to achieve the Abu Dhabi economic vision 2030" (ADEC, 2009). The main objective is to foster a student centered learning environment emphasizing culture and national identity. NSM adopts bilingual teaching (Arabic and English) and the introduction of English as a medium of instruction in Science and Mathematics. The curriculum aims to develop Arabic and English language literacy. As Dr. Al Khaili notes, "a new curriculum, advanced teaching methods and learning materials and resources are introduced in order to enhance student performance by developing the student as a communicator, a thinker and a problem solver, appreciative of the UAE heritage and culture" (El Ajou, 2010).

With the impetus to improve schools and raise achievement levels of students, teacher education is a priority as the reforms taking place in Abu Dhabi demand highly qualified Emirati teachers to teach in schools. But, what exactly are the challenges facing students undergoing teacher education? What support strategies do they use in coping with the challenges that face them in their attainment of their Bachelor of Education teaching degree?

Our study seeks to understand the nature of motivational factors that encourage married female Emirati students enroll in the B. Ed. teaching degree, the challenges they face during their course of study and the support strategies used by them to undertake and complete their degree in a start-up teachers college in Abu Dhabi. Our study employs a situated perspective; that is, it takes into consideration the complexity of overlapping environmental determinants that affect married female Emirati students during their course of study. We investigated motivational factors, challenges

faced and support strategies used within particular contexts of home, college, home/college, government and the wider society.

The particular group on which we focus is that of women who are currently married (not separated or divorced) studying to complete their B. Ed. teaching degree. In 2011, the student body at the college consisted of 400 students of which 122 were married female Emirati students. Participants were selected from across four different year groupings to provide us with a cross-sectional view of motivational factors, challenges and support strategies used in completion of their B. Ed teaching degree. In keeping with our goal, we developed a conceptual framework that draws on Bronfenbrenner's ecological model (1979), socio-cultural influences on role construction and educational changes and development in Abu Dhabi.

Bronfenbrenner (1979) conceives of the environment as a nested systems arrangement each contained within the next. The four systems focused on in this study include: microsystem, mesosystem, exosystem and macrosystem. The microsystem denotes the complexity of relationships the developing person experiences in an environment considered immediate and in which the participants have roles (for example, daughter, parent, student and teacher). The mesosystem comprises the interrelationships that result among major settings containing the developing person. The mesosystem can be considered a system of microsystems. Exosystems define the larger contexts which are experienced vicariously and yet have a direct impact on the developing person. The macrosystem refers to economic, social, educational, legal and political systems existing in the culture that set the pattern for the structures and activities occurring at both the micro and mesosystems.

One tool used to measure the factors that influence women's occupational role is 'The Eccles' Model' (Eccles, 1984). The model states that decisions women make in relation to occupational choice relate to "gender role beliefs, to self-perceptions and self-concept and to one's perceptions of the task itself" (Eccles, 1994, p. 587) and gendered socialization practices "at home, in the schools, and among peers…in shaping these individual differences in self-perceptions and subjective task values" (p. 605). The Eccles' model added to the conceptual framework in terms of understanding the socially constructed roles of these students in multiple contexts.

Students' adoption, modification and negotiation behaviors in counteracting challenges of context to establish support strategies became a focal point of our analysis. We note that their stated reasons for establishing support strategies are rooted in their perception of what it means to be a student, wife, mother, daughter and daughter-in-law. The roles played by them vary given expectations and demands of context. We assert that from the intertwining of multiple contexts, particular challenges emerge and the corresponding behavior patterns that follow account for the manner in which support strategies are established and used in the undertaking of their tertiary level studies.

In the sections that follow, we provide a literature review, describe the methodology and data analysis, present a discussion of our findings and offer suggestions for both program development and future research in the field.

II.   LITERATURE REVIEW"

The literature review starts with a brief overview of opportunities provided for women in the context of Abu Dhabi. It then examines: family life in the UAE; educational opportunities for Emirati women in Abu Dhabi; and the institute in which the study was conducted.

2.1 Overview of the Context of Abu Dhabi

The UAE, a constitutional federation of seven emirates, was established in 1971. The discovery of oil brought with it wealth and transformation to a modern, highly industrialized state with one of the highest standards of living in the world (Green and Smith 2006). With the advent of this transformation, Green and Smith (2006) note that an obvious shift for women tends to involve a break from the traditional cultural attitudes with a focus on the home and activities related to the home. The claim is that younger women are increasingly pursuing higher education and embarking on careers outside of the home (Al-Qazzat, 2003). Further, they have changed employment patterns, are entering the workforce at unprecedented rates, have surpassed their male counterparts in university attendance and are employed in high-status jobs and in key decision-making positions (Salloum, 2003). Salloum describes the modern UAE woman as educated, dignified, raising the children in a modern world and yet preserving traditional values and culture.

2.2 Family Life in the UAE

The current local population of the UAE is tribal in origin. Waves of Arab tribes started to migrate to the region in the middle of the first millennium BC. Within the fold of the Emirati tribe, the head of the family (i.e., the father) is traditionally bound by unavoidable obligations of mutual support and a notion of family integrity not only to his wife and children but, also, to his immediate blood relatives (i.e., father, brothers, paternal uncles and cousins) and to the tribe as a whole. As Islam is the common religion, it has also held the people together (Embassy of the United Arab Emirates in Washington DC, n.d.). Due to this particular relationship, marriage between the son and his paternal uncle's

daughter is strongly preferred. However, age differences or other reasons may make such an arrangement impossible. Accordingly, marriage with a first cousin from the mother's side, or with a more distant cousin, is the norm in this society. Arranged marriages are still common in the Emirates (Rashad, Osman and Roudi-Fahimi, 2005) and marriage outside the extended family is the exception, but it does also occur. Although the UAE sets the legal minimum marriage age at 18, it is important to note that the average marriage age for women is rising (Bristol-Rhys, 2007). Regardless, early marriage continues to occur because of deeply entrenched cultural and tribal traditions that are unresponsive to legal reforms. It is also important to note that the divorce rate is increasing because of broader social change (Nereim and Almazroui, 2012).

The last forty years have brought many changes to the fabric of the Emirati society. Cultural, social and technological changes have merged together to create norms vastly different from just a few decades ago. The expectation that a woman's career revolves around staying home to care for children while her husband works a life time is no longer a realistic picture of Emirati family life. Accordingly, the position of women is changing. Despite the religious teachings and the UAE customs and traditions that encourage marriage at an early age, some Emirati women who want to pursue higher education and start a career choose to delay marriage and motherhood or not to marry at all. This significant shift in modern young women's perspective on marriage and their role in the wider world appear to be forming part of the culture (Elass and Seaman, 2009).

The woman's position is clearly defined in the UAE society. On marriage she keeps her maiden name (her father's name) and remains emotionally closely attached to her own family to whom she can return in case of divorce. The newly married couple may move to live as a unit in a single family home or into the house of the husband's family where separate accommodation is prepared for them and, if at all possible, for the families of all the other sons. The change is often considerable and problems in the fledgling relationship between the bride and her in-laws are common (Hellyer and Abed, 2001).

The traditional Emirati family is extended, often spanning three or more generations. An extended structure offers many advantages, including stability, coherence, financial assistance, and physical and psychological support, particularly in times of need. Although Emirati extended families are increasingly not living in the same home, they frequently live in the same neighborhood to keep in contact. In response to social and economic change in the UAE, the nuclear family has started to break away from the common extended family system and subsequently experience limited first-hand familiarity with the richness and complexity of living within extended family networks. Families in the UAE are also known to have domestic helpers like live-in maids and drivers to fulfill household chores. Domestic helpers tend to be from Asian countries (Hurreiz, 2002).

Although researchers such as Green and Smith (2006) observe that Emirati women are experimenting with other forms of work and pursuing tertiary degrees, their main job continues to be regarded as one of taking care of the family, concentrating on their children and fulfilling duties expected of them by their extended family. When the Emirati male agrees to a female member of his family working, then work environments are carefully scrutinized and might be limited in scope due to social requirements such as gender segregation which is encouraged by Islam. Despite the cultural considerations limiting career choices and career planning for Emirati women, teacher education, accordingly, may be viewed as a profession best suited as it is comparatively female dominated (Salem, 2011). Women in the education sector form the majority of practitioners and opportunities are available for them to engage in career planning and assume leadership roles.

2.3 Educational Opportunities for Emirati Women in Abu Dhabi

The UAE's development of its education system took place after the unification of the seven Trucial States in 1971 (Talhami, 2004). From 1971 until 1978, although the UAE dedicated the largest portion of its budget to defense, the second largest portion was awarded to education (ibid.). Rates of enrollment in higher education in the UAE began to dramatically increase during this period and this increase was rooted in the economic and reform changes introduced. The voiced ideal of the government is to promote reform and education as a means to achieve this. Government political intentions are supported by strong investments in education and in this context women are seen to significantly benefit (Barakat, 2012).

The stimulus for UAE women's development has largely been through access to education strongly promoted by UAE Government scholarship programs (Ministry of State for Federal National Council Affairs, 2009; Crabtree 2007). Based on the UNDP report of 2007, the number of UAE national women enrolled in higher education is actually 24 percent more than the number of UAE national men. According to a Pricewater House Coopers report discussed at the Arab Youth Forum in Dubai (2005), at 77 percent "the UAE is registering the highest rate of females in higher education in the entire world". Gokulan (2012) confirms, "the UAE has the highest percentage of women graduates in the GCC and the highest percentage of women in the workplace" (Gokulan, 2012).

The accelerated process of modernization has brought new opportunities for women to go beyond their traditional stereotypical role of mothers. In relation to the reforms, the gains made by women in taking up tertiary level studies and employment in the workforce are said to reflect outgrowths of the expansion of educational opportunities

and socioeconomic changes rather than gender-specific educational policies.

III. METHOD

This is an exploratory study. Quantitative (survey) and qualitative data collection tools were employed to understand perspectives of married female Emirati students in relation to: motivating factors to become a teacher, challenges faced during the course of their study and support strategies employed to complete their B. Ed. teacher training degree. For the first quantitative phase of the study, a survey instrument was designed. By way of follow up to the survey and in an attempt to gain a deeper perspective of motivational factors, challenges and support strategies, an invitation was extended to participants requesting engagement in conversation type interviews. In this paper, findings from the qualitative analysis of interviews with 30 married female Emirati students are presented to identify motivational factors, the nature and type of challenges faced and support strategies used in attainment of their B. Ed. teaching degree. The findings are presented in keeping with Bronfenbrenner's ecological model (Bronfenbrenner, 1979) and corresponding socio-cultural influences on 'self'.

3.1 Context of the Study

The college in question is the first and only specialist teacher college in the UAE. It is also the only non-federal higher education institution established by the Abu Dhabi government which does not result from a formal partnership with an overseas institution. It was established in Abu Dhabi and is licensed and accredited by the Commission for Academic Accreditation and the Ministry of Higher Education and Scientific Research. The college was created in 2007 by H.H. Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, and the inspired vision of H.H. Sheikh Mohammad Bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces to provide world-class teacher education and to train the next generation of teachers for Abu Dhabi and the UAE (College Student Handbook, 2012-2013). It operates under the auspices of ADEC. The College currently offers a four-year B. Ed. teaching degree in English as the medium of instruction. Emirati students are prepared to teach cycle 1 students (grades 1 to 5) a range of subjects including English and Math and Science in English in accordance with NSM guidelines. A one-year Foundation Program for students who do not fulfill the B. Ed. teaching degree program entry requirements is also offered (College Student Handbook, 2012-2013).

The college provides an environment that contributes to the students' cultural, social, moral, intellectual, and physical development. Its Student Services policy applies to all students – married and unmarried alike (College Student Handbook, 2012-2013). This policy includes personal counseling, student orientation and student representation. In relation to issues of maternity care, married students are required to provide the college with early notification of their pregnancy and must return to classes no later than 2 weeks (10 working days) after their child's birth. The Students Services Department provides assistance with health queries relating to pregnancy and breastfeeding during college hours. At this college, childcare services are unavailable. Suspension of studies is permitted for all students commencing at the start of the first/Fall semester and concluding at the end of the academic year (i.e., the second/Spring semester). Under current arrangements, students granted suspension from their academic program for health or personal reasons are not entitled to practice teaching nor do they have access to laboratories. They do, however, retain their college cards and have access to their email accounts, electronic resources, and library facilities.

3.2 Participants

Majority of female students enrolled in the college commence their degree as unmarried but, over time, get married and, shortly afterwards, fall pregnant. Although in some respects the experiences of married female students are similar to that of their single counterparts, in other respects their experiences are significantly different. For example, in devising this study it was expected that there would be some commonly held perspectives among all students on delivery of the new curriculum using modern pedagogies. However, female married students have different roles as wife, mother, daughter, daughter-in-law as well as that of student. With their various roles come different responsibilities to be fulfilled. Often what drives them to pursue and sustain their studies takes on a completely different dimension to their single counterparts. The challenges facing them during their course of study are complex, often requiring coping strategies that vary in intensity and which draw to the surface the institution's capacity to meet their specific needs. For this reason, the decision was made to focus on married female students.

The number of married female Emirati students across all cohort groupings at the college who completed the survey numbered 100. From this, a cross section of 30 participants from year levels 1-4 participated in the individual interviews. Over 50% were from Year 4, 10% were from Year 3 and 20% were from Years 1 and 2. Age ranges of participants are as follows: 20-24yrs – 60%, 25-30 yrs – 28%, above 30 yrs – 12%. Numbers of years married is as follows: 36% married between 0-2 years, 34% between 3-5 years, 10% between 6-8 years and 20% married more than 8 years.

Married female Emirati students in this study acknowledged they received varying degrees of support reflective of their way of life and social cultural values symbolic of the Emirati society. As noted in the literature reviewed, newly married women usually live close to their families and receive assistance in various ways. Table 1 displays the nature of support available. This form of assistance, as noted in the findings, is considered a support factor in completion of the B. Ed. teaching degree. (See Table 1, for types of support)

Table 1.Types of support

Support Type	Emotional Support	Moral Support	Financial Support	Child Care	Home Management	College Work Support	Social Support	Support being a Future Teacher
1. Husband	17%	15%	40%	18%	26%	20%	14%	16%
2. Father	12%	11%	16%	4%	5%	13%	10%	12%
3. Mother	18%	14%	11%	26%	19%	11%	13%	14%
4. Father in law	5%	7%	5%	2%	3%	5%	6%	8%
5. Mother in law	8%	8%	4%	18%	20%	5%	8%	7%
6. Brother	8%	8%	10%	4%	4%	9%	9%	8%
7. Brother in law	1%	4%	0%	2%	1%	4%	5%	3%
8. Sister	12%	11%	6%	11%	11%	17%	11%	11%
9. Sister in law	5%	5%	1%	6%	5%	4%	5%	4%
10. Uncle	4%	6%	1%	1%	0%	3%	6%	6%
11. Aunt	5%	6%	1%	3%	2%	3%	6%	7%

3.3 Procedure

The survey instrument provided an overarching view of patterns and trends related to challenges and support strategies married female students experienced. Semi-structured interviews allowed entry into the inner world of the married female Emirati student to gain an understanding of motivational factors, challenges and support strategies from an individual perspective (Patton, 1990). Interviews afforded depth of data (Patton, 1990; Denzin and Lincoln, 2003) because participants were encouraged to reflect, discuss and share their thoughts, beliefs and experiences. To obtain rich data and verify authenticity, the following measures were undertaken: i) all interviews were conducted by the research team member fluent in English and Arabic; ii) interviews were conducted on a face to face basis or by phone depending on the wishes of the participants. Venue and times of interviews were negotiated with the participants; iii) to facilitate the interview process, a schedule or guide was developed with questions designed to probe deeper into challenges and support strategies from a qualitative perspective; iv) all interviews were audio recorded; v) audio files were translated into Arabic text by Arabic/English translators. The Arabic text was later translated into English; vi) all translators were instructed to provide verbatim translations of participants' responses; vii) confidentiality agreements were signed by translators in an attempt to minimize harm to participants; and viii) Arabic and English transcripts of interview data were cross checked by the member of the research team conducting the interviews to verify and check for accuracy and authenticity.

3.4 Data Analysis

In terms of data analysis, the researchers began with one interview transcript initially. Interview data was coded and grouped into tentative categories and subcategories using the following process. For example, the first transcript was read to establish data chunks related to reasons for pursuing the B. Ed. teaching degree, challenges encountered and

support strategies utilized. A second reading of the same transcript prompted the emergence of further categories such as 'Ramification of Challenges' and 'Future dreams'. Summary notes, made in the margin of the transcript, formed preliminary codes. This process was applied to other interview transcripts with the idea of determining similarities and differences related to challenges and support strategies. Once all the interview data was coded, a secondary analysis was conducted to confirm the categories and sub-categories that were established and determine which required moving and reconstructing as new perceptions and insights emerged. As the analysis proceeded, an analytical framework was developed that captured the motivational sources, challenges, ramification of challenges, support strategies and future possibilities. Inter-coder reliability was achieved by all researchers working in the data analysis/interpretation process.

3.5 Limitations

This study was limited to the cohorts from one college. The resulting sample size, although small, represented the majority of married female Emirati students in the B. Ed. teaching degree program at the time of the study. As researchers we had to consider that students may have felt the need to act politically correct in responding to and/or acknowledging the challenges they faced. This is a perceived limitation in that an honest response to questions asked by the research team may not be completely possible. Although we do not believe that we can draw broad generalizations from this study for the entire married female Emirati student population undertaking tertiary level studies in the UAE, we do believe we can identify areas of concern that can assist us and other colleagues in supporting this particular social group of prospective students.

IV. RESULTS

In this section, we begin with presenting reasons why the students chose to pursue a teaching degree. Motivation to pursue the B. Ed. teaching degree is strongly linked to how students view themselves in the various nested systems that make up their life experiences. Following this, we report on the challenges they face and establishment of support strategies used to complete their degree.

4.1 Motivation to become a Teacher

Motivation to become a teacher was described by the majority of participants as valuing education, wanting to be an educated woman, expressing a love of learning and teaching and eventually wanting to be a successful teacher. These factors relate to how they view themselves as individuals. Several participants claimed that having a university degree is a personal goal – an achievement: *I desperately need my degree; I do not like to sit at home and do nothing with only a high school certificate.*

Another motivating factor expressed by the majority of participants was the fact that the teaching profession is for women and is culturally accepted by their family. They claimed their spouse and parents preferred them to work in gender segregated environments. The majority confirmed that they themselves felt more comfortable working as a teacher in an all female environment with limited mixed gender interaction: *I prefer to work in a female only environment.*

When asked what motivates you to pursue teacher education, the majority mentioned that they would be able to teach their own children and their siblings. Several mentioned that going through the college had given them the knowledge, skills and strategies to effectively teach their children, monitor their development, deal with issues and positively contribute to their lifelong learning and development: *It is not just to be a teacher but to gain knowledge so that I teach my children.*

The majority of the participants considered that as a teacher they will make contributions to their nation. They were motivated to prepare the future generation, be part of the change movement and have a positive impact on the young students they teach by nurturing their minds and contributing to their development: *As a teacher, bringing up or raising good children is a benefit for the society.*

Encouragement and support from their spouse was another motivating factor in pursuing their teaching degree. Participants affirmed that their husbands felt comfortable that they will eventually be working in a female only environment and that having an educated wife would help in the development of their children. Some claimed that establishing financial stability was another motivating force for becoming a teacher: *Honestly he wants me to finish my degree and help him because he is the type of man who considers matters of husband and wives helping each other.*

4.2 Challenges

Participants expressed family and college responsibilities as major difficulties impeding their academic standing. Multiple non-college commitments and responsibilities interfered with their college work. Due to these responsibilities, the students expressed time constraints influencing their student academic status, perceptions and ability to persist. They felt limited acceptability and support for their 'student' role status both on and off campus. Challenges presented relate to: lack of support from spouse and extended family members, role conflict and lack of college support.

4.2.1 Lack of Support from Spouse and Extended Family

While the participants expected a great amount of consistent social support from their spouse and extended family members, many reported an absence and consequently the effects of stress of fulfilling college requirements were not buffered. There were students who confirmed modest amounts of social support. However, this vacillated or diminished as their 'student' role continued over time: *My husband and my husband's family were not so encouraging to me. Up to this moment I don't see any support from them.*

4.3 Role Conflict

Although these married students were achievement oriented and motivated to succeed, they often had other roles and responsibilities competing for their time and attention. In addition to their role as 'student', they typically reported having roles that included wife, parent and family member. Most of the participants reported their primary role was that of wife and parent and the role of student necessarily occupied secondary status. They believed that family, especially children, needed to come first and their student obligations were met only after all other responsibilities were completed. As full-time students, they expressed vulnerability to the strain and conflicts resulting from multiple role obligations encountered. Perceptions of student demands followed by family obligations were the best predictors of role conflict and role burden: *If I give time to my study, I have to ignore my children and visa-a-versa.*

Many students reported they felt as if the work they are expected to do never ends and being frequently preoccupied with one role while performing another was stressful. In other words, if they were taking care of children and home responsibilities, college demands were always present in their minds; conversely, while doing college work, that felt guilty about neglecting their children and household tasks. Some students reported that, at times, they felt that they did not perform any role adequately. Others reported that because their student role had a lower priority than family responsibilities, they often did not complete college assignments until their children and home responsibilities were met and this had ramifications: *Because of the pressure, I became careless as a mother and wife. I feel depressed because my son's achievement in Math differed negatively from when I used to teach him.*

4.4 Lack of Support from College

The nature of the institution itself did not greatly affect the students' needs; rather it was their status as married women which dictated their needs. Students commented that they realized they differed from other unmarried college students and this led to remarks that they needed external and internal faculty and systemic support to successfully participate in and complete college requirements: *We should be treated differently than the unmarried students and faculty should consider this.*

Participants perceived that not only did they receive little by way of social support from their spouse and extended family members but, also, from the college in terms of continuous support and flexibility:

- The majority of students reported that a definitive communication gap between the college and the students proved to be a stress contributor. The absence of student counseling services contributed to the communication gap: *We don't have counselors to advise us in our enquiries.* Participants also noted that only few faculty members and lecturers are aware and supportive of their status and needs: *I wish we could have supportive lecturers.*
- Inflexibility in course scheduling was viewed by participants as another aspect making the college less attractive to the married students. The absence of course delivery options such as online courses, weekend/evening course attendance options and compressed courses were considered disadvantageous to the married students in giving them the freedom to schedule their time so as to accommodate family and college responsibilities:

  I wish we were given the chance to select the mode of study. Married students need to select their timetable - morning or afternoon.

- The majority of married students expected specific on-campus consideration because of their married social status. They claimed they had anticipated that their unique situations would afford them some flexibility when events or situations out of their control that needed their input eventuated: *We need a well-equipped nursery, a better cafeteria, larger classrooms and library, and clubs.*

4.5 Ramifications of Challenges

Underestimating their own academic and personal capabilities and adjusting to somewhat conflicting role demands were sources of apprehension for the married students. However, positive self-evaluation and commitment to the 'student' role directly increased their persistence to continue and also contributed to their growing sense of ease in adjusting and juggling multiple role obligations. Achieving good academic standing positively affected their outlook and an increased commitment to their student role promoted their ability to cope with the challenges and continue the journey to attain their degree. Their commitment to what it means to be a 'student' nevertheless had both positive and

negative consequences.

Their commitment to the student role contributed to increased family and personal distress. The students expressed being torn between family and student commitments creating an imbalance in role adjustment. The breakdown in their ability to meet family and academic expectations led to symptoms of stress. The majority agreed that child care issues, family scheduling conflicts and household responsibilities are stressors that add strain in their lives. A critical factor in their ability to manage this stress was related to the acceptance and support they received from their spouse, extended family members and the college.

Some participants reported that their role as 'student' and the time constraints involved had negatively interfered with their marriage: *I have many problems with him (her husband).*

Many others reported guilt feelings related to their children. Students with young children felt the most strain and depression: *My children are completely in a state of mess.*

Although students indicated that they had experienced great amounts of stress, they also expressed satisfaction with deciding to enter the college and enrolling in the B. Ed. teaching degree. They claimed their participation in the degree course had increased their self-esteem largely through their ability to achieve academically: C*oordinating between my study and my kids study was so difficult, but, I managed to proceed and finish my education.*

The non-normative role married students adopt while pursuing their degrees combined with multiple role conflicts, role and time constraints, family stress, course scheduling conflicts, gaps in communication within the institution, common feelings of guilt, stress, and exhaustion caused some to seriously contemplate quitting:

> *After I had my last baby, I went through a very difficult period. I left the baby in the hospital and returned to college. Although I decided to quit and care for my son, my friends helped me change my mind.*

4.6. Support Strategies

Support strategies are presented accordingly: at the family level, support provided by the spouse, immediate and extended families and the family infrastructure is portrayed; at the college level, factors associated with the college are mentioned. Government support is noted by a few participants but worthy of noting here in line with policy promoting women in education.

4.6.1 Family Support: Spouse

Despite some evidence indicating that limited and/or sporadic support given by the spouse formed part of the challenges, a high response rate attested to spousal support to continue with their studies. Comments that spouses modify their behavior to show acceptance of their wives' situation is considered a form of support: *At the beginning when he sees me busy he used to complain but later on he just leaves me alone.* For some spouses, having a wife who is a degree holder is a source of pride leading to their encouragement of her pursuing and completing the B. Ed. teaching degree: *He was not educated not even high school certificate so he was happy to have an educated wife.* Support given results from negotiated identification of mutual benefit accrued during and following the obtaining of the degree. Here a 'give and take' reciprocal approach sums up the situation: *When I work, I will support him financially.*

The support given by their spouse takes the form of:

> ***Motivation.***
>
>> *Tells me that my daughter should motivate me to keep studying; He supports me psychologically; He always supports me and says that all of this will end one day and he provides a suitable environment for me to study; He even keeps telling my children that your mother should study and get high grades so he understands .*
>
> ***Child minding.***
>
>> *He will take my son outside to play with him so I can study and concentrate; He takes away some of the responsibility; He spends all the time with my daughter while I am busy; When the children shout, he takes them out and leaves me for my study.*
>
> ***Education.***
>
>> *He is familiar with the computer and he explained the Math for me; Whenever I get stuck and feel I can't think I ask him and he gives me ideas…I would say from the beginning why did I tire myself…he has a lot of ideas Ma shaa Allah; OK as a student he allows me the time I want to finish studying. If I have a project, he sometimes spends hours with me cutting and pasting.*
>
> ***Financial****.*

He brings or buys me anything that is related to the projects; He provides me with everything; He does not use the stipend but keeps it for my own expenses; I remember that when I did not have a driver, he rented a daily taxi for me to take me to college and pick me up.

Shouldering extended family responsibility. *He says it is up to me supporting his family…it's your call; My husband accommodates my circumstances; He doesn't complain if I'm busy and I can't visit his mother.*

Family Support: Immediate and Extended Family. Support given by immediate and extended family members is related to child minding and is provided by the mother and/or mother-in-law: *Especially when I have exams or projects, my mother and my siblings look after my daughter.*

Family Support: Household Systems and Structures. All participants claimed they had support from people employed by them or their extended families to take care of household duties (see Table 1). The highest number of responses indicated access to housemaids in completion of household chores: *I live with my husband's family and I have a maid but she does not have anything to do with the baby. She does the cooking and cleaning;* and nannies for child minding purposes: *I have a nanny who looks after my daughter when I go to college.* Participants also drew attention to family employed drivers facilitating transport to and from college: *My husband provides a driver for me to take me to college.*

4.7. College support:

The nature of support offered by the college is presented according to the following categories: support from faculty, support from student services and systemic support which include aspects of academic programming and structures.

College Support Faculty. Students claimed that some lecturers understood their position and were supportive: *Some college mentors are very cooperative and consider our needs. They try to facilitate any difficulty facing the mentees. They try to understand our married situation.*

College Support, Student Services. Students' comments indicate that support received from student services falls under the categories of: facilitating communication between the student and lecturer, providing information of a general nature and providing overall care and support: *They helped me in my pregnancy. I know they are doing their best according to the power given to them.*

College Support Systemic. There are policies and procedures initiated by the college to generically support all students. One such example is provision of a yellow card which allows students to exit the college without seeking special permission from the administrator. Yellow cards have been granted to those students who have signed permission from their male guardian (father or spouse) to make their own decisions concerning exiting the college during lecture times: *Now after I have the yellow card I feel much better. I can go out and come back without the need for permission.* Some students commented that the general environment or college ethos is one of care: *I always say that our college is much better than other colleges as they appreciate and tolerate the students.*

Government Support. Four students mentioned that the financial support or stipend they received from the government is essential in helping them complete their degree:

> *The government is supporting us by all means. The government supports us financially. Some girls believe that the stipend is not enough but I say it is enough for a student and the government has supported and provided us with all we need and we should say thank God and appreciate our government.*

V. DISCUSSION

There is no doubt that the education of women is seen to be essential and necessary for the construction of a new society (Al-Qazzat, 2003). Current statistics attest to the significant improvement and the remarkable expansion of educational opportunities at all levels available for Arab women (Gokulan, 2012). This study of the married female Emirati students at the college completing their B. Ed. teaching degree amidst the many challenges they encounter yields interesting findings. Utilizing Bronfenbrenner's nested systems (Bronfenbrenner, 1979) and socio-cultural influences on role determinants, it is possible to account for the many layers of challenges they face in pursuit of their B. Ed. teaching degree. It is suffice to say that at all levels (microsystem, mesosystem, exosystem and macrosystem) the married female Emirati student is confronted with shifting contextual determinants on a daily basis. Calls for economic, social and education reform at the macrosystem level have caused a shift in how they perceive of themselves as future contributors to the growth and future development of Abu Dhabi (Al-Qazzat, 2003). At the microsystem level, they experience conflicting role expectations caused by disparate college and family demands. At the college level, they have to meet course requirements within set boundaries generically applicable to all students. This causes the married women with family role obligations and the pregnant student with health care issues stress. At the family level they

have role obligations as wife, mother, daughter and daughter-in-law. A proliferation of different role types produces an over burdening of responsibility which then leads to claims of frustration and feelings of despair. At the mesosystem level where the demands of the college and home are most poignantly felt, we see an acceptance of both world realities and the emergence of negotiation, adjustment and modification type behavior patterns to establish support strategies used as buffers to help them succeed. The data analysis has revealed that the way in which married female Emirati students manage the challenges and utilize their support strategies produces a kind of resilience where a determination to succeed is an option they choose.

The existence of this group in a public educational institution is an example of a growing trend for married women to engage in education with intentions to contribute towards the future growth and development of Abu Dhabi. The uncovering of the actual situation that exists in support of the married female Emirati student at this college raises issues of a systemic nature in meeting the needs of this group. The married status of these women is not yet officially recognized by the college; that is, married and unmarried women are not distinguished by the institution as having separate needs. If the married woman's status was officially recognized then course delivery schedules could be altered to facilitate greater freedom of choice and control in managing the demands of their various roles in individual ways. The role of the college would then not simply be to graduate people in an established number of years but to develop strategies to attend to individual needs of this diverse social group in higher education.

One of the main deficiencies for a contextually relevant discussion on meeting the needs of married female Emirati women undertaking tertiary level studies is the lack of availability of current research and authentic data that allows an evaluation of program/organization structures aimed at supporting this group of students. Answers related to how best to support married women participating in tertiary level studies should come from a substantial research base which reports on their true situation according to life circumstances.

In the case of the married female Emirati student, their life circumstances showed many aggravating factors that present themselves as barriers to their completion of the degree. For example, once a student has children, the home/family/student role conflict she experiences affects her ability to manage the pressures of studies. Despite this, the desire to continue and complete the degree persists. Furthermore, the data analyzed revealed that married female Emirati students use the degree as a stepping stone for future success. They have dreams and aspirations to be successful in the workforce. This is a reflection of opportunities created at the societal level by the government for this social group to succeed in an environment of growth and change that abounds in Abu Dhabi. Without opportunities of access to education and institutional support, married women with children will be excluded from higher education serving as a mechanism for increased social mobility. This social dimension aspect of tertiary level studies should be included in all discussion of educational opportunities that draws on women to contribute towards a country's growth and development.

VI. RECOMMENDATIONS TO EMPOWER THE MARRIED FEMALE EMIRATI STUDENTS

This study demonstrated that married female students' experiences at this college are varied with many diverse influences affecting their student status. Stressors and social support networks impact their ability to successfully participate in and complete college requirements. By studying the challenges and support structures of married female Emirati students within the conceptual framework of Bronfenbrenner's ecological systems theory and socio-cultural factors, approaches for helping this group reduce their levels of stress are made. The approaches are linked to insights contained in this article and are not considered exhaustive. They are designed to generate thoughts of ways to empower and alleviate stress felt by the group. The following are considered viable: 1) The college will need to develop flexible and innovative approaches in the delivery of the B. Ed. teaching degree. 2) The college can empower married female Emirati women by continuing to develop inclusive policies and procedures that are contextually and culturally relevant. 3) Tertiary level institutions that enroll married female students need to conduct research from an ecological perspective to fully understand their role obligations in multiple contexts. Utilizing the data gained, they need to make systemic decisions on what will empower these students to attain their degrees. A 'one size fits all' mentality will not suffice.

In conclusion, the married female Emirati students in this study demonstrated a commitment to the educational process, a willingness to succeed against odds, and a desire to make a valuable contribution to their families, the college community and to the nation. They have valuable knowledge and experiences to contribute and are an asset to the college. If this college and other educational institutions wish to attract this growing body of students, then they need to be proactive in meeting their needs.

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DESIGNING A MODEL OF VOCATIONAL TRAINING PROGRAMS FOR DISABLES IN PAKISTAN

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Abstract: This study was conducted to designing a model of vocational training programs for disables. For this purpose desk review was carried out and the vocational training models/programs of Israel, U.K., Vietnam, Japan and Thailand were analyzed to form a conceptual frame work of the model. Keeping in view the local conditions/requirements a new model of vocational training program was proposed. The proposed model involved the vocational training plan for the job of cashier for mild group, receptionist for moderate and computer operator for severe group. It specified the type of disability as well involved in the training plan. The model recommended the vocational training of three levels of disability; mild, moderate and severe irrespective to the type. The model consisted of details of structure, objectives, professional support involved vocational training plan and syllabus/activities, evaluation and on job training etc. International practices regarding VT mixed with our national existing situations were critically analyzed during desk review and finally a plan of VT for disable was proposed. A survey was conducted via a questionnaire to get opinion of the heads and senior vocational instructors of eleven Federal Government vocational training and rehabilitation centers for PWDs. The collected data was statistically analyzed and suggestions on proposed model were quantified. The major findings included that all stakeholders considered VT helpful in rehabilitation of PWDs. All heads and vocational instructors are willing to adopt this model, minimum or no extra funds are needed in its implementation, the vocational teacher employed in the centers can easily manage to adopt this model at their centers because no extra training is required for the staff and they all endorse the VT plan proposed in this model.
Keywords: Disable, Vocational, Training, Designing, Model

INTRODUCTION

The vocational training is a movement towards reducing the gap between the normal and the handicapped. Disabled persons also need full participation, involvement and co-operation as members of the society. So, the vocational training is an essential tool for integrating the special people in society and making them productive member of community. It is helpful to enable individuals be not dependent on the society from the early stage of life and makes them beneficial citizens rather than being burden on others.

Vocational Training: Meaning and Concept

Vocational Education or Vocational Education and Training (VET), is also called Career and Technical Education (CTE). It prepares learners for jobs that are based in manual or practical activities, traditionally non-academic and totally related to a specific trade, occupation or vocation, hence the term, in which the learner participates. It is sometimes referred to as technical education, as the learner directly develops expertise in a particular group of techniques and technology (Lettmayr, 2011).

About the certification of VT, Gartner, (1994) elaborated that vocational education prepares students for industrial and commercial occupations, but it is not the requirement of university degree. UNESCO, (1984) documented that vocational education designed to prepare skilled personnel at lower levels of qualifications for one or a group of occupations.

Grubb & Ryan, (1999) classified the VET in various categories. Some of these categories are discussed below:
i) Pre-employment VET: prepares individuals for the initial entry into employment. In most countries there are traditional programs of vocational and educational training in schools. They are found both in schools and workplaces as dual systems and are often operated by national ministries of education.

ii) Upgrade training: provides additional training for individuals who are already employed, as their jobs change, as the technology and work environment become more complex, or as they advance within the company.

iii) Retraining: provides training for individuals who have lost their jobs so that they can find new ones, or for individuals who seek new careers to develop the necessary competencies for employment. Individuals in

retraining programs, by definition have already had a labor-market experience; therefore, retraining may not have a direct connection with the occupation they already have.

iv) Remedial VET: provides education and training for individuals who are in some way marginal or out of the mainstream labor force. Typically those who have not been employed for a long period of time or who do not have any labor-market experience, usually people depending on public income.

v) IVET: refers to general or vocational education and training carried out in the initial education system, usually before entering working life. Some training undertaken after entry into working life may be considered as initial training (e.g. retraining). Initial education and training can be carried out at any level in general or vocational education (full-time school-based or alternate training) pathways or apprenticeship.

vi) CVET : is defined by the area of education or training that comes in after entry into working life and aims to help people to (a) improve or update their knowledge and/or skills, (b) acquire new skills for a career move or retraining, (c) continue their personal or professional development. World-wide, the scholars are very much on consensus regarding meaning, concept and type of vocational training.

Theoretical Perspective

Historical background of a concept is always helpful to understand the things better.

The history of vocational training/rehabilitation can be traced back in the early 19th century. The Perkins Institute was the first rehab started in Boston in 1829. In this institute, blind people were trained so that they could get jobs in the manufacturing industry. However, such types of training programs were very few. More such programs were started towards the end of the century, when Progressivism started to gain strength. Rehabilitation (2010). History of Vocational Rehabilitation. Retrieved from mhtml:file://H:/his2.mht, assessed on Sep. 26th, 2012.

In Pakistan since 1980, interest in vocational rehabilitation, vocational training and placement of disabled was increased considerably. The education for the person with disabilities, vocational skills training facilities, career guidance and counseling, job finding, organizational and institutional support all are needed to help almost 1.1 million young people of fourteen to twenty year's age. Vocational training centers for person with disabilities need coordination with National Training Bureau of the Ministry of Labor for the purpose of employment/ placement of trained disabled persons in suitable jobs (Sajjad, Joubish & Khurram, 2010).

All above policies evolved the need of proper methodology/models to implement VT in true spirit for the betterment of the PWDs. Vocational training is the preparation for jobs that call for extensive practical experience and training. Disability-suitable and market oriented vocational training, job related training, job placement or self employment opportunity and reasonable accommodation in work place is very much successful package in the world which has really supported to enhance the economic life of PWDs' in many places. Providing vocational training to PWDs is a bit different and complicated than other people since their functional limitations and essential supports needed varies according to disability category and level of severity.

a) Mainstream model

Government, private sectors or NGO run vocational training centers to provide training for any interested or needy people. These training centers provide quality training and certified trainees as able to work the relevant job or business. In order to mainstream disabled people, the physical infrastructures, rules and regulations, systems, curriculum and evaluation processes provided in training centers should be made disability friendly. The resource persons (trainers) should be also fully oriented about disability issues and capacity of PWDs. Since being inclusive in nature this model is very demanding and effective. Most of the PWDs want to be trained through such types of model.

b) Community based model

Community Based Rehabilitation (CBR) program suggested the best strategies for the overall development, rehabilitation and empowerment of PWDs in the world. One of the key components of CBR is economic empowerment which enhanced the economic participation of PWDs. The economic participation is enhanced by mobilizing the local resource and community's cooperation in the community. This approach provided different types of vocational training to the PWD,s. this training is based on the need of local market. The PWD,s are supported to start the self employment or get relevant job in the local labor market technically and financially. In this CBR model the needy people are also facilitated to include in the locally run mainstream vocational training center.

c) Apprenticeship model

The model provided skill in a particular subject by working with experienced and skilled persons in his/her workshop or workplace. Learning of crafts and trades with experienced people is a very longstanding/ widespread mean of skill development. The model is cost effective good to engage in informal economy. Such types of trainings are very much useful for PWDs who face barriers in accessing formal sectors take such types of trainings very useful.

d) Peer training

In peer training successful business people teach their skills to others. The trainers and trainees are from same background living condition or same disability category in the case of PWDs. There may be a close friendship between trainers and trainees. They both have a good spirit of teaching and learning. The trainee 'we' feelings during training.

e) Group training model

In this method a person learns within the group of people having same training needs. It is a time/resources saving model. Here we may have many groups having same interest involved in same job.

f) Sheltered model

A traditional model where PWDs are kept in specially designed structures and provided different types of vocational training. The trained men are given work in the same shelter and paid for their work. The sheltered workshops market the produced goods. The model is highly expensive and unable to cover the wider population of PWDs. The model is not popular in developing and underdeveloped countries.

The review of the above models implies that each model has its specialties. For example mainstream model considers each and every one to participate, community based model emphasized overall development of the PWDs, the apprenticeship is wonderfully good for skill acquisition, peer training focus the good relations between trainer and trainee, group training model attends the people with similar training needs and sheltered model is considered highly expensive/not popular in developing countries.

In Pakistan, policies are framed for the betterment of disabled persons but their implementation remained a problem. Ahmed, Khan & Naseem, (2011) in a study analyzed to confirm exact status of policies and its implementation for special persons in Pakistan, adopted the historical, analytical and comparative approach. They analyzed/probed these educational policies and their implementation status in Pakistan. In Disabled Persons (Employment and Rehabilitation) Ordinance, 1981, it was mentioned that Councils for the Rehabilitation of Disabled persons would be responsible to issue directions to relevant bodies for the implementation of the projects launched by the government. Establishment of training and vocational centers for equipping special persons with necessary skills is also the responsibility of Provincial Councils.

The National Policy for Persons with Disabilities, (2002), emphasis the provision of conducive environment for the realization of the full potential of persons with disabilities. The National Plan of Action for Persons with Disabilities, 2006 proposed the short term measure which includes expanding and reinforcing vocational training, employment, promoting inclusive education and medical rehabilitation services. The plan identifies that all key reports is the non availability of accurate and reliable data about the magnitude or prevalence of disability in the country and this does not help in proper planning and policy making. It was analyzed in the plan all available legislations/policies/ ground realities and found out that policies were not being implemented in true sprits. It can be concluded that policy makers should revisit all the policies and then there should be complete implementation of these policies in true sprits.

Vietnamese government and the resent emphasis on the importance of inclusion of PWDs in training, work and enterprise development especially for women. Str, (2008) conducted a research named mapping report of Vocational Training an EMP employment for people with disabilities in Vietnam basically it was aimed to help international Labor organization for implementation of certain decisions for the welfare and rehabilitation of disabled in Vietnam. The research is basically an over view of organizations representing PWDs as well as services related to vocational training, employment and entrepreneurship for PWDs with special focus to women with disabilities.

In Thailand, the authorities considered VT as important activity. Murray, (1998) in his research titled vocational training of disabled persons in Thailand: a challenge to policy markers under the umbrella of Cornell University ILR School tried to analyze the status of VT of PWDs and commented on the policies/provisions for PWDs in the country. The researcher explained the role of Department of Public welfare (DPW)/Ministry of Labour and public

Welfare/East Asia Multidisciplinary. Advisory team (EASMAT) of ILO (international Labor organization). This study included the programs run by the Governmental Organization (GOs), Non-governmental Organizations (NGOs) and Special Schools regarding. Vocational training component included in their cumulus.

The above research studies on VT revealed that in each country, the stake holders are trying hard to enhance the role of vocational training in the successful rehabilitation of PWD,s. Jobs are being specified, curriculums are being designed and methodologies are being finalized so that the VT for PWD,s may be ensured and they should be made beneficial/productive citizens of of their communities. ICT/computer based learning is emphasized in this regard and PWD,s are ensured to work independently so that they may feel high being honorable citizens of their countries.

OBJECTIVES OF THE STUDY

The objectives of the study were:
1.   To critically analyze the existing vocational training programs.
2.   To prepare a model of vocational training program for disable children.
3.   To analyze experts opinions on the proposed model of vocational training program

METHODOLOGY

The study was descriptive in nature. Therefore, survey approach was considered appropriate. After the study of related literature, questionnaire as a tool of research was drafted and was validated and a expert opinion on the model. There was 15 items in a questionnaire. There were only yes and no opinion on the questionnaire. The population (66) of the study comprises of the heads and all vocational instructors of all (11) vocational training rehabilitation centers previously governed by the federal government. The sample of the study comprises of 11 heads and 11 vocational (one head and one Senior instructor) from each vocational training and rehabilitation centre.

RESULTS AND DISCUSSION
Data collected through questionnaires was tabulated and descriptively analyzed on the basis of different statistical tool i.e. percentage and mean score using SPSS.

Table 1: Expert opinion on the model   (N=20)

S.N.	Statement	Yes		No	
		f	%	f	%
1	Do you think that Vocational training is helpful for rehabilitation of PWDS?	19	95	01	05
2	Are you satisfied with the present situation of VT for PWDs in the country?	01	05	19	95
3	Is duration period proposed for the training appropriate?	18	90	02	10
4	Do you agree with the structure of this model?	17	85	03	15
5	Do you agree with the procedure of this model?	17	85	03	15
6	Do you consider the model practicable?	18	90	02	10
7	Do you endorse the vocational training plan proposed in this model?	16	80	04	20
8	Do you think that our disabled students will be willing to take VT at the centers through this model?	18	90	02	10
9	Do you think that the model can be generalized for all disabilities?	15	75	05	25
10	Do you think this model will be an extra burden for your institution?	05	25	15	75
11	Do you think extra funds will be needed for the implementation of this model?	05	25	15	75
12	Do you consider this model comprehensive enough for vocational training?	18	90	02	10
13	Do you feel that some extra training is required to the staff for successful implementation of this model?	04	20	16	80
14	Can already working instructors easily manage to adopt this model for the disabled students at their centers?	19	95	01	05
15	Will this model win the fame among the stake holders?	18	90	02	10
	∑	208		92	
	N (no of statements)	15		15	
	Mean	13.86		6.13	
	Standard deviation (SD)	6.01		5.58	

The table 4.1 shows that 95% respondents opined that VT is helpful for rehabilitation of PWDs and only 5% respondents did not agree with this. Only 5% respondents were satisfied with the current situation of VT for PWDs in the country while 95% were not. 90% respondents considered the duration of period for VT appropriate while only 10% did not think so. 90% respondents are agreed with the structure for the model while 10% did not agree with it. 85% respondents were agreed with the structure & procedure of the model while only 15% were not. 90% respondents considered model practicable while 10% did not think so. 80% respondents endorsed the VT plan in the model while 20 % did not endorse it. 90% respondents thought that the students would be willing to get VT through this model while 10% are of opposite view. 75% respondents said that the model could be generalized for all disabilities while 25% did not think so.75% respondents did not think this model an extra burden while 25% took it as burden. 75% respondents were of the view that no extra funds were required for implementation of the model while 25% had opposite opinion. 90% respondents thought that the model was comprehensive enough for VT while 10% did not think so. 80%

respondents opined that no extra training of the staff is required for implementation of the model while 20% thought it required. 95% respondents opined that the working instruction could easily manage to adopt this model in their centers while only 5% had opposite opinion. 90% respondents were of the view that the model would win frame among the stakeholders while 10% did not think so. Mean score of "Yes" was 13.86 while the mean score of "No" was 6.13 and SD for both types of options was 6.01 and 5.58 respectively.

It was found out that most of the respondents (95%) this VT model will be helpful for PWDs. Most of the respondents (95%) were not satisfied with present position of VT for PWDs in the country. Mostly respondents (90%) agreed the period proposed for VT is appropriate. Most of the respondents (90%) agreed with the structure of the proposed model while others not agreed. Mostly (85%) agreed with the procedure while some of them not. Most of the respondents (90%) considered model practicable while some of them do not. Mostly (80%) of the respondents agreed to endorsed the vocational training plan proposed in the model while some do not want. Most of the respondents (90%) of the view that students would be willing to got VT while some of them not. Mostly respondents (75%) thought it could be generalized for all disabilities while some not agreed. Most of the respondents (75%) opined that the model would not be in extra burden for their institutions and it needed not any extra funds for its implementation while others have opposite opinion. Majority of the respondents (90%) considered the model comprehensive enough for vocation training while others do not think so. Mostly respondents (80%) agreed the extra training of staff while others do not. Most of the respondents (95%) were of the view that the already working instructors can easily manage to adopt this model without any extra training and the students will be willing to get VT through this model while some do not agree. Most of the respondents (90%) hoped that the model would win frame among its stakeholders while others do not think so.

Table 2: Analysis of open ended question   (N=20)

Item No.	Statement	Responses	f	%
16	Would you like to suggest certain changes / instructions in this model?	The model should have been proposed disability-wise.	10	50
		The implementation of this model should be through concerned authorities.	06	30
		The vocational rehabilitation centers for disabled must be established in each district headquarters of the country.	04	20
	Mean		**6.67**	
	Standard deviation (SD)		**2.5**	

In the response of open ended question, 50% respondents suggested that the model should have been proposed disability-wise. 30% wanted its implementation through concerned authorities. 20% suggested that vocational rehabilitation centers for disabled must be established in each district headquarters of the country.

It was found out that the model should have been proposed disability-wise. Implementation of this model should be through concerned authorities. Vocational training and rehabilitation centers for disabled may be established in each district of the country.

CONCLUSIONS AND DISCUSSION

All models of vocational training, which are being implemented in the different countries of the world have their own strengthens/weaknesses keeping in view the local condition/requirements. Dual model of Germany is considered though very successful model for VT but still almost all countries have their reservations about it, owing to their local conditions and requirements. Lack of proper management of the coordination between theory and practice seems the most crucial in this regard. Isreali model for VT still needs adaptation from other countries keeping in view their legislation, policies, plans and infra structure. On the job vocational training models as wonderful advantages of practical nature but lacks theory of the concept. Apprenticeship vocational model also face problems of infra structure and lack of coordination between theory and practice. Proposed model also needs expansion towards all the disabilities/locations/professions meant for/adaptable by the PWDs. ICT implementation in vocational training of PWDs is considered remarkably beneficial and admired at all levels by all stake holders.

The findings of the study revealed that different vocational models/programs implemented in different countries emphasized that proper vocational training is the most important requirement in the process of rehabilitation of PWD world-wide. Technologies are making the things better. Therefore need for proper syllabus and vocational activities is being felt at all levels. Infra structure for vocational training of disable is required. Expansion in provision

and trends are needed to be merged with the existing practices. The situation needs special attention of all stake-holders and authorities for up-dation of current practices at the special education centers for the implementation of the Proposed Model of vocational training of disable in the country.

Recommendations

The study recommended that;
1.   Vocational training model on various jobs for specific disabilities may be developed.
2.   Vocational training model for after school youth may also be developed on similar pattern.
3.   Course curricula of vocational training should be standardized and up-graded.
4.   Supported employment should be introduced in Pakistan.
5.   An effective vocational assessment should emphasize before enlisting the pre-requisites of the job.
6.   The provision on job training should be made available.

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ANNEXURE- A : Pictorial Representation of Proposed Model of Vocational Training Program for Disable

MODEL OF VOCATIONAL TRAINING PROGRAM FOR DISABLE
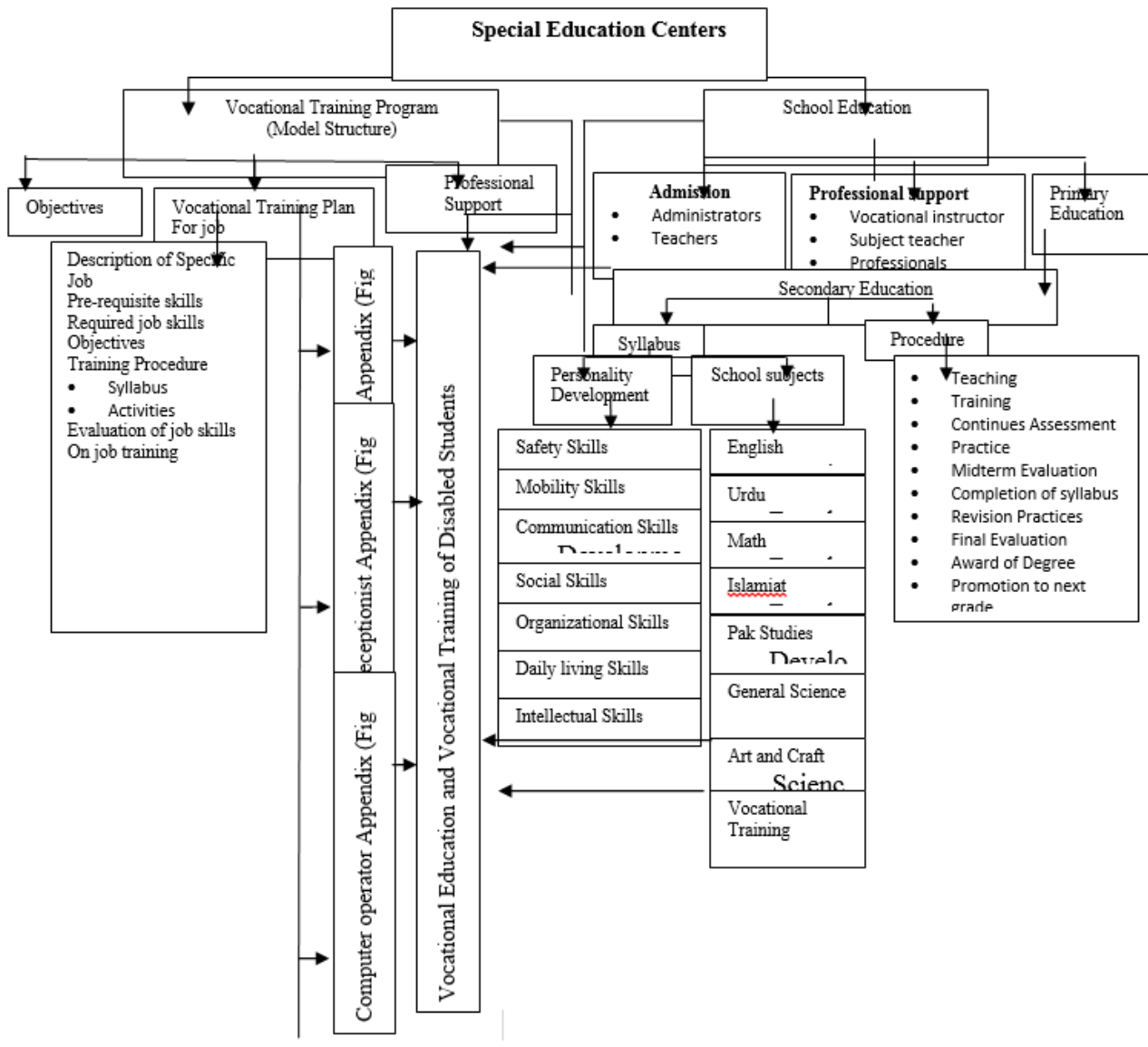
DIVERGENT AND CONVERGENT THINKING PROJECTS IN INTERDISCIPLINARY STUDIES

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ABSTRACT
Several researches have indicated that designers solve problems through synthesis: they design activities to reflect a "way of thinking" and use design thinking as a methodology for the practical, creative resolution of design problems (Buchanan 1992; Cross 1982, 2011; Lawson 1980; McKim 1973; Rowe 1987; Simon 1969). Designers need to think from a "designerly" perspective, and "design thinking" is now used to describe a particular style of innovative problem solving. It generally implies the ability to transform the way products, services, processes, and strategies are developed. This study addresses the innovate quality of design thinking and extends the concept of a "designerly way of thinking" to a project-based course called "Design and Application of Intelligent Electronic Systems,". e use Brown's five characteristics of design thinkers—empathy, integrative thinking, optimism, experimentalism, and collaboration (Brown 2008)—to develop a systematic account of the creative thinking-in-action approach to problem solving for this cross-engineering-and-design project. This study also discusses how the concept-knowledge (C-K) theory facilitates the development of techniques that will better harness the potential for innovation across disciplines. We discover that synthesizing methods can successfully harness both creative and rational activities, so that engineering students who work with design students can more easily adopt a designerly way of thinking and thus solve problems innovatively.

THINK DESIGNERLY AND INTERDISCIPLINARILY

Cross (2001) observes that scientists solve problems through analysis, and designers, through synthesis. Other researchers have indicated that design, by nature, stirs the imagination of a better future and paves the way to obtaining it (Grocott 2005; Rosenburg 2006). The concept of design thinking involves the use of the method, language, material, and practice of design to create knowledge that transforms people's understanding of the possibilities of the discipline (Downton 2003; Fallman 2005; Haseman 2006). The universal thinking approach of designers—"designerly ways"—is recognized as an intuitive and divergent process of problem solving. This manner of thinking also differs from the traditional techno-scientific convergent approach used by engineers (Dym et al, 2005; Beder, 1999; Akay, 2003; Pappas, 2002). The engineering field appears to be ripe for a new educational approach that will integrate the design and engineering disciplines through teaching that runs through both disciplines seamlessly, meets the ever-changing socially responsible requirements, and creates models of reflective practicum (Beder 1999; Green 2001; IME 1985). According to Grasso and Martinelli, the need of the hour is a new kind of engineer who can think broadly across disciplines while considering the human element (Grasso and Martinelli 2007). Akay notes that design consultancies and manufactures now require flexible and adaptable engineers who can operate effectively in global multidisciplinary environments (Akay, 2003).

The expansion of the scope of design brings with it problems that are significantly more complex. An interdisciplinary approach, according to Walker (2011), involves the integration of theory, methods, or knowledge from two or more traditionally distinct disciplines. By its very nature, design represents the human power of conceiving, planning, and creating objects that serve human needs. Samraj and Swales (2000) argue that the effective integration of cross-disciplinary perspectives demands research to obtain grounding on the specific problems faced in the each field. Norgaard and Sharachchandra (2005) observe that although scientists come together in cross-disciplinary teams based on some shared interest, the outcomes do not necessarily translate into an effective research plan with clear links between the various disciplines. Although the need for connections on a vertical dimension is undoubtedly important, it is also necessary to conduct an analysis using an interdisciplinary approach in this specific context, as it can provide useful insights into the problems encountered by researchers in their disciplinary training and conditioning. Many researchers have argued that creativity is of utmost importance in engineering, as it endows practitioners with the insight and discipline necessary to seek out and address problems in the field's various disciplines (Ghosh 1993; Pappas

2002). However, many engineering institutions continue to focus on engineering science and train potential engineers in technological task completion. As a result, students do not have the opportunity to develop design aptitude or creativity (Dym 2005; Beder 1997; Akay 2003; de Vere 2009).

Thus far, the design activities in an engineering process are concurred to solve ill-defined problems. The process requires the synthesis of problem framing and solving; a creative, divergent, and adaptable approach; and less fixation on prior solutions (Cross 2006). Schön viewed the problem-solving elements of design research as "situated activity" and considered design in terms of "reflective activity" and related notions, including "reflective practice," "reflection-in-action," and "knowing-in-action" (Schön 1983). To be able to explore and develop their ability in problem framing, engineering design students have to be capable of divergent thinking, critical reflection, and creativity. These aspects have conventionally been characterized as "ill-defined" (Simon 1969) or "wicked" problems (Rittel and Webber 1972; Dunne and Martin 2006) fraught with "figural complexity" (Schön 1990).

The traditional methods of reasoning used by engineers are no longer sufficient because the current situation in the field is radically different from classical optimization and modeling (Hatchuel and Weil 2011). Such is the situation in the field of design as well; the direction of contemporary design research has already been transformed from one based on the production of artifacts to one that is focused on the integration of varied knowledge and fields at different stages. However, designers in the knowledge domain encounter multifarious problems. In order to work with experts from diverse fields, they have to adopt more systematic models that give due consideration to both rationality and innovation. In this study, we examined an interdisciplinary project by using a project-based study that develops a teaching process implemented on the basis of' Brown's five characteristics for design thinkers (2008) and Schön's design-thinking process (Schön 1983), to observe how design and engineer students co-work and react in the process of problem solving of interdisciplinary context. After the course was completed, we analyze means of developing and delivering a multidisciplinary design-thinking project—in this case, for engineering and design students—by referring to the concept-knowledge (C-K) theory and employing reflection-in-action analysis.

CONCEPT-KNOWLEDGE THEORY

Brown (2008) puts forth five characteristics for design thinkers: empathy, integrative thinking, optimism, experimentalism, and collaboration. Design thinkers need empathy to adopt a people-first approach with which to imagine the world from different perspectives; integrative thinking, to create novel solutions for great innovations; optimism, in the face of many challenges, for better solutions; experimentalism, in order to move from taking small incremental steps to creating breakthrough innovations; and collaboration, in order to work with others from different disciplines. Brown also states that the design-thinking process can best be represented as a "system of spaces." He said that there are three spaces—inspiration, ideation, and implementation. Inspiration refers to the opportunity or motivation to search for solutions to a problem; ideation, the process of generating, developing, and testing new ideas; and implementation, the execution of ideas from the project stage to people's lives (Brown 2010). Brown's characteristics and spaces serve as important guidelines for creating a valuable framework by which to consider the concept of design from the perspectives of problem acknowledgement and definition to the final problem resolution (Howard and Davis 2011). However, when focusing on teaching and learning activities in project-based design for engineering students, Brown's system appears to depart from the engineering and interdisciplinary domain. His system omits some expert knowledge on teaching and learning elements for engineering and other students. Therefore, in the present study, we apply the C-K theory to Brown's system in order to enhance the integrity of the course design for engineering students and the relevant interdisciplinary teaching situations.

The C-K theory is a unified design theory introduced by Hatchuel and Weil (2003). It is at once a theory of design and a theory of rationality in design, and seeks to describe certain design activities rationally (Hatchuel and Weil 2003; Kazakci and Tsoukias 2004). Design, then, is defined as "the interaction of concept and knowledge spaces." The C-K theory rests on the assumption that design can be modeled in terms of an interplay between two interdependent spaces: concepts and knowledge (Hatchuel and Weil 2003, 2009). Since design is a dynamic mapping process between required functions and selected structures, the C-K theory can be considered a research field and teaching area (Hatchuel and Weil 2009). Schön's (1983) concepts of reflective practice, reflection-in-action, and knowing-in-action are presented in the dynamic mapping process between the interdependent spaces of concept and knowledge. The C-K theory is mainly used to investigate the divergent and convergent design thinking processes of engineering students. For an interdisciplinary learning approach targeting both engineering and design students, it is necessary to obtain a significant and designerly solution to the problem. Moreover, the aim is to enable students from both fields to adopt a designerly way of thinking and solve their problems innovatively.

In much of the literature, the C-K theory is summarized as a theory that teaches divergent thinking (DT) and convergent thinking (CT) in a collaborative, controlled manner. Divergent thinking comes into play in situations where new,

original worlds have to be created, and it requires the ability to break existing generative rules and create alternative realities. On the other hand, convergent thinking equips students with the ability to use knowledge to activate expertise, transform it into usable skills, and link existing abstract engineering science models (Brereton 1999; Boden 1990; Dym et al. 2005; Loch et al. 2006). Hatchuel, Masson, and Weil (2011) state that the C-K theory can serve as a supportive framework to improve PBL; it can improve students' critical abilities, allowing them to give due thought to the main issues in innovative design education. Additionally, in an interdisciplinary project that falls within the C-K theory structure, students tend to have different tasks when focusing on both design and engineering perspectives (Eris 2004; Dym et al. 2005; Hatchuel, Masson, and Weil 2011; von Hippel 2001; Magnusson 2003; Pahl and Beitz 2006; Finke 1990; Ward et al. 1999; Shah et al. 2003; Plety and Cremet 2007).

According to Hatchuel and Weil (2002, 2009), interactions between the concept and knowledge spaces match the particular cognitive efforts that designers deploy during the design process. The C-K theory proposes to model them through the four operators: K→C, C→K, C→C, and K→K.

• K→C involves the generation of tentative concepts by adding new attributes to an already partitioned existing concept. This operator adds or subtracts a property from the K-space as a new attribute of a concept in the C-space. As it allows the partition of an initial concept, this operator expands the C-space with elements from the K-space. From a managerial perspective, it models a step of the description of a design path.

• C→K involves the search of attributes in K that can be used to partition C; then, it must be confirmed whether the newly generated C is a concept or knowledge. This operator seeks to add or subtract properties in the K-space in order to reach propositions with a logical status. When it succeeds, it creates a "conjunction" which stops the design process. When it does not succeed, the operator expands knowledge through the adjunction of concepts, which leads designers to the knowledge acquisition process.

• C→C implies a graph operator in space C (paths, chains). This operator relies on the classical rules in set theory that control partition or inclusion. From a managerial perspective, a partition can be either restrictive or expansive. A restrictive partition reduces the space of possibilities without changing the definition or attributes of the object to be designed. An expansive partition modifies the identity of the initial design object by adding unexpected attributes to the initial concept. It is precisely these expansions that make breakthrough innovations, including surprises, possible.

• K→K is the reasoning of one type of knowledge to another (classification, deduction, abduction, etc.). This operator relies on the classical rules of logic and propositional calculus that allow the K-space to have self-expansion; e.g., proving new theorems. For managers, K→K operations describe designers' actions to increase the reliability of propositions in K.

The C-K theory provides a consistent and formal account of creativity and learning during the design process, and reflects a thinking process between DT and CT. Kruger and Cross (2006) observe that designers focus closely on the problem at hand and strictly use only the information and knowledge that is needed to solve that problem. In the interdisciplinary approach, the emphasis lies in defining the problem and finding a quick solution. Hence, Dym et al. (2005) stated that the teaching of innovative design in a project-based program requires a better understanding of design thinking. The theory of design thinking is extremely useful because it can be taught and learned in a relatively short period using controllable processes, with evaluations and exercises to improve creative efficiency. However, considering the sheer variety of cross disciplines in existence, the problem is how to develop a design-based project to harness existing knowledge and integrate DT and CT processes to fulfill educational goals.

In this research, we use the C-K theory in an interdisciplinary project-based course called "Design and Application of Intelligent Electronic Systems." The participants comprise third-year students from the electrical engineering and digital media design departments of the National Yunlin University of Science and Technology in Taiwan. The purpose of the course program is to allow integration and cooperation in two domains. The aims of this research are to explore how engineers can acquire the capacity for innovative design reasoning (McMahon et al. 2003), how designers can obtain rational reasoning knowledge (Eris 2003, 2004), and how students can gain critical abilities and give due consideration to the main issues in innovative design education. Moreover, when investigating the characteristic of reflection-in-action, which is reflected in the C-K spaces, on behalf of addressing a teaching reference for cross-disciplinary courses, it helps to teach creative design in project-based activities, especially in the engineering and design domains. The rationale behind recruiting students from two departments was that the digital media design students had only a very basic background in programming, while the electrical engineering students were used to project-based courses that required some experience in innovation.

METHOD AND CASE INTRODUCTION:
Participant observation has been used in qualitative research in a variety of disciplines for collecting data about people, processes, and cultures (Preissle, & Grant, 2004); it helps deepen researchers' understanding of the context and phenomenon under study, allowing them to discover, through immersion and participation, the 'hows' and 'whys' of

human behaviour in a particular context. The researcher is required to engage in a variety of activities and pay attention to multiple considerations (DeWALT & DeWALT, 2002). For many years, it has been applied in both anthropological and sociological research. Recent years have witnessed an increase in the number of qualitative studies in the field of education that include participant observation as a data-collection tool (Kawulich, 2005), including establishing rapport with those being observed, checking for nonverbal expression of feelings, selecting key informants, grasping how participants communicate with each other, establishing processes for conducting observations, deciding what to observe and when, keeping field notes, and writing up one's findings (Whyte, 1979, SCHMUCK, 1997). During the participant observation process, the observers must maintain a certain degree of openness while conducting the research, and redefine and modify the research questions on the basis of their discoveries and observations. Participant observation is a key strategy used to gain understanding of aspects of human conditions that are otherwise difficult to academically examine. Data are collected primarily through direct observation and experience (Jorgensen, 1999).

In the present study, we used participant observation to investigate how students from different knowledge backgrounds cooperate in the design process, and how they 'act-in-reaction' in the process of learning and delivering. We document mainly the course process, which includes teaching, group discussion, presentation, and feedback. Different kinds of data are collected for analysis—videos, photographs, conversation records, and all drawings and drafts produced during the process. We focus on the analysis of such interplays to 'to improve our recognition of design activities. Similarly, the recognition of groups and analysis of their structures are necessary for group activity detection, so the observers were allowed to interview students informally at the same time at which they were conducted participant observation, when they need more detailed descriptions and explanations to understand the context. Therefore, we used two models to analyze the data. In the first model, we investigate what kind of backgrounds do participants bring to the group and, in the context of these backgrounds, how they react to the introduction of a new concept or new knowledge, and the divergent and convergent thinking they exhibited during the four processes of this project. We categorize students' discussing and thinking activities into mind maps for the four processes. We particularly focus on the concept-generating phase, wherein ideas are generated, and how students' design and engineering skills are dispersed and integrated. In the second analysis, we investigate how the structure of the C-K operators (K→C, C→K, C→C, and K→K) is formed in a system involving three systematic spaces, and analyze how action and reaction occur between these spaces.

The course under investigation, Design and Application of Intelligent Electronic Systems, is developed for both the electrical engineering and digital media design departments. The course is taught by four professors, two with electrical engineering backgrounds, and two from the media design field. Forty-seven students enrolled in the course: 21 from design school, 25 from engineering, and one from architecture design. The aim of the newly amended course was to establish an interdisciplinary and integrative setting for students from all departments, enabling them to implement existing knowledge of the design process and gain new knowledge as well.

All 47 students attended class together; they were grouped into teams of two, one member from each department. There were three extra engineering students, and each was assigned to an already "complete" team. Thus, three of the teams had three members.

The six-week course analyzed in this study was the first project for the semester (Table 1). The teaching goals were twofold: design and technique. To achieve the design goal, students had to create ample and interesting interaction by incorporating functions into their own old toys using micro controls. To achieve the technique target, students had to learn micro controls and system design. The project consisted of teaching phases that were decided on the basis of Brown's (2008, 2010) five characteristics: empathy (E), integrative thinking (I), optimism (O), experimentalism (EX), collaboration (CO) of design thinkers; and the system of spaces: inspiration (A), ideation (B), and implementation (C). All activities were divided into 10 phases, which took into account all the above-mentioned criteria: (1) visual thinking warm-up exercise, (2) mind map for toys, (3) group sharing, (4) team building and project explanation, (5) introduction of micro controls, (6) concept development and converging, (7) comments and discussion, (8) project execution, (9) design-technical suggestions and instruction, and (10) final presentation and demonstration (Table 2). Below is a detailed description of the phases and their time distribution.

1. Warm-up exercise

    This activity was designed to inspire students to think visually, and help them shake off the conventional associate thinking. It was also important in teaching students to think and draw spontaneously.

2. Mind map for toys

    Students were asked to bring one or two of their old toys to class. Each had to draw an individual mind map from emotional, sensational, interactive, reminiscent, and material aspects to describe the toy(s) (Fig. 1). They were also encouraged to develop their own categories when drawing their mind maps.

3. Group sharing

    Since this was a big class, and it was vital that all students be able to share, they were divided into eight groups.

Thus, each student had enough time to share and discuss their toy(s) and mind map with their groups (Fig. 2).

4. Team building and project explanation

Each student was asked to find a partner from another department. Since there were 25 students from engineering but only 22 from design, three engineering students could not be paired off. Each "extra" was added to a team, so that three of the teams had three members. Students were also taught how to develop their projects from both the technical and design perspectives, and what to bring for their final achievements (Fig. 3).

5. Introduction of micro controls

This phase was taught by one engineering professor alone. In the first week, the Arduino hardware platform and its software development environment were introduced; the students learned the basic concepts of digital input and output. Finally, they were asked to finish a laboratory experiment that included LED controls, a 7-segment LED, and a button. During the second week, the students learned the Arduino program language, followed by communication with a PC via the RS-232 interface, lighting sensor, and servo motor control. In the third week, the students were introduced to the pressure sensor, infrared sensor for distance measurement, and 3-magnetometer.

6. Concept development and converging

Students had three weeks to develop and retrieve their designs while simultaneously learning how to use micro controls. At the end, they were asked to put down their concepts on three 2K pages (Fig. 4).

7. Comments and discussion

Students were divided into two groups, A and B, each of which had one week for comments and discussion (Figs. 5 and 6).

8. Project execution

Students were encouraged to develop their projects, giving due consideration to the design concepts and techniques taught in phases 1-7.

9. Design-technical suggestions and instruction

All the students and professors joined a private group on Facebook; we used this space as a virtual classroom to exchange ideas and hold discussions, along with face-to-face discussion (Fig. 7).

10. Final presentation and demonstration

In the sixth week, the students presented their final projects (Figs. 8 and 9).

Table 1: Project timeline

Time / Phase		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
1	In class	30 min					
2	In class	30 min					
3	In class	90 min					
4	In class	30 min					
5	In class		3 h	3 h	3 h (group A)	3 h (group B)	
	Homework		▬▬▬▬	▬▬▬▬	▬▬▬▬	▬▬▬▬	
6	Homework	▬▬▬▬	▬▬▬▬	▬▬▬▬			
7	In class				3 h (group B)	3 h (group A)	
	Homework			▬▬▬▬	▬▬▬▬	▬▬▬▬	
8	Homework				▬▬▬▬	▬▬▬▬	▬▬▬▬
9	Virtual discussion				▬▬▬▬	▬▬▬▬	▬▬▬▬
10	In class						3 h

Table 2: Project teaching plan, with comparisons between design characteristics and system of spaces

Phase	Characters	Systematic spaces	Activities
1		A	warm-up exercise
2	E	A	mind map for toys
3	I	A	group sharing
4	I	A	team building and project explanation
5		B	introduction of micro controls
6	I; O	B	concept development and converging
7	I; O	B	comments and discussion
8	EX; CO	C	project execution
9		C	design-technical suggestions and instruction
10			final presentation and demonstration

Designer characteristics: empathy (E); integrative thinking (I); optimism (O); experimentalism (EX); collaboration (CO).
Systematic spaces: inspiration (A); ideation (B); implementation (C).

Fig. 1 Mind map for toys

Fig. 2 Group sharing

Fig. 3 Team building and project explanation

Fig. 4 Concept development and converging-1
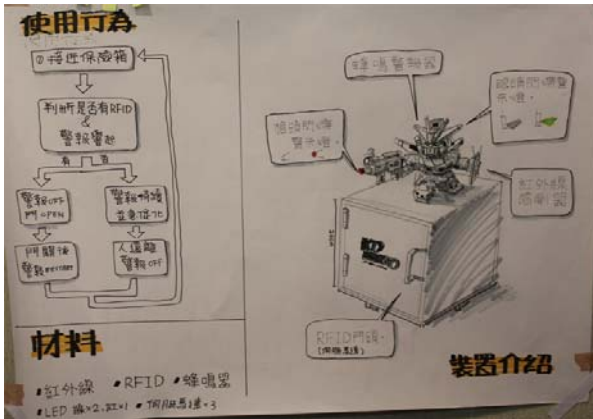
Fig. 5 Concept development and converging-2

Fig. 6 Comments and discussion

Fig. 7 Concept sharing in a group

Fig.8 Final presentation and demonstration – Donut bear project

Fig. 9 Final presentation and demonstration – Spy turtle project

CASE ANALYSIS

The research was subjected to a two-step analysis. The first step was an addition to the extended analysis of the C-K theory, which teaches divergent and convergent thinking in a collaborative, controlled manner. We observed a synergy model with a reference value for the interdisciplinary project-based design (Fig. 10).

The serial models focus on project exploration and cooperation, and mainly demonstrate how concepts and ideas are diverged and converged interdisciplinarily during the design activities. The first phase shows how "brainstorming" brings together multidimensional concepts. The second phase, "converging ideas," involves condensing and reconstructing. Here, the students have to make compromises by practicing restraint in their personal design plans to give way to consensus. The third phase, "ideation," implies the development of deeper concepts and the conveyance of knowledge from both sides to verify the entire scope of the project. The final phase, "implementation," not only involves a division of labor but is also a phase where close attention is paid to cross-disciplinary adjustment and comprehension. This working diagram can help educators or project managers set their own working models.

1. Brainstorming-bringing together multidimensional concepts
2. Converging ideas-concept polishing
3. Ideation-develop deeper concepts and convey knowledge from both engineering and design sides
3. Implementation-division of execution and cooperation

○ concepts developed at the beginning
○ new concepts explored in the integrative process
● concepts needed to practice through design discipline
● concepts needed to practice through engineering discipline
◉ concepts needed to practice through both disciplines

Fig. 10 Synergy of divergent thinking (DT) and convergent thinking (CT) processes

In the second step, we applied the system of three systematic spaces and the C-K theory combinations operators (K→C, C→K, C→C, and K→K) in analyzing how reflection-in-action can be divided with the concept-knowledge theory, and if all the teaching phases have fulfilled the goal of the project. A diagram extracted from this case is illustrated in Figure 10. The first column on the left lists the 10 phases designed for the teaching process, and the second column is integrated from Table 1 for referring to the status of the analysis. The third and fourth columns are the concept and knowledge spaces, which are meant to seek to the design activities rationally. After comparing the results with the dynamics diagram of the original C-K theory combination operators from Hatchuel et al. (1999, 2004), we found several points of concern for both the cross-disciplinary situation and the design thinking teaching process. However, we divided the four operators into eight categories to clarify the action and reflection in the design-thinking interrelated activities within engineering and design disciplines. The eight categories are design concept, engineering knowledge, design knowledge, design concept exploration, engineering concept with design exploration, engineering integrated with design knowledge, design concept with engineering exploration, and design integrated with engineering knowledge.

Fig. 11 Case study of reflection-in-action

1.   With regard to the systematic design thinking process, more existing knowledge is fostered in the inspiration space, where the students from both backgrounds need to cooperate with each other to firmly grasp the concept, knowledge, and design limitations of the topic of discussion. Although the problems faced by students from different departments may be the same, eventually, what they take with them from the course and the knowledge they acquire are very different. For example, if the topic under discussion in the knowledge space is "material," the design student will be concerned about the taction, texture, and sensation of the material. On the other hand, the engineering student will consider the component, weight, toleration, and assembly possibilities of the material.

2.   In reality, the cross-discipline learning process takes on a more complicated C-K working structure compared to a solo discipline and initiates the C-K theory.

3.   Normally, the design and engineering fields assume their own paths for concept and knowledge space and reflective action. However, because this project was a cross-discipline concern, the students' concept and knowledge paths were intertwined, and they had to solve phasic problems together before moving on to the next task.

4. The concept and knowledge status can be planned in projects to ensure that certain specifications and knowledge are imbibed by the students. If not, the reflection-in-action cognitions reflected between concept-knowledge spaces are spontaneously contingent on the dynamic exporting processes.

5. The reflection-in-action cognitions reflected between concept-knowledge spaces are not linear. Therefore, the four interdependent operators of the concept-knowledge theory (K→C, C→K, C→C, and K→K) can occur simultaneously. These reflective paths are not fixed; they depend on the actions and reflections of students from both disciplines.

6. Kazakci (2006) purports to extend the concept-knowledge design theory by taking into account the environment (E). He states that it is of particular importance to designers to provide a situated context. However, according to our investigation and analysis, we believe that the situated context is created in between the concept and knowledge spaces. Further, the environment factor is likely to be subsumed to these two spaces.

7. To ensure that learning objectives are attained at all stages of this multidisciplinary project, the learning processes need to be planned properly, and integrity of discussion should be allowed for both solo disciplinary and interdisciplinary fields. Conversely, some amount of flexibility should also be allowed in case of irregular innovation and inspiration.

Designer characters: Empathy (E); Integrative thinking (I); Optimism (O); Experimentalism (EX); and Collaboration (CO)
Systematic spaces: inspiration (A), ideation (B), and implementation (C)
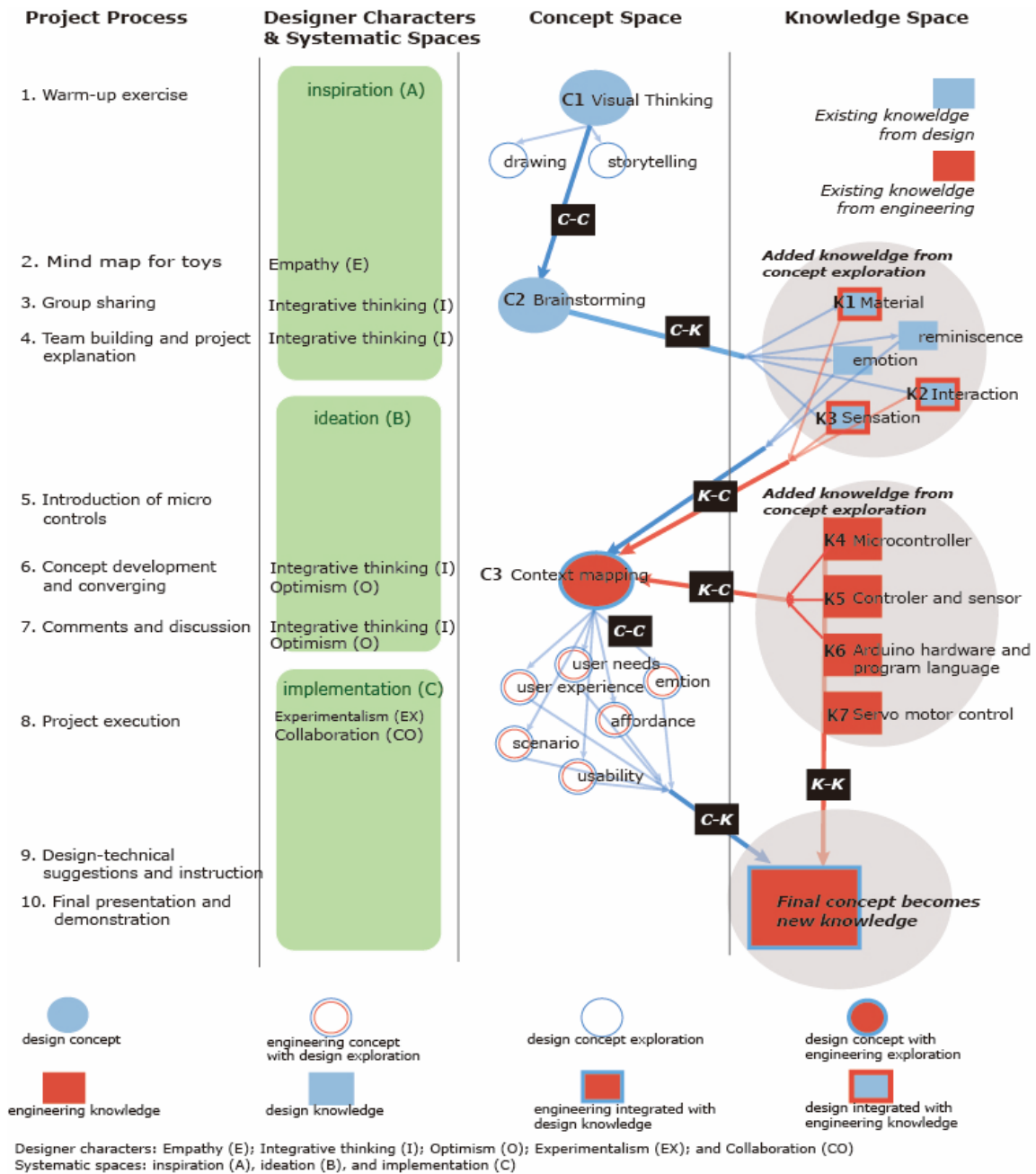
CONCLUSIONS

In this study, we aimed to discover how engineering and design students can accomplish design thinking in an interdisciplinary project through the use of synthesizing methods. We hoped that through this project-based case study, students would acquire skills related to both innovation and knowledge in two expert fields—design and engineering. Teaching a project-based program means providing students with procedural knowledge (Koedinger and Corbett 2006) and planning particular contextual tasks for them. Figures 10 and 11 show how the integration and evolution models for various learning theories and types of knowledge can be used in interdisciplinary project-based teaching. Design thinking is a schematized approach, in which divergent thinking becomes convergent, and new knowledge is created. In order to teach design thinking in interdisciplinary fields, clear tasks should be set for several learning stages, and instructive self-reflection and steps of action research are needed to intensify the spirited interaction between concept and knowledge.

According to Hatchuel et al. (2011), design is both a dynamic mapping process and a generation process of new objects, involving the construction of mental representations and external artifacts (Liikkanen and Laakso 2012). If an educator from any discipline attempts to employ design thinking as an apparatus for activating present discipline and knowledge,

it is necessary for that educator to develop an elaboration likelihood context that students can experience and explore, and to facilitate portals wherein students can explore, analyze, and find solutions. In the end, the aim of this research is not to establish a paragon for interdisciplinary teaching projects; rather, it is to build a potential referencing model for teaching design thinking in interdisciplinary fields. The model will be considered as a concept-and-knowledge, action-in-reflection design contextual process to fulfill the needs of an interdisciplinary design project. Another goal is to enable students from both fields to adopt a designerly way of thinking and solve their problems innovatively. However, this research postulates the case study as an interdisciplinary project; although the C-K theory is mainly used to investigate the design thinking processes in engineering students, we did not particularly distinguish between engineering and design students. They were asked to work out all phases together, rather than discuss how the concept and knowledge activities could be designed upon the various disciplines engaged in the situation.

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FUNDING SOURCES AND FOSTERING OF EDUCATIONAL PROJECTS

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ABSTRACT

The quest for unconventional solutions of funding sources and fostering of educational projects can be performed through observation of current projects or the ones already implemented by other institutions. Competing never meant guarantee of obtaining resources, but it is a different opportunity of diverse fundraising sources commonly used. Certainly the universities need to overcome inertia to ensure its sustainability and survival, but before that they need to do their homework in various sectors.

Keywords: fostering educational projects; funding sources; homework for universities; sustainable educational resources

INTRODUCTION

In many relevant areas Portugal have the latest technology. Why not in technology-mediated learning?

In this paper I focus on analyzing the search for sources of funding for educational projects via observation of congeners and the main challenge that reaches the Portuguese higher education institutions in the face of economic crisis that, contrary to what we might think, does not lie in the lack of financial resources, but in doing homework.

The article is based on findings from the research "Implementation Strategies and Development of an Open and Distance Education System for the University of the Azores" funded by the European Social Fund. The main objective of this research was to observe the recent events related to the probable paradigm shift in the educational area and propose to the UAC the adoption of solutions that can, at the same time, correct implementations already made, meet their internal demands and respond to these new challenges.

We may have available the most modern technological means, unlimited financial resources and still not produce anything - or something with quality.

Doing less with more resources any one can do. Doing more with more resources, most people can do. Doing less with fewer resources is a difficult task.

But the big challenge that presents itself to Portuguese universities and in the specific case, to the University of the Azores (UAC) is doing more with fewer resources.

R. Ribeiro (personal communication, September 10, 2012) recalls that in Portugal: "We have spent many years creating solutions to problems which did not exist with just a senseless waste of resources".

People who do not want things to change are those that, for some reason, feel they have a disadvantage with the change. Probably effective changes will only be observed in Portugal through mechanisms of pressure, derived from the current situation where crisis, reducing costs and budget constraints have become watchwords.

At the same time that the UAC survives the expense of underfunding of the Portuguese state and EU funds (public

funds), little or even nothing is perceived as returning to communities, to those who through their taxes have generated these resources. The so called 'community services' provided in the creation of Azores University Institute. And this observation refers to non-profit services, but free of charge. After all, charging a product and/or service of who sustains the institution without giving anything in return does not seem to be something logical, but it is what actually occurs. There should be a mandatory compensation, actions of university extension, something to be offered free of charge to communities.

In addition to the growing dependence created in relation to the Regional Government, with the consequent loss of academic autonomy and independence that this fact can generate, the resources of Operational Programme of the Azores for Convergence depend on the ERDF which in turn originate in the EU, that is, remain public resources, related to structural funds which in addition are not forever, should be directed to create structures and not to the payment of salaries and operating expenses, principal demands of UAC.

Faced with a situation of difficulties the institution does not seem sensible or even committed to the pursuit of unorthodox solutions that could provide growth options outside their physical facilities. Since the beginning of the collapse of Republican Government (with the advent of tuition fees through the law No. 37/2003, of 22 August), no other sources of funds were identified diverse of the Regional Government and actions of the Gaspar Frutuoso Foundation. (http://www.fgf.uac.pt/)

The proliferation of private foundations to support public universities resulted from a strategy of survival of these institutions that sought, in this way, an instrument to overcome (bypass) the legal limitations and ensure sufficient resources for their maintenance and development. While such instruments provided a greater ease in asset management, financial and human resources, they also facilitated the dysfunctions such as scattering (divert) the funds received without proper (correct) accountability. They also provided to professors (public servers), under full-time positions, to accumulate academic and non-academic functions including administrative positions and advisory and/or consulting services, incompatible with exclusive dedication that should preclude the exercise of any such other office or public or private employment. This autonomy in reverse meant also a dangerous distancing of the institutions of control environment provided by the public accounting and traffic of public resources. The extinction of the foundations system to universities and the creation of a new enhanced autonomy system seeks to correct the distortions observed.

(http://expresso.sapo.pt/universidades-desconheciam-extincao-das-suas-fundacoes=f744419)

The observation of current projects and the ones already implemented in other institutions, not only in the national territory, allows the identification of different sources of funding. Allied to the information available on the internet it is possible to mount (and then maintain) a relevant database that should include significant details of the calls.

During his research, Roth (2013) identified some institutions:

• Knowledge Society Agency (UMIC): is the Portuguese public agency with the mission of coordinating information society policy and its mobilization through awareness, qualification and research activities, promoting the technological development and knowledge creation by the scientific and technological system and enterprises, and fostering the development of e-Science. (http://www.english.umic.pt/)

• European Research Council (ERC): can be described as the transnational analogue of FCT at EU level. Generate the IDEAS programme of the Seventh European Framework which provides an opportunity for the R&D centres, associated laboratories and state laboratories, to improve the working conditions of resident researchers or to attract to Portugal talented researchers from around the world, bringing prestige and significant funds for the development and internationalization of Portuguese science. (http://erc.europa.eu/)

• European Regional Development Fund (ERDF): aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. In short, the ERDF finances: direct aid to investments in companies (SMEs) to create sustainable jobs; infrastructures linked notably to research and innovation,

telecommunications, environment, energy and transport; financial instruments (capital risk funds, local development funds, etc.) to support regional and local development and to foster cooperation between towns and regions; technical assistance measures. The ERDF can intervene in the three objectives of regional policy: Convergence; Regional Competitiveness and Employment; and European Territorial Cooperation. (http://ec.europa.eu/regional_policy/thefunds/regional/index_en.cfm)

• European Social Fund (ESF): the ESF operational programme for Portugal aims to anticipate the challenges of the country. In response to the weakening economy, an aging population and the unsuitability professional, the ESF funding concentrates on crucial measures of implementation of improvements. Training and education are essential, as well as the actions to combat social exclusion and inequalities between men and women. With a GDP per head below 75% of the EU-25 average, the Azores region is eligible under the convergence objective. (http://ec.europa.eu/esf/home.jsp?langId=en)

• Calouste Gulbenkian Foundation (FCG): promotes, directly or in partnership with other entities, a set of programs and projects in its four statutory areas: art, health and human development (beneficence), education and science. Contribute to the educational development in Portugal and the debate on the progress of education in the world, whether in the school or within the society are some guidelines of the Foundation's activity in the field of education, the statutory area in which they invest a little more than a third of its annual budget. Aside from the numerous scholarships that assigns annually, the Foundation supports projects and activities that emphasize lifelong learning and the acquisition of new skills and new knowledge to make more effective the education/training system. (http://www.gulbenkian.pt/)

• EDP Foundation: is a private institution, non-profit, created by EDP - Energias de Portugal. The constitution of EDP Foundation has consolidated the EDP Group's commitment with the imperative of citizenship that has taken throughout its existence, demonstrating a concern for affirmation of modernity and the strengthening of support for relevant causes. Particularly dedicated to the development and diffusion of energy and environmental issues, the EDP Foundation sponsors and, increasingly, also promotes initiatives of cultural, educational and social. (http://www.fundacao.edp.pt/)

• HC Foundation: is a non-profit entity whose purpose is to promote the realization of cultural activities, teaching, training, research, sports promotion, beneficial and other similar. (http://www.hcenergia.com/)

• Luso-American Development Foundation (FLAD): is a private, financially independent Portuguese institution. Its main goal is to contribute towards Portugal's development by providing financial and strategic support for innovative projects by fostering cooperation between Portuguese and American civil society. Financially supports programs for the internationalization of Portuguese institutions and has a special program for the Azores. The Antero de Quental mobility program is conducted by the University of the Azores in partnership with a consortium of American universities based in regions where there are significant Portuguese communities, such as the University of Berkeley, Brown University, University of Massachusetts-Amherst, University of Massachusetts-Dartmouth and Bristol Community College. The agreement aims to promote the exchange of professors and students between member universities. (http://www.flad.pt/)

• Foundation for Science and Technology (FCT): continually promotes the advancement of scientific and technological knowledge in Portugal, exploring opportunities that become available in all fields of science and technology in order to achieve the highest international standards of knowledge creation, and stimulate their diffusion and contribution to the improvement education, health and the environment, quality of life and welfare of the general public. This mission is mainly accomplished through the granting of funding according to the proposals merit assessment of institutions, research teams and individuals presented in public open calls, and also through cooperation agreements and other forms of support in partnership with universities and other public and private institutions, in Portugal and abroad. (http://www.fct.pt/)

• Foundation for National Scientific Computing (FCCN): is a private non-profit institution designated public utility that has contributed to the expansion of the Internet in Portugal with the support of universities and various national institutions of R&D. The main activity of FCCN is the planning, management and operation of the Science, Technology and Society Network (RCTS), a high-performance network for institutions with higher communication requirements,

thus constituting a platform for experimentation to applications and advanced communications services. Beyond managing the RCTS, FCCN is responsible for managing the registration service of domains '.pt' and provides services mainly oriented to his community and is involved in national and international projects in their area of activity. (http://www.fccn.pt/)

• Portugal-Africa Foundation: has supported several initiatives. Such support can be categorized into: colloquia and seminars, social promotion, exhibitions, training, initiatives and publications. The activity of the Foundation is based, at this time, in seven projects covering diverse areas of intervention, among them culture and education. In this area are planned support under design of programs and teaching materials as well as teacher training in Mozambique. (http://www.fportugalafrica.pt/)

• Vodafone Portugal Foundation: is a non-profit organization with legal personality and own funds, set up to encourage the development of the information society and fight info-exclusion. In the area of scientific and technological research has supported postgraduate courses and the creation of infrastructures for higher education institutions, namely: Madan Park (creation of a Laboratory of Multimedia Technology and Telecommunications on the campus of the Faculty of Science and Technology of the New University of Lisbon), Catholic University Foundation, post-graduation course of Technical Higher Institute, post-graduation course of Higher Institute of Economics and Management, post-graduation course of Legal Institute of Communication, Law Faculty of the University of Coimbra. In the Azores, the Vodafone Portugal Foundation supported the installation of several GPS stations on the islands of the central group, an initiative of the University of Beira Interior which aims to study and quantify the risks arising from natural geodynamic processes. (http://www.fundacaovodafone.pt/)

• Azorean Regional Fund for Science (FRC): is a coordinating and management body within the financial resources available for scientific research and technological development in the Autonomous Region of the Azores (RAA). (http://frct.azores.gov.pt/)

• Promotion Office of the 7th Framework Program for RTD (GPPQ): was created by the Ministry of Science, Technology and Higher Education (MCES) in order to promote and support the participation of scientific and business national communities in the 7th Framework Programme. The GPPQ connects researchers and Portuguese companies and FP7, through mutual coordination of delegates to committees, representatives in Technology Platforms, Joint Technology Initiatives (JTI) and the network of National Contact Points (NCP). This network was created to: spread information and documentation on FP7, organize promotional activities of FP7 (info-days, seminars, conferences), support the preparation and submission of applications to FP7, identify national strategic partners and other countries for collaboration in projects of the FP7 (partner search). (http://www.gppq.mctes.pt/_7pq/)

• Portuguese Institute for Development Assistance (IPAD): the IPAD aims to propose and execute the Portuguese co-operation policy and coordinate the cooperation activities undertaken by other public entities that participate in its implementation. Among other things, draws up Indicative plans of cooperation (PIC), the main instruments of action; promotes the implementation of various programmes and projects and prepares semi-annual reports; ensures a link with the authorities of the beneficiary countries; emits its prior opinion on the projects proposed by other entities; convenes the Interministerial Commission for Cooperation (CIC) and ensures the representation and participation of the Portuguese state in international organisations related to cooperation and public assistance to development, particularly in the European Union, the OECD/DAC and the Community of Portuguese Language Countries (CPLP), without prejudice to the competence of specialized sectoral representations. These organizations can submit applications for funding of projects of development cooperation (include the PALOP and East Timor), and during the second half of each calendar year for development education projects. (http://www.ipad.mne.gov.pt/)

• Proconvergence - Operational Programme of RAA (FEDER): the Azores operational programme for convergence falls within the 2007-2013 programming period of the European Union's regional policy, being provided by the ERDF Structural Fund. The Proconvergence was prepared summarizing the main proposals in the field of development policy for the near future, in compliance with the Community Strategic Guidelines and the National Strategic Reference Framework. The strategy defined is based on major strategic priorities that structure the programming, involving, respectively, within the economy, human resources and development of the territory. Also contemplated is a priority

axis that includes specific assigned allocation programming in the context of support to compensate for additional costs in the outermost regions. (http://www.proconvergencia.azores.gov.pt/)

• Pro-employment - Operational Programme of RAA (ESF): this program, financed by the European Social Fund for the Azores (2007-2013), based on an increased diversity of objectives and types of project, which is supported not only by the inclusion of two general objectives: support the structuring of the science and technology system and create conditions for its growing approach to corporate sector; and promoting the employability of vulnerable groups from the promotion of their conditions of social inclusion. The program also bets on greater diversification of types of project oriented to the improvement of employability, inserting the component of education at all levels. (http://proemprego.azores.gov.pt/)

• National Strategic Reference Framework (QREN): takes as main strategic design the qualification of Portuguese, enhancing the knowledge, science, technology and innovation, and the promotion of high and sustained levels of economic and socio-cultural development and territorial qualification within a framework of equal opportunities, as well as increasing the efficiency and quality of public institutions. The pursuit of this great strategic plan, essential to ensure the overcoming of the most significant constraints to the consolidation of a dynamic of sustained success in the process of economic, social and territorial development of Portugal, is ensured by the implementation, with the support of the Structural Funds and the Cohesion Fund, for all Operational Programmes for the period 2007-2013, three large thematic operational agendas, which focus on three main areas of intervention, the human potential, the factors of competitiveness of the economy and the development of the territory: Operational Agenda for Human Potential, Operational Agenda for Competitiveness Factors; and Operational Agenda for Territorial Development. (http://www.qren.pt/)

• The Seventh Framework Programme (FP7): the 7th Framework Program for RTD (2007-2013) funded by the European Commission, has as main objective to increase the potential for economic growth and enhance European competitiveness through an ambitious investment in knowledge, innovation and human capital. It is the opportunity for the EU to put its research policy to match its economic and social ambitions by consolidating the European Research Area (ERA). The Seventh Framework Programme is organized into four main programs (Cooperation, Ideas, People and Capacities). (http://cordis.europa.eu/fp7/)

• Visegrad Fund: this international fund was created by the Visegrad Group (V4), an alliance of four Central European countries (Hungary, Poland, Czech Republic and Slovakia) for the purpose of cooperation. It aims to facilitate and promote the development of closer cooperation among citizens and institutions in the region as well as between the V4 region and other countries, especially the Western Balkans and countries of the Eastern Partnership. The Fund does so through grant support of common cultural, scientific and educational projects, youth exchanges, cross-border projects and tourism promotion, and through individual mobility programs (scholarships, residencies). (http://visegradfund.org/)

CONCLUSIONS

The paper argues that the consequences of the UAC's immobility are perceived in face of the difficulties of articulation to participate in calls as FP7-INFRASTRUCTURES that could allow obtaining a high-speed backbone, between all islands, connected to the network GÉAN. Competing never meant guarantee of obtaining resources, but it is an opportunity of access to different sources of funding from the ones commonly used. No one wins the lottery without playing.

Marquis (2012) recognizes that is not to say, however, that the situation is beyond hope. He suggests that the output lies in an innovative new solution and points out some alternatives that are already in operation or are in the process to provide a sustainable solution. The spectrum of possibilities can then be expanded taking as starting point a variety of the funding models currently in use, suggested by Downes (2006): endowment, membership, donations, conversion, contributor-pay, sponsorship, institutional, governmental, partnerships and exchanges; lessons from projects Free/Libre/Open Source Software (FLOSS), the new social networks for collective funding (transfunding), collective fundraising (cofundraising), frequent flyer programs, customer programs, mileage programs, loyalty programs, reward and recognition programs; and the work of Anderson (2010).

I conclude by suggesting that certainly Portuguese universities need to overcome inertia to ensure its sustainability and survival, but before that they need to do their homework in several sectors including the lack of professional managers with management training, combating the national incentive spending spree at the expense of savings (resources must be fully consumed in the budget of that year) and the lack of a crisis office, namely, a team focused on troubleshooting and supporting new projects...

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GENDER AND STEM RELATED ADVANCED PLACEMENT EXAMS: A REVIEW OF THE LITERATURE

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Abstract
In this analysis of the literature, we reviewed the research and theory related to gender differences in the STEM field and then in STEM related Advanced Placement exams. In particular, we focused on (a) the gender gap in math and science education, (b) the history of STEM education, (c) the history of AP, (d) gender and AP performance, and (e) the economy and AP. Given the importance of increasing involvement in the STEM field and of gender equity, we documented in our analysis the continued presence of strong gender differences. Implications of our critical analysis of the literature are provided.
Keywords: Gender differences, STEM, Advanced Placement

Introduction

According to the U.S. Department of Labor predictions, by 2018 nine of the 10 fastest growing careers will require mathematical, technological, or scientific training (National Science Board, 2010). In recent years, growth of STEM careers has been approximately three times faster than the growth of non-STEM careers (Langdon, McKittrick, Beede, Khan, & Dome, 2011). Langdon and colleagues (2011) contended that STEM "workers drive our nation's innovation and competitiveness by generating new ideas, new companies and new industries" (p. 1). However, as the nation's need for STEM workers is growing, the STEM workforce is aging (American Association of University Women, 2010; Langdon et al., 2011; National Science Board, 2010). In his 2011 State of the Union address to Congress, President Obama (2011) remarked:

Maintaining our leadership in research and technology is crucial to America's success. But if we want to win the future -- if we want innovation to produce jobs in America and not overseas -- then we also have to win the race to educate our kids. (para 33)

To maintain the nation's economic stability, it is imperative that the STEM workforce grows in number and becomes more diverse (American Management Association, 1998; Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000; Langdon et al., 2011).

Gender Gap in Math and Science Education

The stereotype that boys are superior to girls in science and math has been a long-held belief. However, girls tend to earn better grades in school than boys in all subjects, have a higher grade point average in math and science courses than boys, and earn more high school math and science credits than boys (Dwyer & Johnson, 1997; Kimball, 1989; National Center for Education Statistics, 2010; Shettle et al., 2007). Yet, boys tend to outperform girls on tests, especially when the tests are timed or given under stressful conditions (Gonzales et al., 2009; National Center for Education Statistics, 2007, 2010). Gender differences in math and science achievement and class selection are still present but have decreased since 1980 (Clewell & Campbell, 2002; Kimmel, Miller, & Eccles, 2012).

"Mathematics is a major key necessary in unlocking a majority of important career opportunities available for our most intelligent and academically able students" (Rekdal, 1984, p. 11). In 1973, Sells stated that math courses prevent many women from pursuing higher paying careers in science and technology related areas. Ma and Johnson (2008) argued that Algebra II was the most important course in determining if students would pursue a career in engineering or physical sciences. Science courses also serve as gatekeepers for future study, and the gender gap in science achievement may partially explain why fewer women pursue STEM related degrees and careers (Amelink, 2009b; Hazari, Tai, & Sadler, 2007; Madigan, 1997). Successfully completing high school science and math courses may be an important factor in students' decisions to enter into a STEM related major in college (Eccles, 2007; Ma & Johnson, 2008; Sells, 1980; Shaw & Barbuti, 2010; Trusty, 2002). Trusty (2002) argued that for girls, math achievement was a stronger predictor of entrance into a STEM major than it was for boys. Conversely, success in science was the better predictor for boys' decisions to pursue a STEM career (Trusty, 2002). In addition to high school success in math and science, doing well on STEM related AP exams, and a desire for an advanced degree were all positively correlated with students successfully completing a degree in a STEM related field (Shaw & Barbuti, 2010).

Historical Overview of the Gender Gap

In 1974, Maccoby and Jacklin argued that boys were inherently better at mathematics than girls starting at about age 12. Similarly, Fennema (1974) noted that although a noticeable difference between boys and girls was not present in mathematical performance during elementary school, a difference emerged during high school. Boys tended to do better than girls at higher level tasks and girls generally surpassed boys on tasks that required lower level thinking,

simple computation, and repetition (Fennema & Carpenter, 1981). In their study of mathematically precocious youth, Benbow and Stanley (1982) stated that boys earned higher scores than girls on the math portion of the Scholastic Aptitude Test.

In an analysis of investigations through 1985, Stage, Kreinberg, Eccles, and Becker (1985) determined:

The following results are fairly consistent across studies using a variety of achievement tests: 1) high school boys perform a little better than high school girls on tests of mathematical reasoning (primarily solving word problems); 2) boys and girls perform similarly on tests of algebra and basic mathematical knowledge; and 3) girls occasionally outperform boys on tests of computational skills...Among normal populations, achievement differences favoring boys do not emerge with any consistency prior to the 10th grade, are typically not very large, and are not universally found, even in advanced high school populations. (p. 240)

Hyde, Fennema, and Lamon (1990) mentioned the presence of a small, statistically significant difference between the performance of boys and girls on mathematical tests, but concluded that the difference did not provide evidence that boys were always better at math than girls or that boys were more capable of understanding math than girls. However, boys did tend to outperform girls on higher-level tasks and problem solving questions that are often present in high school level math courses. Hyde and colleagues (1990) asserted that these differences were important because higher level thinking and problem solving are two important skills required for many math-related careers and the difference may account for some of the disparity in women pursuing jobs requiring the extensive use of mathematics.

Another reason posited for the performance difference on math tests between boys and girls is that girls take fewer upper level math classes than boys (Kerr, 1991; Laing, Engen, & Maxey, 1987; Pallas & Alexander, 1983; Reis, 1987). However, the number of boys and girls taking advanced math classes has increased in recent years. As can be seen in Figure 1, the percentage of both boys and girls taking upper level math courses has increased. In 2004, a higher percentage of girls (53%) took Pre-Calculus or Calculus than the percentage of boys (50%). The percentage of boys and girls not taking math has decreased from about 25% in 1982 to less than 10% in 2004.
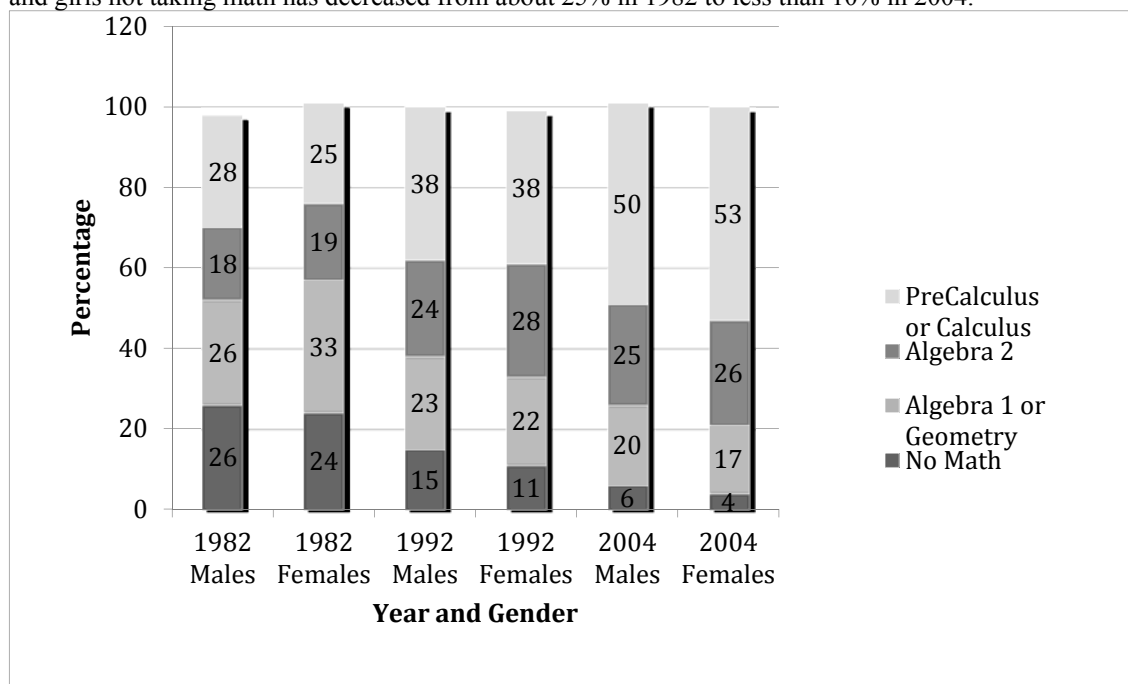
Figure 1. Percentage of high school graduates taking math classes from 1982 - 2004. Data were synthesized from the National Center for Education Statistics (2004).

In the 1980s and 1990s, the authors of several studies (e.g., Brophy, 1985; Friedman, 1989; Hayes & Slate, 1993; Marsh, 1989) indicated that gender differences in math performance persisted but were becoming smaller. However, boys still outperformed girls when completing tasks that involved higher cognitive thinking and problem solving skills, and girls tended to score higher than boys on tests involving computational or lower level thinking skills (Feingold, 1988). Another important difference noted by researchers (e.g., Gallagher & DeLisi, 1994; Low & Over, 1993; Mills, Ablard, & Stumpf, 1993) was the methods that boys and girls selected when solving mathematical problems. Boys were more likely to utilize shortcuts and new strategies to solve problems, whereas girls had a propensity to rely on techniques learned in their math classes. Strategies chosen by girls often require more time than the strategies utilized by boys, and therefore girls were at a disadvantage on timed tests (Gallagher & DeLisi, 1994; Low & Over, 1993; Mills et al., 1993).

The authors of two more recent studies (e.g., Else-Quest, Hyde, & Linn, 2010; Hyde, Lindberg, Linn, Ellis, &

Williams, 2008) stated that even though gender differences on math tests still existed, they have decreased in size. Hyde et al. (2008) determined that the average effect size (i.e., Cohen's *d*) of *d* = 0.15 for all samples in the meta-analysis was small, with the largest effect size (*d* = 0.32) being present for problem solving at the high school level. However, boys expressed higher confidence and less anxiety when performing mathematically (Else-Quest et al., 2010). Else-Quest and colleagues (2010) postulated that girls should perform comparable to boys if they are "encouraged to succeed, are given the necessary educational tools, and have visible female role models excelling in mathematics" (p. 125).

Ingels and Dalton (2008) posited that differences in science performance between boys and girls begin in elementary school and persist through high school. Boys tend to outperform girls on tests that assess how well specific content is mastered even though girls often complete the same coursework as boys (Amelink, 2009b). Although the gender gaps in science have narrowed between boys and girls, differences in performance on assessments persist (Amelink, 2009b). O'Reilly and McNamara (2007) concluded that boys scored higher on both reading comprehension and science knowledge and girls scored higher on science strategy. Males also tended to have higher scores on both free-response questions and multiple-choice questions than girls, especially when the tests were given under timed or stressful conditions (O'Reilly & McNamara, 2007; Penner, 2003). In their analysis of performance on multiple choice and free-response questions, O'Reilly and McNamara (2007) documented a medium effect size (i.e., Cohen's *d* ranging from 0.51 to 0.58). However, girls were more likely to outperform boys on science tests that involved life sciences (Ingels & Dalton, 2008; National Assessment of Educational Progress, 2005).

Madigan (1997) examined national science achievement data from the National Education Longitudinal Study (NELS) and student transcripts and determined that overall 54% of students increased in science proficiency between grades eight and 12. However, girls were less likely than boys to increase their science proficiency between grades eight and 12. Madigan (1997) suggested that the taking eight or more science courses was positively associated with science proficiency. As displayed in Figure 2, the percentage of boys and girls taking advanced science classes (e.g., Chemistry II, Physics II, or Advanced Biology) has increased slightly since 1982. Over the same time, the percentage of both boys and girls not taking a science class or only taking a basic science class has decreased from about 30% to less around 7% for boys and 5% for girls.
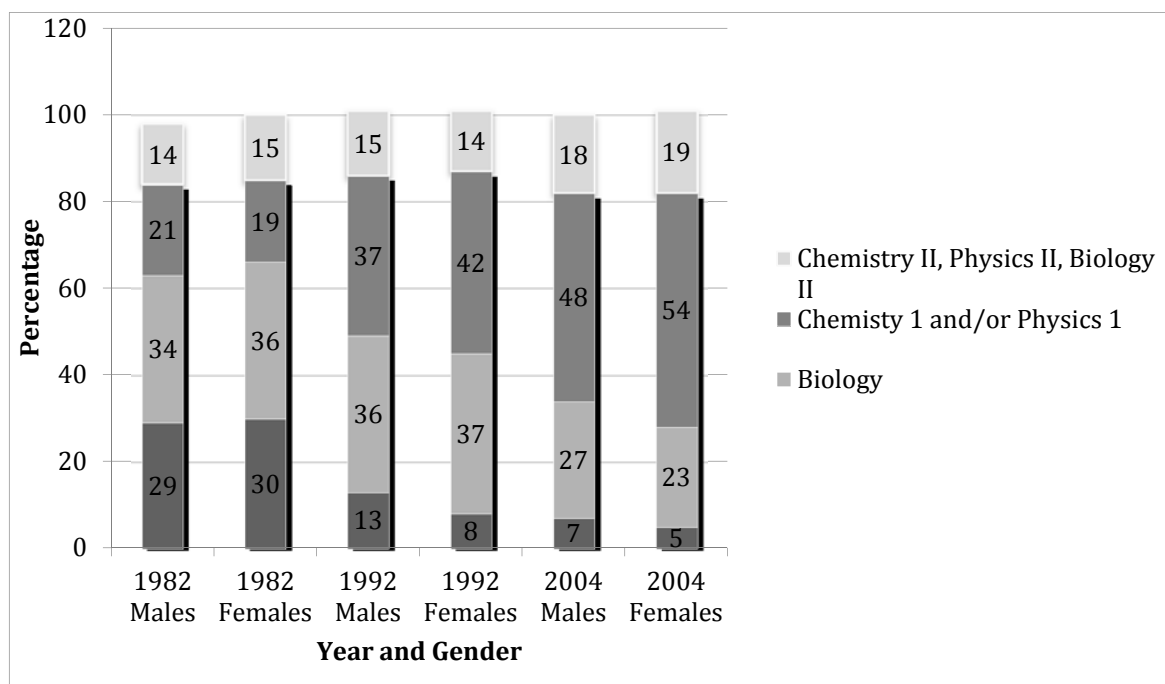
Figure 2. Percentage of high school graduates taking science classes from 1982 - 2004. Data were synthesized from the National Center for Education Statistics (2004).

Lee and Burkam (1996) concluded eighth grade girls scored better in life science courses and had a better grade point average, but boys tended to score better on physical science assessments. The gender difference for the physical science courses became larger as the difficulty level of the course increased (Lee & Burkam, 1996). In a 2003 investigation, Bacharach, Baumeister, and Furr argued a statistically significant difference was present for science achievement between boys and girls by Grade 8, and the difference increased with age, with boys outperforming girls. One factor that may influence the ability of boys and girls to master science topics is how the material is taught in class (Schroeder, Scott, Tolson, Huang, & Lee, 2007). Girls benefited more from laboratory experiences in physical science

courses, and boys performed better in courses that required extensive memorization (Lee & Burkam, 1996). For physics courses, girls noted a higher level of understanding when the instructor was able to connect the material being taught to their real-life experiences and did not rely on the typical examples provided in a physics class (Hazari et al., 2007). Present in Table 1 is a summary of research into gender differences in math and science performance.

Table 1*Summary of Research into Gender Differences in Math and Science*

Study	Significant Findings	Gender Favored	Effect Size
Maccoby & Jacklin (1974)	Yes	Boys	Not reported
Benbow & Stanley (1982)	Yes	Boys	Not reported
Stage et al. (1985)	Yes	Boys	Not reported
Hyde et al. (1990)	Yes	Boys	Small
Bacharach et al. (2003)	Yes	Boys	Not reported
Hyde et al. (2008)	Yes	Boys	Small
O'Reilly & McNamara (2007)	Yes	Boys	Medium
Ingels & Dalton (2008)	Yes	Boys	Not reported

The reasons for the persistent differences in math and science performance are not clear (Gibbs, 2010). But, whatever the reasons, gender has been identified as an important factor in several studies regarding STEM careers (Betz, 1997; Cross, 2001; Eccles, 1994, 2009; Hanson, 1996; Kimmel et al., 2012; Rosser, 2004; Watt, 2008). In an attempt to explain the math and science gender gap, two hypotheses have been proposed: (a) innate gender differences exist in the mathematical or scientific ability of boys and girls; and (b) social, cultural, or environmental factors may explain the different choices boys and girls make regarding pursuit of science and math (Legewie & DiPrete, 2012). Some researchers (e.g., Ellison & Swanson, 2010; Kimura, 2002; Lohman & Lakin, 2009) claimed that innate differences exist between boys and girls, and these differences can explain why boys outperform girls in math and science. Conversely, other researchers (e.g., Ceci, Williams, & Barnett, 2009; Hoffmann, Gneezy, & List, 2011; Penner, 2008) argued that environmental and social factors explain the math and science differences between boys and girls. Stereotyping and culturally accepted norms may negatively influence the decision made by girls as to whether or not to pursue STEM-related study (Charles & Bradley, 2002; Ridgeway, 2001). Girls expressed a greater interest in jobs that center around people and helping others, whereas boys expressed a greater interest in careers involving physical objects and rewards (Eccles, 2007; Johnson, 2001).

History of Science, Technology, Engineering, and Math Education

Politicians, business leaders, and researchers have argued that for the United States to maintain a global leadership role, the education of young people must be a priority, and students with the interest and ability to pursue STEM-related careers must be encouraged to do so (American Management Association, 1998; Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000; Hilton & Lee, 1988; Langdon et al., 2011; Obama, 2011; Subotnik, Tai, Rickoff, & Almarode, 2010). Hilton and Lee (1988) established that in 1972 four times as many high school boys indicated an interest in math, science, and engineering (MSE) majors as did high school girls. By 1982, more girls were expressing interest in MSE careers. Even so, in 1982 twice as many boys expressed an interest in MSE careers as girls (Hilton & Lee, 1988). Although girls enter MSE majors at a lower rate than boys, the persistence level for girls was higher than for boys, with 29% of boys changing majors compared to 14% of the girls changing majors (Hilton & Lee, 1988). In 2008, members of the National Mathematics Advisory Panel (NMAP) conducted an examination of the nation's STEM education in general but specifically focused on mathematics education. The authors of the report concluded:

During most of the 20th century, the United States possessed peerless mathematical prowess—not just as measured by the depth and number of the mathematical specialists who practiced here but also by the scale and quality of its engineering, science, and financial leadership, and even by the extent of mathematical education in its broad population. But without substantial and sustained changes to its educational system, the United States will relinquish its leadership in the 21st century. (NMAP, 2008, p. xi)

When students are challenged with rigorous curriculum, strong instruction, and peer interaction, they are more likely to pursue STEM-related majors in college (Pyryt, 2000; Subotnik, Duschl, & Selmon, 1993; Tai, Liu, Maltese, & Fan, 2006). A variety of options exist for creating the environment described above, but one approach that has been used since the early 1900s is specialized math and science schools (Subotnik et al., 2010). Talented and interested students apply to and are accepted into schools specializing in STEM education. The schools might be residential schools, schools within schools, or magnet schools (Subotnik et al., 2010). The idea of high schools providing focused instruction in math and science originated at the beginning of the 19th century (Means, Confrey, House, & Bhanot, 2008). Schools originally established as trade schools began to refocus instruction on science and math. Gradually these schools became more exclusive, with students having to complete applications and take exams prior to admittance (Hanford, 1997). The governmental push for specialized math and science schools continued into the 1950s because of

the space race and the Cold War as well as the desire of America's leaders to gain technological supremacy over the Soviet Union (Hanford, 1997). Another reason for the creation of specialized math and science schools was school desegregation. Larger school district used these specialized schools to attract or to retain White students by offering special programs with restrictive enrollment (Metz, 2003). The number of STEM schools continued to increase during the latter part of the 20th century but continued to focus mainly on gifted students (Means et al., 2008).

Specialized STEM high schools were one feature of the 2007 America COMPETES Act signed into law by President Bush. The American COMPETES Act (2007) was intended to increase the nation's global competitiveness by providing funding for states to start schools specializing in STEM related fields. However, access to STEM schools is not readily available to all students because not all states have STEM schools and many states have fewer than five specialized schools. Thus, most students continue to be educated in traditional schools (Subotnik, Edmistron, & Rayhack, 2007).

Since the beginning of the 21st century, an understanding has developed among leaders and educators that if the United States is to maintain its position as a world leader more STEM educated citizens are needed, and these students cannot come from a same pool of gifted students (Means et al., 2008). As a result, in 2004, more than 200 STEM education programs received almost three billion dollars from the federal government (Kuenzi, 2008). Among the programs supported with federal money are college scholarships for students majoring in STEM related careers and programs to improve K-12 math and science education (Atkinson, Hugo, Lundgren, Shapiro, & Thomas, 2007; Means et al., 2008). As can be seen in Figure 3, the federal government supported over 250 STEM programs with $3.4 billion in 2011 (Federal Inventory of STEM Education Fast-Track Action Committee, 2011).
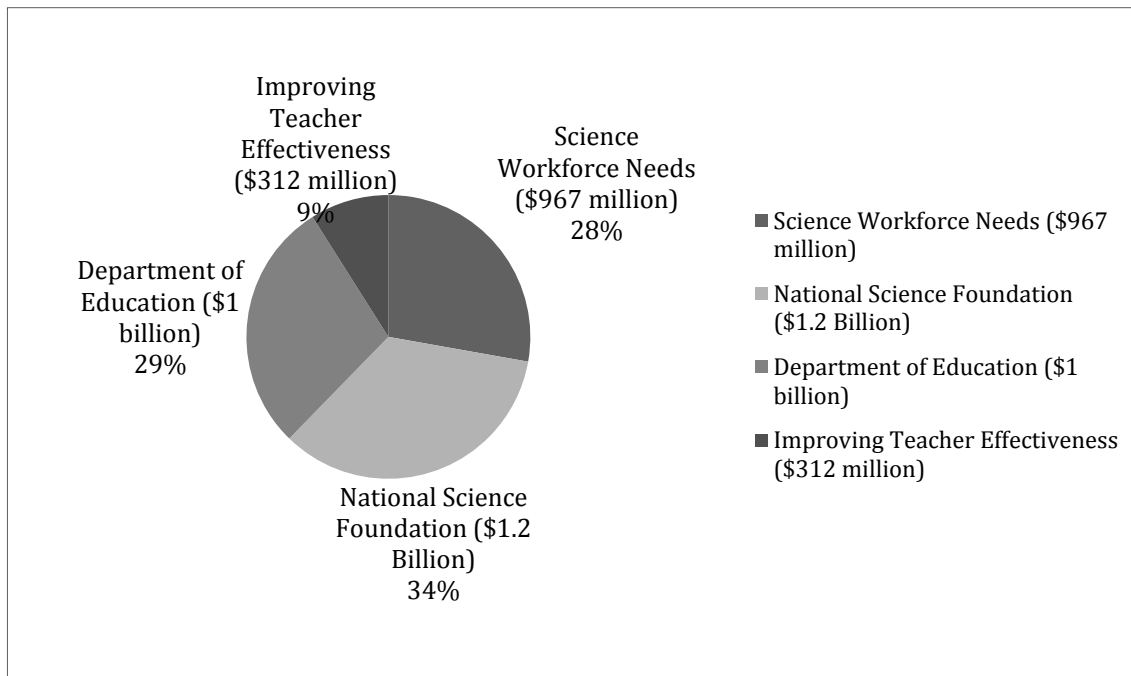
Figure 3. Expenditures of the Federal Government on STEM education programs, 2011. Data were synthesized from the Federal Inventory of STEM Education Fast-Track Action Committee (2011).

Specialized STEM schools alone cannot meet the need for preparing students for further study in STEM related fields and so all high schools must improve their math and science curriculum (Means et al., 2008). Several federal initiatives have been proposed to improve the STEM education for all students (Federal Inventory of STEM Education Fast-Track Action Committee, 2011; Means et al., 2008). The recommendations included in the *American's Competitiveness Initiative* of 2006 are as follows: (a) expand AP and International Baccalaureate (IB) programs, (b) retain mathematicians and scientists to teach in high schools, improve math and science instruction in elementary schools, and develop more rigorous science assessments. Suggested in a second 2006 initiative, *Innovation America*, were to develop and support Best Practices STEM Centers to improve teaching and to solicit proposal requests to develop best practices for STEM education. In 2007, the authors of *Rising Above the Gathering Storm*, recommended the recruitment of 10,000 math and science teachers, additional training in STEM education for current teachers, increase the number of students passing AP and IB tests, and increase the number of students majoring in STEM areas. Conducting a survey of all STEM related federal programs, developing a 5-year strategic plan for STEM education, and creating a Committee on STEM Education were ideas put forth in the *America COMPETES Reauthorization Act* of

2010. (Committee on Prospering in the Global Economy of the 21st Century, 2007; Federal Inventory of STEM Education Fast-Track Action Committee, 2011; Means et al., 2008).

Focused on in the federal initiatives were improving STEM education for all students in secondary high schools. Both the *America's Competitiveness Initiative* and *Rising Above the Gathering Storm* focused on expanding the AP program through increased recruitment of traditionally underrepresented students, teacher training, and improved test scores as a means of improving STEM education in the United States (Means et al., 2008). The College Board (2012) also seeks to increase the number of traditionally underrepresented students participating in the AP program.

History of Advanced Placement

According to the College Board (2003), the AP program is the "premier program advancing educational excellence in secondary schools across the United States" (para. 1). In the 1950s, educators began to search for methods to provide capable students with the opportunity to earn college credit while still in high school following the realization that the gap between high school completion and higher education was widening (College Board, 2003; Dounay, 2006; Nugent & Karnes, 2002). The Ford Foundation established the Fund for the Advancement of Education in an attempt to determine what educational reforms were needed to reduce the duplication of course work between high school and college and to encourage able students to perform up to their capabilities (College Board, 2003). One of the studies funded by the Ford Foundation was led by Chalmers, the president of Kenyon College. The plan, entitled the Kenyon Plan, was designed to improve secondary education by providing students with the opportunity to enroll in challenging coursework while in high school and then to enter college with advanced standing (Kenyon College, 2011). Santoli (2002) stated that in 1952 leading educators from a variety of fields were recruited to design the curriculum and assessments for 11 courses (i.e., English composition, English literature, biology, physics, chemistry, French, Latin, German, Spanish, and history). By 1955, the College Board (2003) began to oversee the program, renaming it the College Board Advanced Placement Program.

The AP program has grown from 11 courses in 1952 to 34 courses in 2011 (College Board, 2003, 2012). More than 4,000 universities and colleges consider students' AP exam scores during the admissions process and offer advanced standing or college credit to students based on the results (College Board, 2011). In 2011, almost 2 million students from over 18,000 high schools took an AP exam (College Board, 2012). Overall, the number of students taking AP exams and scoring 3 or better on AP exams has increased from 2001 to 2011 (College Board, 2012). Present in Table 2 are the number and percentage of students taking AP exams, as well as the number and percentage of students scoring a 3 or better on at least one AP exam during high school.

Table 2 *Number and Percentage of Graduates Taking and Scoring a 3 or Higher on an AP Exam from 2001 to 2011*

Year	Taking an AP Exam	Percentage of Students Taking an AP Exam	Score a 3 or Higher on an AP Exam	Percentage of Students Scoring a 3 or Higher
2001	431,573	16.8	277,507	10.8
2006	645,277	22.3	402,610	13.9
2010	852,475	28.2	508,378	16.8
2011	903,630	30.2	540,619	18.1

Note. Information in Table 4 is synthesized from The College Board (2012).

As can be seen in Table 4, both the number and percentage of students taking AP exams has increased from 2001 to 2011. The number of students taking AP exams more than doubled from 2001 until 2011. Similarly, the number and percentage of students earning a score of 3 or higher has increased for the same time.

Traditional accelerated learning programs for high school students have included AP, IB, and dual credit. Researchers (e.g., Blanco, 2006; Eyring, 2011; Palaich, Blanco, Anderson, Silverstein, & Myers, 2006) argued that accelerated learning programs might increase student readiness for college and may increase enrollment, persistence, and graduation rates. Several researchers (e.g., Ewing, 2006; Geiser & Santelices, 2004; Hargrove, Godin, & Dodd, 2008) suggested that a relationship exists between AP exam performance and college preparedness. Klopfenstein and Thomas (2009) asserted that taking AP courses may predict college success, but warned that a causal relationship between participating in the AP program and college success has not been established. Students with high motivation and ability often enroll in more AP classes, and these students are often successful in college. Klopfenstein and Thomas (2009) predicted that the usefulness of participation in the AP program as a predictor for college success would be reduced as more students with lower abilities begin to take AP courses. Researchers (e.g., Lacy, 2010; Lichten, 2000, 2007, 2010; Sadler, 2010) cautioned against unprepared students taking AP courses and suggested that the reputation of the AP program will be diminished if increasingly larger numbers of unprepared students enroll and are unsuccessful in AP classes.

The College Board (2002) created a policy to encourage access to AP courses for traditionally underrepresented students. The *AP Equity Policy Statement* (College Board, 2002) reads:

The College Board and the Advanced Placement Program encourage teachers, AP Coordinators, and school

administrators to make equitable access a guiding principle for their AP programs. The College Board is committed to the principle that all students deserve an opportunity to participate in rigorous and academically challenging courses and programs. All students who are willing to accept the challenge of a rigorous academic curriculum should be considered for admission to AP courses. The Board encourages the elimination of barriers that restrict access to AP courses for students from ethnic, racial, and socioeconomic groups that have been traditionally underrepresented in the AP Program. Schools should make every effort to ensure that their AP classes reflect the diversity of their student population. (p. 2)

Equitable access to AP courses is one of three parts of the College Board's (2012) College Completion Agenda to increase the "percentage of 25- to 34- year-olds who hold an associate degree or higher to 55 percent by 2025" (p. 17). The other two goals of the agenda are increased rigor and increased support of math, science, and technology related courses (College Board, 2012). The National Math and Science Initiatives (NMSI, 2012a) Training and Incentive Program and the National Governors' Association (2007) AP Expansion Project are two programs working with the College Board (2010) to increase enrollment and success for traditionally underserved students.

Together with the College Board, the NMSI created recommendations for improving and supporting STEM education at the school, district, state, and university level. The recommendations developed by the College Board and NMSI include suggestions for improvement at the school, district, state, and national levels. Schools should increase STEM related afterschool activities and clubs, increase the recruitment of traditionally underrepresented groups for STEM activities and AP classes, and increase hands-on learning and application to real-world problems in class. At the district level, grade-weighing policies for pre-AP and AP courses should be implemented, along with vertical teaming for teachers and increased laboratory skills in pre-AP classes. Recommendations for actions at the state level include providing fee subsidies for AP exams, requiring high school seniors to enroll in math and science classes, and rewarding school that increase participation and success of students in STEM related courses. Universities can improve STEM education by actively recruiting students who successfully completed AP exams, encouraging STEM faculty to work with local high schools, and providing inventives for STEM teachers (College Board, 2012). The strategies are included in the *8th Annual Report to the Nation* to support the emphasis on improving STEM education that is one of the three goals of College Board's (2012) College Completion Agenda.

National Math and Science Initiative

The NMSI, a non-profit organization, was founded in 2007 to "to address one of this nation's greatest economic and intellectual threats - the declining number of students who are prepared to take rigorous college courses in math and science and equipped for careers in those fields" (NMSI, 2012a, para. 1). Formed in partial response to the *Raising Above the Gathering Storm* report prepared by the Committee on Prospering in the Global Economy of the 21st Century (2007), the NMSI (2012a) is a public-private partnership funded by private donors such as the Michael and Susan Dell Foundation, the Bill and Melinda Gates Foundation, and Exxon Mobil Corporation. One of the primary goals of the NMSI is to assist with the implementation of the recommendations provided in the *Raising Above the Gathering Storm* report, and thereby, improve elementary and secondary math and science education in the United States (NMSI, 2012a, 2012b, 2012c). According to information provided on the NMSI (2012a) website, the purpose of the organization is to find existing programs that have "proven effectiveness and quantifiable results, and scale them up nationwide" (para. 4). To improve K-12 math and science education, the following actions are recommended: (a) increase the number of effective math and science teachers, (b) continue the training of current math and science teachers, and (c) increase the number of students with the interest and skills needed to pursue STEM careers (NMSI, 2012c).

The Advanced Placement Training and Incentive Program (APTIP) is one of the existing programs supported by the NMSI (2012c). The program, originally started in Texas as Advanced Placement Strategies (APS), was selected by the NMSI to be implemented in six states in 2008 (APS, 2012). Four main components are included in the APS (2012) model to increase student performance on AP tests: (a) improved teacher training, (b) increased student support, (c) incentive program, and (d) program management. The stated mission of APS (2012) is to improve the performance and increase the participation rate on AP exams of traditionally underserved Texas students.

Six states (i.e., Alabama, Arkansas, Connecticut, Kentucky, Massachusetts, and Virginia) were selected for a 5-year grant by the NMSI (2012c) out of the 28 states completing applications for the program. During the 2008-2009 school year, the APTIP program was in 67 public high schools in these six states. By the end of the 2010-2011 school year, 228 schools were utilizing the APTIP program (NMSI, 2012c). For the 2011-2012 school year, 13 states (i.e., Alabama, Arkansas, Colorado, Connecticut, Georgia, Hawaii, Kentucky, Massachusetts, North Carolina, Oklahoma, South Dakota, Texas, and Virginia) participated in the APTIP program. Since 2008, NMSI (2012c) has provided training to over 8,000 teachers who teach pre-AP and AP classes through APTIP.

Between 2008 and 2011, students attending schools in the original cohort participating in the APTIP program had an increase in average passing scores for math and science AP exams of 138%, over five times the national average increase on these scores (NMSI, 2012c). During the same time, the average math and science score increase for girls was 144%. Schools that began the program during the 2010-2011 school year also experienced increased average

scores on math and science of 128% for all students and 126% percent for girls (NMSI, 2012c). Present in Figure 4 are the percentage increase in scores of 3 or better on AP exams for the three APTIP cohorts compared to the national average increase in scores of 3 or better.
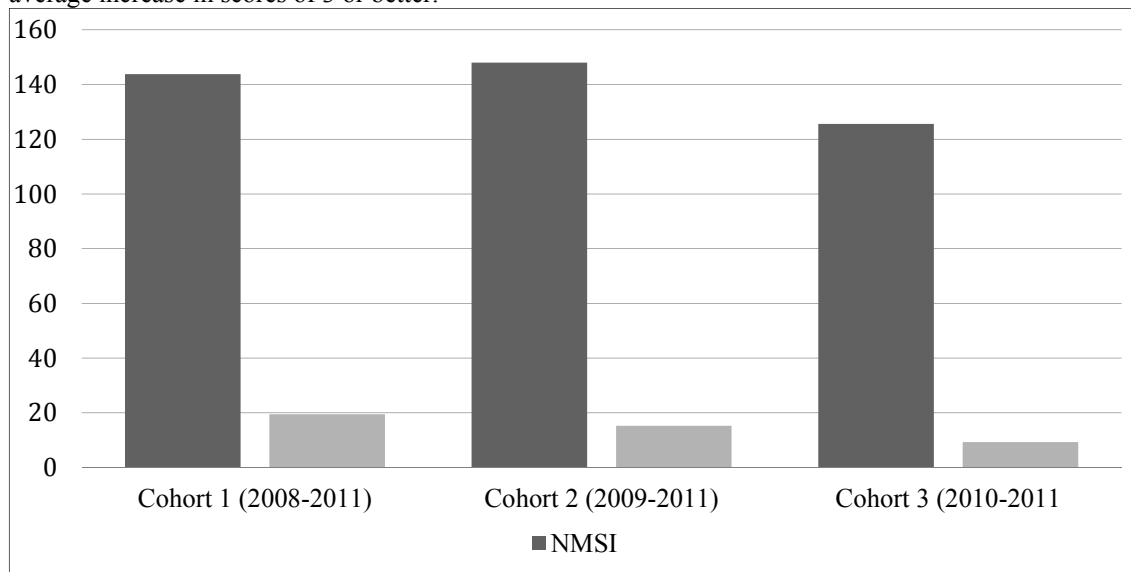
Figure 4. Percentage increase in scores of 3 or better on AP exams by APTIP Cohort. Data were synthesized from the NMSI (2012c).

The 228 high schools participating in the original cohort of the APTIP comprised only a small fraction of the over 23,000 high schools in the United States, but they accounted for almost 7% of the increase in passing scores on AP math, science, and English exams and about 6% of the increase in the passing scores of girls on the AP math and science exams (NMSI, 2012c).

Gender and Advanced Placement Performance
Willingham and Cole (1997) analyzed 1992 and 1993 AP exam data by gender and ethnic groups (i.e., Asian American, Black, Mexican American, other Hispanic, and White). Asian American girls did statistically significantly better than White girls relative to the boys in each group. Otherwise, the difference in performance on AP exams for boys and girls was 0.20 for multiple-choice questions and 0.06 for free response questions, with boys performing better than girls. No effect sizes were reported (Willingham & Cole, 1997). For participation rate, the ratio of girls to boys was close to 1.0 for all groups expect Black students. Even though almost twice as many Black girls took AP exams as Black boys, the relative difference in the performance of Black girls and boys was similar to the relative difference in the other four ethnic groups (Willingham & Cole, 1997). Thus, Willingham and Cole (1997) concluded that differences in exam performance were most likely due to differences in specific content knowledge rather than ethnic group.
Moore and Slate (2008) documented approximately 17% of girls enrolled in AP courses compared to about 13% of boys. Analysis of data from the College Board (2011, 2012) indicated that girls tend to enroll in history, language, and English courses at a higher rate than boys. However, boys tend to enroll in STEM-related courses with the exception of biology, environmental science, and statistics at a higher rate than girls (Amelink, 2009a, 2009b; College Board, 2011, 2012; Moore & Slate, 2008). Displayed in Figure 5 are the percentages of boys and girls taking 2007 AP science exams.
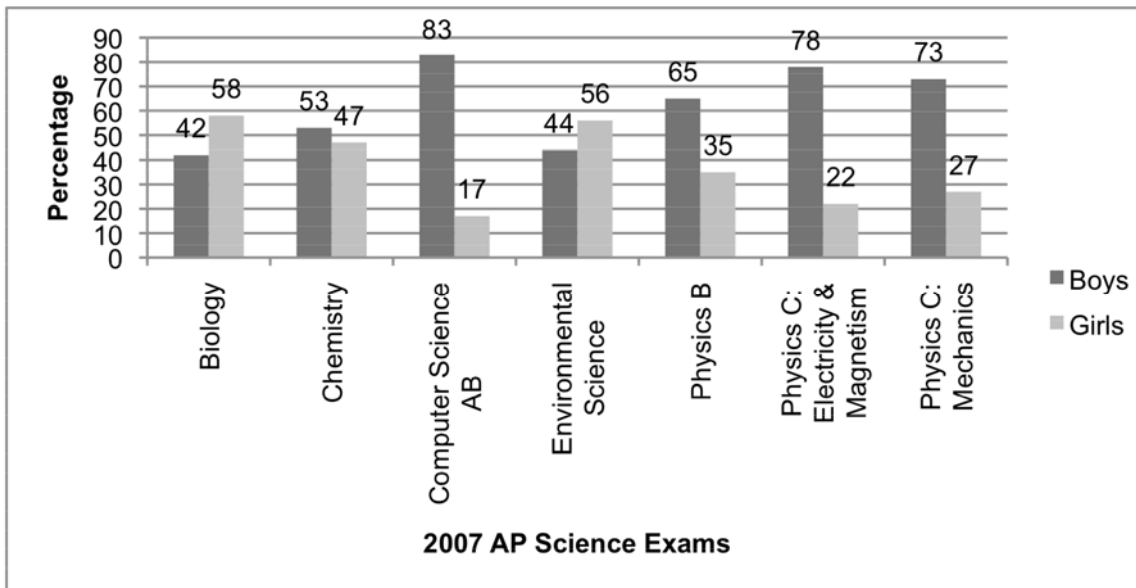
Figure 5. Percentage of boys and girls taking 2007 AP Science exams. Data were synthesized from Amelink (2009b).

As depicted in Figure 5, greater percentages of boys take Computer Sciences AB and all three physics exams than the percentage of girls taking these four exams. Presented in Figure 6 are the percentage of boys and girls taking 2007 AP math exams. A higher percentage of boys take the Calculus BC test, and the same percentage of students take the Statistics test.
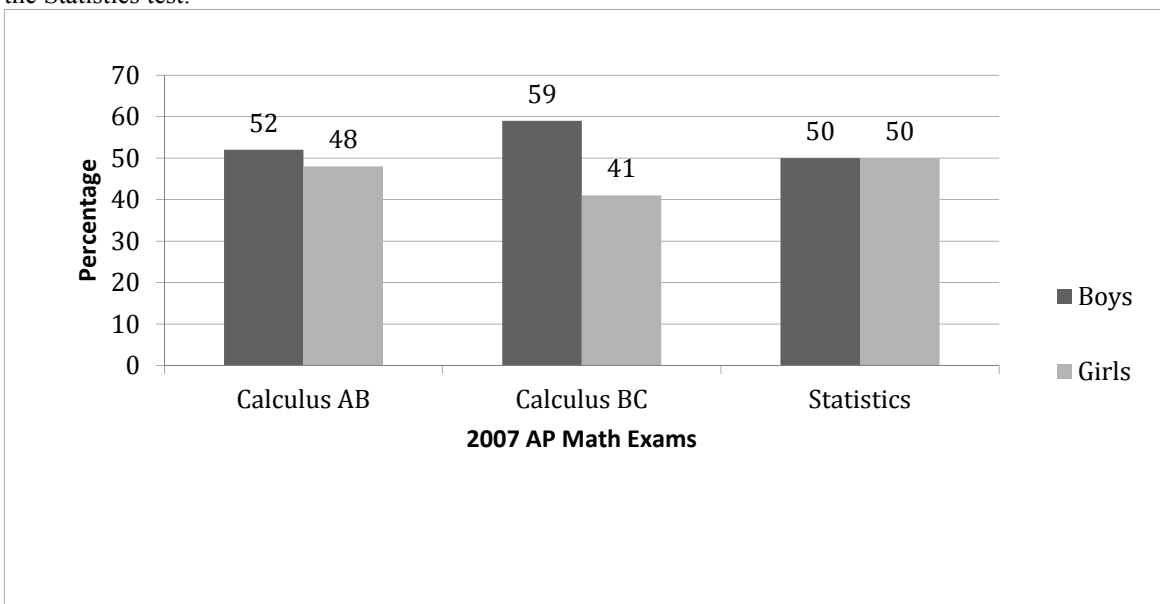
Figure 6. Percentage of boys and girls taking 2007 AP Math exams. Data were synthesized from Amelink (2009a).

In an investigation of performance of Texas students on the 2005 and 2006 AP exams, Moore and Slate (2008) documented a statistically significant difference with a very small effect size (0.08 and 0.11) between boys and girls. Boys scored better than girls both years. Moore, Combs, and Slate (2010) analyzed the performance of boys and girls on the 12 most popular AP exams in 2007 (i.e., English Literature & Composition; U.S. History; English Language & Composition; Calculus AB; Government Politics U.S.; Biology; Psychology; Spanish Language; World History; European History; Statistics; and Chemistry). Moore et al. (2010) concluded that for the May 2007 AP exam administration, boys performed better than girls on 10 of the 12 most popular AP exams. Only on the English Literature and Composition and Spanish Language exams did girls outperform boys. The effect size, Cramer's *V* (ranging from .03 to .15), was small for all analyses conducted (Moore et al., 2010). In their study of gender and AP math performance, Morris and Slate (2012b) documented that boys were more likely to score higher than girls on all three of the AP math exams, the effect size (Cramer's *V*) was small for each of the tests conducted. Boys were more likely to receive a score of 5 on the AP math tests than were girls (Amelink, 2009a). Similar to the math tests, boys had

a higher average score than girls on AP science tests and boys were more likely than girls to receive a score of 5 on AP science tests (Amelink, 2009b). Brookhart (2009) asserted that a larger proportion of boys than girls scored 3 or better on the Biology and Calculus AB exams.

Buck, Kostin, and Morgan (2002), analyzed gender differences in scores on the biology test to determine if the format or content of the biology test was biased. Twelve categories that might influence performance were identified, and boys performed better than girls on 11 of the 12 categories. Girls scored better on the free-response questions and on content that was related to people (Buck et al., 2002). Buck et al. (2002) conducted a backwards stepwise multiple regression and determined that eight of the 12 categories (i.e., atmospheric science, experimental apparatus, structure and function relationships, cell division, experimental design, genetics and inheritance, human physiology, and zoology and classification) accounted for 65% of the variance in boys' superior performance on the biology test.

More Hispanic, Black, and American Indian girls participated in the AP program in 2010 than Hispanic, Black, and American Indian boys (College Board, 2011). A small decrease was present in the gap between White and Black students and between White and Hispanic students on mean AP scores and the percentage of students who scored a 5. However, White students tend to outperform Black and Hispanic students on AP exams (Plucker, Burroughs, & Song, 2010).

Moore and Slate (2010) examined gender differences between American Indian boys and girls on the 2007 administration of the AP exams. Overall, boys outperformed girls on AP exams with about 49% of boys scoring a 3 or better compared to only 41% of girls (Moore & Slate, 2010). The effect size for this statistically significant result was small (Cohen, 1988). In the same study, Moore and Slate (2010) determined that no statistically significant difference was present between American Indian boys and girls on the AP Biology exam.

In an analysis of 14 years of AP data, Moore and Slate (2011) concluded that Asian American boys had statistically significantly higher mean scores on AP exams than did Asian American girls for each year studied. The average 2010 AP score for Asian boys was 3.25 and the average 2010 AP score for Asian girls was 3.05. From 1997 until 2010, the average AP scores for Asian boys varied from 3.13 to 3.27. During the same time, the average AP scores for Asian girls ranged from 2.96 to 3.06, dropping below 3.00 for 9 of the 14 years. Displayed in Table 3 is a summary of the research into performance on AP exams as a function of gender.

Table 3 *Summary of Research into Performance on AP Exams as a Function of Gender*

Study	Significant Findings	Gender Favored	Effect Size
Willingham & Cole (1997)	Yes	Boys	Not reported
Moore & Slate (2008)	Yes	Boys	Very small
Moore et al. (2010)	Yes	Boys on 10 of 12 Exams	Small
Moore & Slate (2010)	Yes	Boys	Small
Moore & Slate (2011)	Yes	Boys	Small
Morris & Slate (2012a)	Yes	Boys	Small/Moderate
Morris & Slate (2012b)	Yes	Boys	Small

Plucker et al. (2010) asserted that the focus of the majority of testing in the United States has been meeting minimum standards and that achievement gaps for advanced students is not a priority. Traditionally underrepresented students are less likely to participate and be successful at the most advanced levels (Plucker et al., 2010). As documented in Table 5, several researchers have examined the overall performance of boys and girls on AP exams. However, few multi-year studies in which national data were analyzed have been completed to determine what patterns might be present in STEM related AP exam scores for boys and girls. Because of the large number of students participating in the AP program and in the importance of STEM education to the future of the nation, further study is needed to determine if a gender gap on STEM related AP exam performance exists.

The Economy and Education

Quality education is important to the future of the United States if the nation is to retain its competitive edge in the global economy (Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011; Subotnik et al., 2010). To maintain an adequate STEM workforce, more students need to be encouraged to enter into STEM majors (Beede et al, 2011; Carnevale, Smiht, & Strohl, 2010; National Academy of Sciences, 2012). Carnevale and colleagues (2010) predicted a shortage of STEM workers for all 50 states in the future. California is an example of a state that acknowledged STEM shortages. "Despite record unemployment, California employers report being unable to find qualified candidates in science, technology, engineering and math" (California STEM Learning Network, 2012, para. 4).

Recently, the United States has been near the middle of international standings in educational attainment. The United States high school graduation rate for 2003 was 73%, 16th internationally and below the 90% high school graduation rate of several countries (Kirsch, Braun, Yamamoto, & Sum, 2007). In a 2009 analysis of over 60 countries,

the United States was ranked 23rd in science and 31st in math (Organisation for Economic Co-operation and Development, 2009). The United States was ranked 12th in the world in the percentage of adults with a college degree in 2010 (Lee & Rawls, 2010). The authors of the STEM Summit 2010 Report (National Academy of Engineering, 2010) argued that the educational system must be reformed to improve math and science education for all students if the nation is to maintain its economic stability.

Careers in STEM related fields are among the highest paying jobs available (Carnevale et al., 2011). Women hold 24% of the STEM degrees awarded, despite receiving over 50% of bachelor's degrees earned (Beede et al., 2011). This disparity may have far reaching implications for women's earning potential and the ability of the United States to remain competitive in the global economy. In general, people holding jobs in STEM related fields earn about 26% more on average and are less likely to be unemployed than people in non-STEM careers (Langdon et al., 2011). Also, people earning STEM degrees tend to earn more than people without STEM degrees even if they do not have a job in a STEM related field (Langdon et al., 2011).

Roughly two thirds of STEM jobs require at least a college degree (Langdon et al., 2011). Thus, the rising cost of college is another hindrance for people seeking STEM degrees. College costs have increased at a rate higher than inflation, for the past 20 years, while state funding for colleges has decreased (U.S. Department of Education, 2006). The State Higher Education Executive Officers reported that:

> state and local support for a full-time-equivalent (FTE) student was $6,532, a $500 constant dollar (or 7 percent) decrease from 2009, and the lowest in the last 25 years. This trend continued in 2011 with state and local support per FTE at $6,290, an additional 3.7 percent decrease. (2012, p. 7)

Displayed in Figure 7 are the costs for tuition, room, and board for full-time undergraduate students for the 2000-2001 to the 2009-2010 school years.
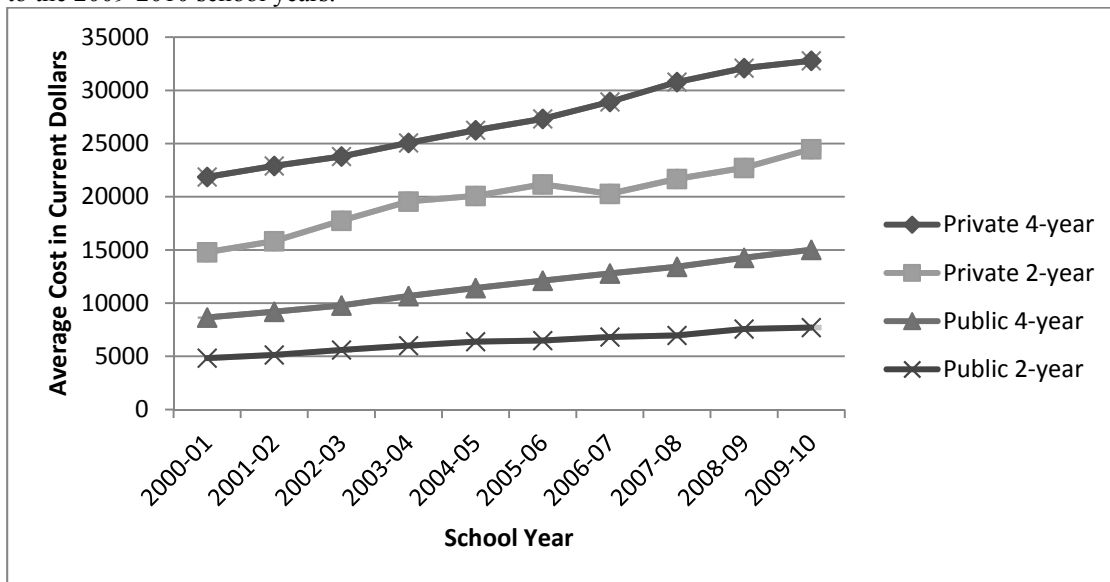
Figure 7. Total tuition, room, and board rates charged for full-time undergraduate students in current dollars by type from 2000-2001 to 2009-2010. Data were synthesized from the U.S. Department of Education, National Center for Education Statistics (2011). *Digest of Education Statistics, 2010* (NCES 2011-015).

Earning college credits while still in high school is one method of reducing the cost of a college degree (Palaich et al., 2006). Dual credit, AP tests, and IB exams are all ways for high school students to earn college credit (Blanco, 2006; Eyring, 2011; Hoffman, 2003; Mattern, Shaw, & Xiong, 2009). Several researchers (e.g., College Board, 2010; Hertberg-Davis, Callahan, & Kyburg, 2006; Robinson, 2003) argued that one of the reasons for the rapid growth of the AP program is that students who successfully complete AP exams are able to earn college credit, and thereby, reduce the cost of their education. However, Klopfenstein (2010) and Moore and Slate (2010) concluded that taking AP classes and passing AP exams does not necessarily increase the chances of an individual graduating early from college. Earning passing scores on AP exams does not guarantee that colleges or universities will grant students credit or advanced standing. Some colleges allow students to take a more advanced course after earning a high score on an AP exam, but do not grant credit toward graduation (Tilsley, 2013).

The AP program continues to be the primary means of providing advanced educational opportunities for secondary students. Inconsistencies in the performance of boys and girls in math and science documented in the literature reviewed in this chapter reveals the importance determining if a gender difference exists in the performance on STEM-related AP exams. Examining gender differences on STEM related AP exams might provide useful information regarding the effectiveness of AP courses and steps that can be taken to improve STEM education in the United States.

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INCIDENTAL VOCABULARY LEARNING AND RETENTION THROUGH READING A GRADED READER AMONG IRANIAN EFL LEARNERS

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ABSTRACT

A lot of studies have found evidence that vocabulary can be acquired incidentally from reading. This experimental study investigated whether Iranian EFL learners could acquire English vocabulary from reading the graded reader, *A Little Princess.* The instruments employed in this study were Nation's (2001) Vocabulary Level Test (VLT) to decide a suitable Graded Reader for the students, and a set of three different tests: word-form recognition, meaning-recognition (Multiple-Choice), and meaning-translation test to assess different types of word knowledge (partial and full knowledge) gained by 30 Iranian grade 1 high school students. These three tests were administered immediately after the treatment which was reading the graded reader. The results showed a considerable vocabulary gain at all levels of word knowledge, but not to the same extent. Knowledge of form was strongly enhanced and knowledge of meaning was increased as well. In conclusion, the reading approach is an effective approach for vocabulary development.

Keywords: Reading, Extensive reading, Incidental Vocabulary Learning, Retention, Graded Reader

INTRODUCTION

Reading is one of the most important ways for learners to acquire vocabulary (Horst, 2005; Krashen, 2004). A number of studies in the first language acquisition domain have documented considerable word learning gains from reading (e.g., Nagy, Anderson, & Herman, 1987; Saragi, Nation & Meister, 1978).

Research in second/foreign language vocabulary acquisition has also displayed that learners acquire vocabulary incidentally through reading (Daskalovska, 2011). Many researchers have hypothesized that most second language vocabulary learning occurs through reading texts while learners are involved in reading for comprehension (Day, Omura & Hiranatsu, 1991; Huckin & Coady, 1999; Hulstijn, 1992; Paribakht & Wesche, 1997; Pitts, White & Krashen, 1989; Waring & Takaki, 2003). They also found evidence that second language learners could learn vocabulary incidentally and indirectly from reading. A number of vocabulary acquisition researchers have investigated the rate of words learners learn from reading in a second or foreign language (Waring & Nation, 2004).

Krashen (1982; 1989; 2003) believes that vocabulary acquisition occurs through comprehensible input. He also maintains that "competence in vocabulary is most efficiently attained by comprehensible input in the form of reading" (1982, p. 440) that contains structure a little beyond our current level of linguistic competence (i+1)" (Krashen, 1982, p. 21). At this level ('i+1') as he argues, the learner is able to use the textual context to fill in the gaps in understanding. In fact, one of the most commonly accepted views of vocabulary acquisition is that second language vocabulary acquisition occurs incidentally through comprehensible input (Krashen, 1989) while reading a text (Waring, 2001):
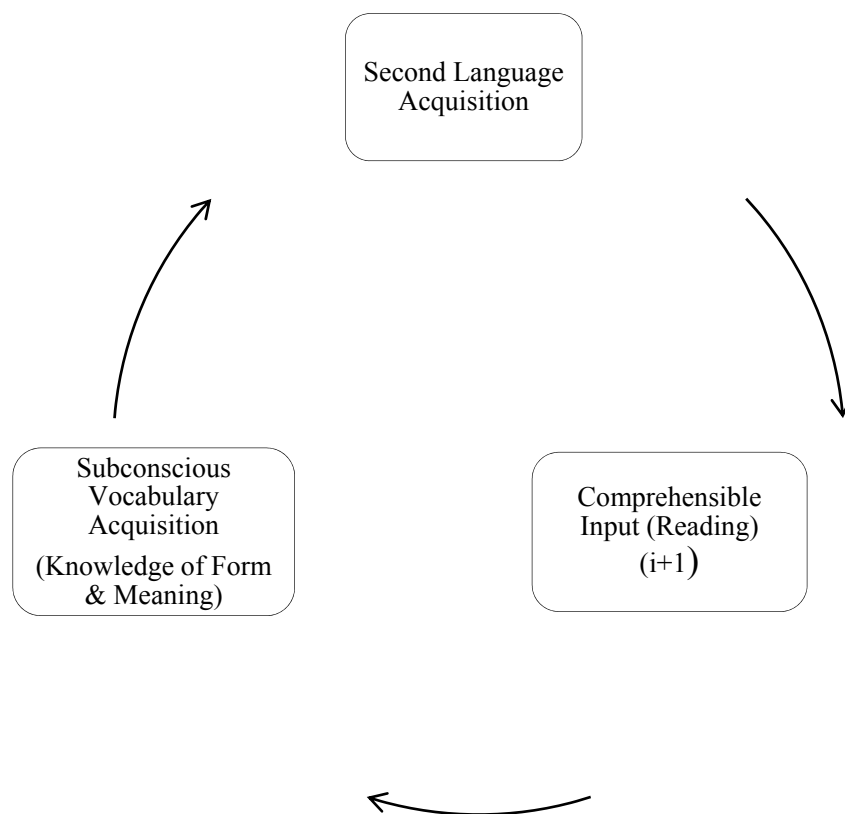
Figure 1: Theoretical Framework for the Study.

Comprehensible Input is an essential element in second language acquisition. According to Krashen (2003), "Comprehensible Input in the form of free voluntary reading has been shown to be highly effective for first- and second-language development" (p. vii). Several studies on second/ foreign language acquisition have demonstrated that reading can help learners enrich their vocabulary knowledge through reading (Brown et al., 2008; Cho and Krashen, 1994; Dupuy and Krashen, 1993; Grabe and Stoller, 1997; Hafiz and Tudor, 1989; Horst et al., 1998; Pigada and Schmitt, 2006; Pitts et al., 1989; Waring and Takaki, 2003; Zahar et al., 2001). The findings in these studies imply that reading can be an important source for vocabulary acquisition. One of the techniques that teachers can use to enhance their pupils' vocabulary is reading. Despite the important role it has, vocabulary learning through reading program is not a core part of language program's curriculum in EFL/ESL contexts (Waring, 2012). Teaching vocabulary through reading approach is rarely practiced in EFL/ESL English classrooms. EFL/ESL learners are not exposed to enough language to build a large vocabulary (Grabe and Stoller; 2002). "Iranian students do not have ample opportunities for more natural acquisition of the language" as well as vocabulary acquisition (Hosseini, 2007, p. 4). "Under such circumstances, there is very little scope for genuine and meaningful interaction and effective language learning" (p. 6). As little attention is paid to vocabulary development in English classes in Iran, one of the challenges for Iranian students in the process of language learning is learning vocabulary. It is also a challenge for English language teachers to know how to help students develop their vocabulary. Therefore, it seems to be a must to investigate whether Iranian students gain vocabulary knowledge from reading a graded reader. This study as a replication of the study by Waring and Takaki (2003), aims to provide empirical support to the prediction that vocabulary is acquired from reading. It is designed to investigate whether Iranian high school (grade 1) students as EFL learners too, will gain vocabulary knowledge while being exposed to reading from a graded reader. This study aims to find the answer to the question "Does reading a graded reader increase vocabulary knowledge of Iranian EFL high school students (grade 1)?" The reading method results in deep and thorough knowledge of words: form (spelling) and meaning. Words encountered in a variety of contents in which new words are presented contribute the learners or readers to acquire the mastery of full knowledge of semantics (Krashen, 1989).

Following Krashen's (1989) idea on full mastery of word knowledge through reading, different measures are required to measure full knowledge of vocabulary gained from reading (Waring & Takaki, 2003) as word knowledge comes in different levels: knowledge of recognition of form, recognition of meaning, and producing meaning. Another reason for using different measures is that as vocabulary acquisition is an incremental process (Krashen, 1989; Nagy et al., 1985;

Schmitt, 2010), using measurements that are sensitive to capturing partial knowledge is also required. Most previous research present "a one-dimensional picture" of the learning process "as the result of the treatment" (Waring & Takaki, 2003, p. 133). Using only multiple-choice test used by most previous studies, does not show the actual vocabulary learning. Multiple measures of vocabulary are needed to give a full picture of vocabulary knowledge (Schmitt, 2010, p. 21; Webb, 2007) and a detailed analysis of vocabulary learning through reading. Therefore, using different vocabulary tests on the immediate test, this study replicating the study by Waring and Takaki (2003) is going to shed light on the effect of reading a graded reader on incidental vocabulary learning and give a fuller picture of vocabulary learning through reading. The present study is different from and all past incidental vocabulary studies in several aspects. First, following Waring and Takaki (2003) three different measures at different sensitivities have been used in this study that no other studies have used them. Other studies mostly used multiple-choice tests (e.g., Day et al., 1991; Dupuy and Krashen, 1993; Pitts et al., 1989). Only a single measure does not guarantee measuring full knowledge of word meaning (Webb, 2007). In addition, "a multiple-choice test is not the best way to assess learning new words from context" (Waring & Takaki, 2003, p. 149).

A second difference is that the knowledge of all types of words is tested rather than that of only nouns and adjectives or adverbs that previous studies measured.

A third difference is that participants in the present study are high school students. Previous studies conducted research with mostly highly educated students at college level or high school students. To the best of my knowledge, little research has been done specifically with first grade high school students' incidental vocabulary learning through reading a graded reader.

And the last difference is the use of 'substitute words' instead of real L2 words like Waring and Takaki (2003). The advantage of using substitute words is that it ensures that target words are unknown and new to participants (Webb, 2007). And as a result, the gains "can be attributed entirely to the treatment" (p. 149).

AIM OF THE STUDY

This study aims to provide empirical support to the prediction that vocabulary is acquired from reading. It is designed to investigate whether Iranian high school (grade 1) students will gain vocabulary knowledge while being exposed to reading from a graded reader. To answer research problems, this study aims to find answers to the question: Does reading a graded reader increase vocabulary knowledge of Iranian EFL high school (grade 1) students?

METHOD

Overview of the Experiment
In this study, 25 words that appeared with different frequency of occurrences in the graded reader, *A Little Princess* were selected as test words and were changed into substitute words. After reading the book, 30 Iranian high school students (grade 1) were tested on their recall of the words in three tests over two test periods, one immediately after the treatment and the other 1 month later.
Participants

A random sample of 30 Iranian female high school students at grade 1 was selected for the experiment. The participants were selected from among the students who had registered for a summer English course in two private English institutions in Mazandaran. Random selection was used for the purpose of external validity of the research or generalizability of the results of the study. Another reason for random sampling is that it is considered as the best single way to obtain a representative sample that is required by inferential statistics. In this way, all of the individuals in the accessible population have an equal chance of being selected. All participants studied English as a compulsory subject for 2 years during Lower-secondary. They were all at the lower-intermediate level based on their teachers' evaluation and their educational background information available at school. They were studying an English course in the 'all-girls' Iranian English Institutions.
Research Design
The participants received the treatment which was reading a story from a graded reader containing 400 headwords. After the treatment, vocabulary test was administered to the participants. Three types of vocabulary tests were used in two test times: immediate and delayed tests. The immediate test was used to examine whether learners learned new words from reading. It was conducted immediately after the treatment and the delayed test (was administered) 1 month later. The time of the delayed test was chosen (1 month later) because of the researcher's time constraints as well as the teacher's and the students'. The delayed test was used to see whether vocabulary retention occurred through reading as Krashen's (2004) IH stated that vocabulary was best learned through incidental vocabulary learning approach (Waring & Takaki, 2003). Researchers believe that only when learners can remember the words after a while, can it be claimed

that they have retained the word knowledge. In order to see whether they would recall the knowledge of words they had gained from the treatment, there was a need to administer a 'delayed' test a while after the treatment. In fact, to examine retention of vocabulary learned from reading, assessment of word knowledge a while after the treatment is a must (Waring & Takaki, 2003).

Like Waring and Takaki's (2003) study, three types of tests were used that include: word-recognition test, multiple-choice meaning recognition test, and word translation test. These tests were selected for three reasons. First, to get a more precise picture of word knowledge gained from context, it was necessary to assess different levels of word knowledge. Therefore, different measures or tests were required to be used. Second, according to Horst (2005), the tests that are used in incidental vocabulary acquisition studies, are usually multiple-choice or translation tests. Finally, measurement of word gains is performed through test types measuring form-meaning relationship such as multiple-choice and translation tests (Waring & Nation, 2004). The figure below shows the research design:

Figure 2: *The Research Design*
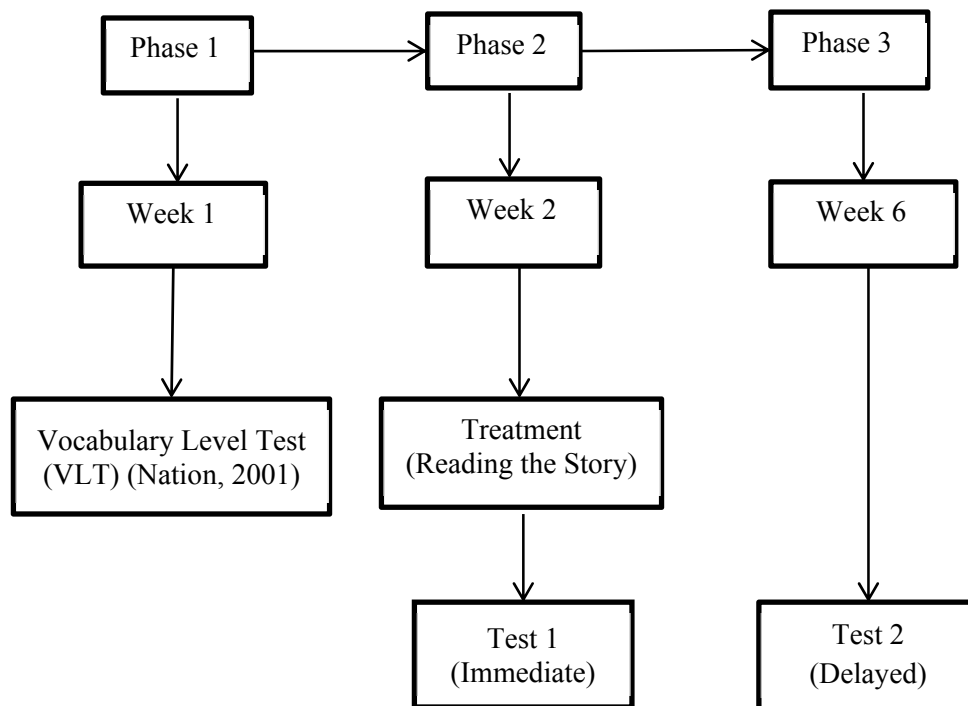
Following Waring and Takaki (2003), we did not use a pre-test because it caused participants to carry over the knowledge of the words to the test 1 which would be administered immediately after the treatment. The result of the immediate test would potentially show vocabulary growth as participants have no prior knowledge of the substitute words. For example, the mean score obtained from each type of test shows the rate of vocabulary knowledge gained for a specific level of word knowledge. Thus, there is no need for a pre-test to be conducted before the treatment to compare its result to the result of the test which is conducted after the treatment for measuring the learners' vocabulary learning.

We used different types of vocabulary test to measure full knowledge of vocabulary gained from context to testify Krashen's (1982) IH stating that language acquirers could gain different levels of knowledge of word: knowledge of form and meaning from reading. Considering this, different vocabulary tests are needed to measure different levels of word knowledge that are assumed to be gained from reading according to IH.

Procedure to Select the Material and Test Words

Selection of Material

According to Krashen's Input Hypothesis (IH) (1982), vocabulary is acquired through the input (in this study written input or reading) which is not too difficult to understand, at the level 'i+1'. In addition, to carry out a successful vocabulary acquisition research through reading so that successful learning can occur, two points in the selection of

material need to be taken into account. First, providing "a good balance of known and unknown" in the text for "successful guessing to occur" (Waring & Takaki, 2003, p. 134) is necessary. Second, providing several repetitions (ten to fifteen) of an unknown word "before it is learned" seems to be essential (Waring & Takaki, 2003).

Following the criteria above, graded readers are considered as ideal sources for vocabulary learning not authentic or natural texts as they meet all the criteria mentioned above. They are the written comprehensible input meeting Krashen's Input Hypothesis requirement.

Based on the result of the Vocabulary Level Test (VLT) that showed the participants' vocabulary level, the graded reader *A Little Princess* by Anthony Robinson was recognized to be suitable for the participants in this study. This graded reader is a level 1 book of Oxford University Press which includes "400 most frequent and useful words in English" (Waring, 2000, p. 9). The reader is at the level i+1 recommended by Krashen (1982). Therefore, it is found to be at the level that Iranian high school students (grade 1) as pre-intermediate learners can read and understand. In this way, it can be safe to claim "learners would be reading at about an i+1 level", at the 96% to 99% which is necessary "for successful guessing from context" (Waring & Takaki, 2003, p. 137).

Selection of Test Words

After selecting the material, the test items need to be selected. They must not be too much difficult for the participants to guess from context. They must not be known to them, either. Words from all parts of speech are chosen as mentioned in the section 'the present study', although it is believed that verbs are a bit difficult to guess because of their appearance when used with different inflections.

Following Waring and Takaki (2003) and Brown et al., (2008), in order for the test to be reliable, 25 words form the graded reader were selected as test items. These words include nouns, verbs, adjectives and adverbs. Like their study, we made 5 sets of 5 words with a range of appearance from 4 to 20 times. In other words, these words were repeated from 4 to 20 times throughout the story so that they could be learned.

To assure that the participants did not know the test words, we did not use a pre-test as conducting a pre-test might make participants aware of the test words as Waring & Takaki (2003) state. We used words created by Waring & Takaki (2003), substitute words, instead. Substitute words are presented within easy context so that the participants can guess their meanings from the context. Since the text is easy, it is possible for them to understand the concept of the substitute words. Therefore, they will not have any problem guessing the meaning of substitute words. The list of words and their substitute word equivalents are shown in Table 2.

Table 1: *The list of English words and their Substitute word equivalents and the number of occurrences in the text. (Adapted from Waring & Takaki, 2003, p.138.)*

English word	Substitute word	Number of occurrences in the text	Test word group
House / s	Windle / s	17	
Yes	Yoot	17	
Face	Mand	18	15-18 Group
Mine	Brench	18	
Money	Mear	15	
Good	Mork	14	
Night	Cadle	13	
Beautiful	Smorty	13	13-14 Group
New	Tantic	13	

Window	Bettle	14	
Name	Parrow	9	8-10 Group
Year / s	Jurg / s	10	
Quietly	Molden	8	
Rich	Tring	8	
Bread	Toker	8	
Smiled	Nase	4	4-5 Group
Slowly	Bick	4	
Understand	Prink	5	
Snow	Sind	4	
Winter	Greal	4	
Sun	Blund	1	One Occurrence Group
Special	Palk	1	
Moment	Tance	1	
Wrong	Vack	1	
World	Rimple	1	

Instruments

The instruments that were employed in this study included Nation's (2001) Vocabulary Level Test, and a test set: word form recognition test, meaning recognition test (multiple-choice) test, and meaning translation test that were used as an immediate test after reading. These tests were considerably adopted and adapted from Waring & Takaki's (2003) study. Detailed explanations regarding these tests are given below.

Vocabulary Level Test (VLT)

The Vocabulary Level Test (VLT) (Nation, 2001) is a standardized test that is used to measure the students' existing knowledge of words "at several frequency bands and the Academic Word List" (Webb, 2012, p. 116). We found the vocabulary test at 1000 level suitable for the participants in my study as they were at pre-intermediate level. The 1000 vocabulary level test consists of two parts: A and B containing 40 True-False tests with some drawings that students have to answer within 30 minutes. The VLTs A and B are in Appendix A. Table 3 displays the structure of Nation's (2001) VLT at 1000 level:

Table 2: *The Structure of Nation's (2001) Vocabulary Test (VLT).*

No.	Test Level	Time	Number of Question
1. A*	The 1,000 level	15	20
1. B*	The 1,000 level	15	20
TOTAL		30 Minutes	40 Items

Note: A. represents about test A vocabulary, B. represent about test B vocabulary

To answer each question, the students have to match three words to their meanings (Nation, 2002). They choose the correct option from the left column and write the related number in the blank on the right within 45 minutes. The example by Nation (2001) below clarifies the point:

1 business

2 clock

3 horse   --- 6 ---   part of a house

4 pencil   --- 3 ---   animal with four legs

5 shoe   --- 4---   something used for writing

6 wall

The VLT can help determine how much vocabulary students already know and how much they need to know to be able to read a novel. The general rule is that to understand a text, students need to have familiarity with about 98% of the words of any text. To read a novel, they need knowledge of approximately 8,000 to 9,000 words (Nation, 2002)

Word Form Recognition Test

In this test, a list of words was presented. The participants were given forty-two substitute words among which were twenty-five substitute words they had met in the text. Seventeen other words were distractors. Distractors were used to investigate to what extent they could guess correctly. To answer the word-form recognition test, the subjects were required to guess the words they had seen in the text and circle them. Data were collected for the correct and wrong recognitions. The test is in Appendix B.

Meaning (Translation) Test

In the translation test, the participants were asked to write and produce the meaning of the twenty-five words given in a list in their L1 (Persian) since the use of L1 meanings was more sensitive to partial knowledge of form and meaning than L2 definitions (Webb, 2008). There were two other blanks for each item to give the subjects a chance to provide alternatives that were near if they could not give an exact equivalent. The purpose was to see whether the participants could guess answers which were near to the correct answers. The test appears in Appendix C.

Multiple-Choice Recognition Test

This is a standard test with four choices including the correct meaning and three distractors that are of the same part of speech. In this test, other than these, an 'I don't know' option has been used in order to prevent participants from guessing. For instance, if a substitute word is a concrete noun, all four choices are concrete nouns. Distractors were chosen in a way not to be close in meaning to the correct answer so that partial knowledge could be demonstrated. The characteristics of multiple-choice is that it can capture partial knowledge gain of the target words being tested (Wan-A-Rom, 2010). In this test, participants were to answer twenty-five tests by selecting the correct answers from among five alternatives. Appendix D displays the test.

The test items were tested in isolation not in context. The reason for this was that in case the words were presented in contexts, their meanings might be inferred by the learners while taking the test. Thus, it would not be clear whether the learning was the result of reading task or guessing from context at test time (Waring & Takaki, 2003).

PROCEDURE OF RESEARCH

The tests were administered in an order which the information learned from one test would not be transferred to another. For instance, if meaning recognition test was given first and the translation test second, it was very likely that some meanings would remain in the subjects' memory. This knowledge would be transferred to the translation test. Schmitt and Meara (1997) also highlighted this point stating that "this was necessary to ensure that they would not transfer suffixes or associations from the receptive section to the productive section" (P. 23). Therefore, following this logic, the test "requiring the least amount of word knowledge" according to Waring and Takaki (2003, p. 139) i.e., word-form recognition test was given first. Then, translation test and finally the multiple-choice test were administered. Table 4 shows a summary of the types of test given for immediate test.

Table 3: *Summary of the types of tests used (Adapted from Waring & Takaki, 2003, p. 140).*

Test Type (in order of presentation)	Test Time

Reading the text

1. Word-form Recognition Test	(Immediately after reading)
2. Meaning (Translation) Test	(n=30)
3. Multiple-Choice Recognition Test	

1. Word-form Recognition Test	(1 week later)
2. Meaning (Translation) Test	(n=30)
3. Multiple-Choice Recognition Test	

Data Collection Procedure

Before data collection, the students were assured that the results of the tests would not affect their course grades and that they would be used only for academic purposes. The data was collected by administering three tests: a) word-form recognition test b) meaning-translation test c) multiple-choice meaning-recognition test. The test took about 120 minutes and participants were required to answer 25 items.

The treatment which was reading the story was conducted within 1 week. The immediate test was administered after the end of the treatment on the last session. It was believed that the results of the tests would determine whether the word knowledge would be gained.

Data Analysis Procedure

In this study, the data collected from subjects' performances for the three tests were analyzed to see whether vocabulary learning through reading approach enhanced learners' vocabulary. To examine the amount of vocabulary knowledge, both descriptive statistics and inferential statistics for three measures were used. In short, the results of the tests were compared and analyzed in terms of comparing the mean (X) and standard deviation (SD) conducting One Way Repeated Measures ANOVA using the Statistical Package of Social Science (SPSS) software. Tables and charts were used to illustrate the trend and relationships among data.

Analysis of Research Question

Does reading a graded reader increase vocabulary knowledge of Iranian high school students (grade 1)?

The results of the three types of test for the immediate test (test 1) are summarized in Table 4.

Table 4: *The results of Descriptive Statistics for three test types for immediate test (test 1).*

Tests					95% Confidence Interval of Differences	
	N	Mean	S.Deviation	SD. Error	Lower	Upper
Word Form Recognition	30	8.87	3.80	.694	7.45	10.29
MC Recognition	30	4.37	2.22	.405	3.54	5.20
Translation	30	2.10	2.13	.391	1.30	2.90

Note. For all analyses, $p<.05$.

Table 4 displays the total scores for test 1. The results show a vocabulary gain of the mean score of 8.8 for the *word-form recognition test*, the mean score of 4.37 for the multiple choice test, and the mean of 2.10 for *the translation test*. The mean scores for all three test types indicate a gain in the students' vocabulary knowledge through the incidental vocabulary learning approach. Therefore, the Null Hypothesis (Reading has no significant effect on vocabulary development of EFL learners) is rejected and the alternative hypothesis is accepted. This finding also supports the result of the study by Brown et al., (2008) that indicated incidental vocabulary occurs through reading.

The table also shows that the highest gains were achieved in word-form recognition test. The score for the *Multiple-Choice (MC) recognition test* was half of the word-form recognition test. The lowest score obtained belongs to the *translation test.* From the data it could be found which type of test was easier or more difficult for the learners. *Word-form recognition* test seems to have been easier for them and meaning translation test the most difficult.

The results for word-form recognition test show that substantial 36% of 25 words were learned. This suggests that the highest vocabulary gain, across all tests, was obtained from word-form recognition test.

DISCUSSION

The results of the current study indicate that learners have gained vocabulary knowledge of the new words from reading which corroborates the study conducted by many previous research discussed in literature including those by Day et al., (1991), Hulstijn (1992), and Brown et al., (2008). Findings from Descriptive Statistics carried out show that reading a graded reader adds to the vocabulary knowledge of these Iranian EFL learners. The findings of this study signify that reading does have a positive effect on vocabulary development of EFL learners. This finding supports Krashen's (1989) comprehensible Input Hypothesis saying that second language vocabulary is acquired through input which is comprehensible. They also corroborates Pigada and Schmitt's (2006) finding that "vocabulary knowledge can be greatly enhanced during reading even from a small number of exposures" (Min and Hsu, 2008, p. 95) and their conclusion "that more vocabulary acquisition is possible from extensive reading than previous studies have suggested" (Min, 2008, p. 76). Pigada and Schmitt's (2006) study indicated that vocabulary knowledge was enhanced and 65% of the words tested were learned in terms of orthography. Their study, in general as they contended, showed more vocabulary gain than previous studies displayed. Thus, it was concluded that, in this study, vocabulary was incidentally learned through reading a graded reader.

The findings corroborate previous research (such as Nagy et al., 1985; Pitt et al., 1989; Horst et al., 1998) suggesting that vocabulary is acquired through reading. They are also in congruent with the results of Waring and Takaki's (2003) study who have concluded that "the data support the notion that words can be learned incidentally from context.

The findings of this study can also support the notion stated by Laufer (2009) that indirect approaches have found theoretical support. They also corroborate the study by Horst (2005) that showed higher vocabulary gains than past studies. Horst's (2005) study showed "an overall mean gain of about 16.88 words" (Min, 2008).

This study also supports the findings of a more recent study conducted by Brown et al., (2008) saying that the reading approach has an important role in vocabulary learning among 35 Japanese university students. Their study like Waring and Takaki's (2003) study demonstrated that "new words could be learned incidentally …." (p. 136) but not many.

The final analysis of the data presents that the three measurements used in this study are helpful in answering the research question of this study. The results demonstrate that different levels of word knowledge: knowledge of form, meaning, and producing meaning can be gained from reading a graded reader. The findings give an accurate and clear picture of the process of word learning from reading. They also confirm Krashen's (1989) theory underlying this study saying that second language as well as vocabulary can be acquired through reading which is at the ability level of the learners. They proved Krashen's Input Hypothesis (IH) stating that vocabulary can be learned through reading which is comprehensible for the learners.

Pedagogical Implications

The findings of this study have pedagogical implications for instruction and curriculum development. First, curriculum designers and English teachers should be aware of the positive role of reading and its benefits for students' vocabulary development. They should incorporate some in-class or out of class reading activities to develop learners' vocabulary knowledge as it is not possible for them to teach many words in the classroom because of time constraints. This could also contribute to learners' vocabulary enrichment and help them learn different functions of language in authentic contexts and make them aware of the significance of learning new words in context rather than in isolation.

Recommendations and Conclusions

This study has indicated vocabulary gain from reading a graded reader among Iranian EFL learners. More practice and more reading of this kind (graded readers) are required so that they can add more to their word knowledge at different levels. More encounters with the words and great amounts of exposure to the graded readers are needed for more knowledge gain as Nation and Wang (1999) recommend use of a book per week at coverage of 95% and above (Brown et al. (2008) for vocabulary development.

Finally, learners should be given opportunities to examine the effectiveness of the reading approach. For instance, some activities like guessing from context can be practised in class so teachers can see how the learning process is and how effectively they can apply the inferring strategies they have been taught. Examining the effect of several graded readers on vocabulary learning would be a useful follow-up to this study.

The results of current study show that reading a graded reader has a great impact on incidental vocabulary learning of EFL/ESL learners. The overall conclusion would be that reading can greatly contribute to incidental vocabulary learning (Daskalovska, 2014). Other studies have also demonstrated that different levels of word knowledge can be enhanced through reading As some researchers believe, many aspects of word knowledge can only be learned in context. Therefore, there is a need to incorporate an extensive reading program into the school curriculums and provide an opportunity for the learners to see and learn the language functions in context and enrich their vocabulary.

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Appendix A

Word Form Recognition test

Test 1: Circle the words you met in the story.

(تست 1دور کلماتی که در متن دیده ا ید دایره بکشید)

bandle	bettle	tantic
bing	windle	sind
borch	tance	vack
clath	parrow	jurgs
crasty	greal	blund
dice	mear	mork
diggle	brench	yelt
fale	bick	prink
flart	yoot	mand
mave	tring	toker
nutious	cadle	palk
quent	smorty	stoll
sheddle	molder	rimple
smick	nase	speat

Appendix B

Meaning (Translation) test

Test 2: What do these words mean? Write the meaning in Persian.

(تست 2: معنی این کلمات چیست؟ معنی انها را به فارسی بنویسید.)

(معنی تقریبی هم قابل قبول است.)

windle	1………………………	2………………………	3…………………………………………
yoot	1………………………	2………………………	3…………………………………………
mand	1………………………	2………………………	3…………………………………………
brench	1………………………	2………………………	3…………………………………………
mear	1………………………	2………………………	3…………………………………………
mork	1………………………	2………………………	3…………………………………………
cadle	1………………………	2………………………	3…………………………………………
smorty	1………………………	2………………………	3…………………………………………
tantic	1………………………	2………………………	3…………………………………………
bettle	1………………………	2………………………	3…………………………………………
parrow	1………………………	2………………………	3…………………………………………
jurgs	1………………………	2………………………	3…………………………………………
molder	1………………………	2………………………	3…………………………………………
tring	1………………………	2………………………	3…………………………………………
toker	1………………………	2………………………	3…………………………………………
nase	1………………………	2………………………	3…………………………………………
bick	1………………………	2………………………	3…………………………………………
prink	1………………………	2………………………	3…………………………………………
sind	1………………………	2………………………	3…………………………………………
greal	1………………………	2………………………	3…………………………………………
blund	1………………………	2………………………	3…………………………………………
palk	1………………………	2………………………	3…………………………………………
tance	1………………………	2………………………	3…………………………………………
vack	1………………………	2………………………	3…………………………………………
rimple	1………………………	2………………………	3…………………………………………

Appendix C

Multiple Choice Recognition test

Test 3: Circle the words you think nearest to these words.

(دور کلماتی که گمان میکنید به کلمات دا ده شده نزدیک ترند خط بکشید.)

Blund	sun	Mountain	Photo	flower	I do not know
Palk	happy	Doubtful	Special	easy	I do not know
Tance	air	Moment	Love	respect	I do not know
Vack	hard	Busy	Free	wrong	I do not know
rimple	world	Mouth	Music	club	I do not know
parrow	letter	Piano	Hand	name	I do not know
Jurgs	year/s	Sea	Bird	song	I do not know
molder	rapidly	Only	Quietly	simply	I do not know
Tring	rich	Dark	Pretty	interesting	I do not know
Toker	shoe	Bread	Car	stair	I do not know
Mork	red	Clever	Mad	good	I do not know
Cadle	tree	Night	College	glass	I do not know
smorty	dry	Crazy	beautiful	dirty	I do not know
Tantic	new	Intelligent	Cold	active	I do not know
Bettle	cow	Window	Mud	station	I do not know
Nase	took	Smiled	Picked	got	I do not know
Bick	slowly	Wisely	Correctly	exactly	I do not know
Prink	drink	Come	understand	meet	I do not know
Sind	snow	Pepper	Chair	eye	I do not know
Greal	paper	Tape	Game	winter	I do not know
windle	bread	Elephant	House	book	I do not know
Yoot	yes	Oh	Why	OK	I do not know
Mand	dog	Room	face	sky	I do not know
brench	water	Mine	help	cake	I do not know
Mear	money	Pen	cat	file	I do not know

ROOFS, STAIRS & LINES: MIDDLE SCHOOL STUDENTS' STRATEGIES IN SOLVING STEEPNESS PROBLEMS

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ABSTRACT
Research shows that middle school students use a variety of strategies to solve proportion related problems (Hart, 1981). Mathematically, there is a connection between proportional reasoning and steepness, since steepness can be measured by the proportion which is the slope of a line. In this study, sixteen middle school students' solution strategies in solving problems regarding steepness are explored, based upon their abilities to solve proportion related problems. Two tests were administered to students: an adapted version of the Ratio and Proportion Test (Brown, et al., 1981) and a Steepness Test (Author, 2013). This article contributes to literature on early algebraic reasoning exploring applications of proportional reasoning.

INTRODUCTION

According to assessments administered by the International Association for the Evaluation of Educational Achievement, students internationally struggle with responding to real-life situations involving proportional reasoning and slope (Gonzalez, et al., 2008). Slope is an important concept because it represents a bridge between arithmetic and algebra (Lobato, 1996). The concept of slope draws upon knowledge of proportional reasoning and leads into the more general concept of rate of change, which is applied to increasingly complex types of functions in algebra and calculus. Steepness has been proposed as an intermediary concept to be introduced to bridge the conceptual gap between proportional reasoning and slope (Stump, 2001; Lobato & Thanheiser, 2002; Lobato & Ellis, 2010).

Through careful analysis of students' strategies as they work with proportions, we know a lot about students' development of knowledge about proportionality (Hart, 1984). And through careful analysis of students' strategies as they work with linear equations, we know a lot about the development of slope (Schoenfeld, Smith & Arcavi, 1993; Lobato & Thanheiser, 2002). However, there is little research that helps us understand how students make the conceptual leap from proportionality to slope. Mathematically, there is a clear connection between proportionality and slope, but the research base has not yet carefully examined this connection in terms of students' understandings.

The present paper explores this connection through an examination of students' strategies on a class of problems that are designed to bridge the concepts of proportionality and slope. As described in more depth below, we refer to these problems as "steepness" problems, in that the problems involve determining which of two situations (e.g., two roofs, two staircases, two lines) is steeper. As we argue below, understanding how students approach steepness problems helps the mathematics education community to understand whether and how students are using their knowledge of proportionality as they begin to learn about slope.

We begin by examining past studies that have focused on students' solutions to proportion-related, slope-related, and steepness-related problems; we then discuss the idea that using a ratio to measure steepness is a connecting concept between proportionality and slope.

STEEPNESS AS A CONCEPTUAL BRIDGE BETWEEN PROPORTIONALITY AND SLOPE

Many studies have found that the development of students' proportional reasoning follows a common learning trajectory (e.g., Kaput & West, 1994; Lamon, 1993). When first encountering contextual problems involving multiple quantities, some of which are related proportionally, there is evidence that many students have difficulty determining which of the quantities are relevant and which are irrelevant to the proportionality of the context (Karplus & Peterson, 1970). In addition, even when students are able to discern the relevant data, they may coordinate it in non-proportional ways, such as using only two of the three relevant pieces of information or using the three relevant pieces of information but in an additive way (Hart. 1981). Over time, students eventually learn to correctly coordinate the relevant quantities in problems whose solution processes require use of proportional reasoning (Lamon, 1993).

Research has also investigated the strategies used by students who are able to reason proportionally. For example, in order to solve missing value proportional reasoning problem (i.e., a problem that could mathematically be expressed using the equation $a/b=?/d$, where letters represent known quantities and the question mark represents an unknown quantity) and comparison proportional reasoning problems (i.e., a problem that could be mathematically be expressed as determining which of the two fractions, a/b or c/d is greater), Siegler (1976) found that, en route to thinking multiplicatively, students progress from using simple strategies that involve mostly additive reasoning to increasingly sophisticated strategies that take into account multiplicative relationships between quantities.

Studies have also determined that the numerical quantities involved in solving problems and the contexts in which the problems are situated may determine students' success on problems requiring proportional reasoning. For instance,

problems asking for a comparison between four quantities which are related proportionally are easier for students to solve when there is some mathematical similarity between the quantities to be related, (Noelting, 1980), such as the numerators of 2/3 and 2/5 both being 2. Related, students tend to have greater success in solving comparison problems situated in contexts where the ratios are related by an integral factor (Lesh, Post & Behr, 1988), such as 2/2 and 6/6 which are related by a factor of the integer 3. In addition and more generally, students' familiarity with contexts can influence success on problem solving (Tourniaire & Pulos, 1985).

In addition to research studies' being conducted on students' development on proportionality, many studies have also investigated students' development of knowledge of slope and steepness. Researchers have observed that students tend to first develop a local perspective of slope prior to understanding slope as a global property of a line (Walter & Geruson, 2007; Schoenfeld, Smith & Arcavi, 1993). An understanding of slope at the local level involves identifying and interpreting slope for a specific segment of a line. However, students who understand slope only at the local level may think that the slope varies along a line segment as other points on the line are considered (Lobato & Siebert, 2002). For example, a student who is given the coordinates of three points on a line might separately compute the slopes of two separate line segments formed between the three points, instead of noticing that the slope of a line is constant throughout the line. A global understanding of a physically drawn line's slope entails knowledge that the slope of the line is constant, independently of the points selected from the line. An understanding of slope's meaning in a functional context involves understanding that slope is a constant rate of change between two quantities (Schoenfeld, Smith & Arcavi, 1993).

Much like the literature base on the development of strategies used to solve proportional reasoning problems, researchers have also observed that students' strategies used to solve slope problems often traverse a learning trajectory. This trajectory begins with the (erroneous) consideration of irrelevant information to determine slope and steepness. For instance, students may use the lengths of extraneous line segments in a diagram to determine steepness of a line (Lobato, 1996). Students may also consider the slope to be the y-intercept of the line (Moshkovich, 1996). Students' strategies progress to identifying the relevant information but using it in an incorrect way, such as finding the difference between the height and base length of a ramp rather than finding the ratio between the height and base length (Simon & Blume, 1994). Ultimately, when students understand the concept of slope, they are able to use relevant information to find the slope as a measure of steepness (Simon, 2006).

The existing literature base informs us that it is a difficult conceptual leap for students to use proportional reasoning in situations involving slope. When students are using additive reasoning to relate the relevant quantities instead of using proportional reasoning, it is likely that there is general confusion around at least one of the following ideas: proportionality, the proportionality that is inherent in slope, and the use of slope as a measure of steepness (Swafford & Langrall, 2000). Since an understanding of the concept of steepness is an intermediary step towards understanding that proportionality exists in situations regarding slope, this study examines the connections between students' abilities to solve proportional reasoning problems and students' strategies used to solve steepness problems, in an effort to understand when and why proportionality is used in slope work.

One way to help better connect proportionality with slope is through the use of finding a measure of steepness. In fact, after observing pre-service teachers working with slope-related problems, Simon and Blume (1994) postulated that using a ratio to determine the measure of steepness is a key developmental understanding, or fundamental prerequisite knowledge, of the concept of slope. Building off of this idea, after observing middle school students solving steepness-related problems, Lobato and Thanheiser (2002) outlined a series of steps which students would need to be able to do in order to accurately use a ratio as a measure of steepness: isolate the attribute that is being measured, determining which quantities affect the attribute and how, understanding the characteristics of a measure, and constructing a ratio. These empirically-based observations about the connections between proportionality, steepness, and slope are consistent with the mathematical connections between these concepts, which are all part of the multiplicative conceptual field that Vergnaud (1994) described as concepts whose relationships could be described multiplicatively.

In comparison to the abundant literature on students' strategies used to solve proportional reasoning problems and slope problems, there is very little literature on students' strategies used to solve steepness problems. An eighth grade teacher found that exposing her students first to the steepness of staircases helped these students later understand the formula for slopes of lines graphed on the coordinate plane, in other words, developing knowledge about steepness helped the students connect the geometric and algebraic conceptualizations of slope (Smith et al., 2013). In an activity which asked students to list how they would change a staircase to make it less steep, one eighth grade student suggested to make the stairs vertically shorter and to decrease their depth. While this student is indicating that both the vertical and horizontal dimensions of the staircase should be considered, the student demonstrates limited understanding of how these dimensions are coordinate with respect to steepness. If the original staircase has a vertical displacement of 1 foot and a horizontal displacement of 1 foot, following the student's suggestion to result in stairs that are steeper (e.g., 0.75 feet vertically and 0.5 feet horizontally), equally steep (e.g., 0.5 feet vertically and 0.5 feet horizontally), or less steep (e.g., 0.25 feet vertically and 0.5 feet horizontally). In order to better support this student to make a connection between steepness and slope, it would be useful for a teacher to know whether and to what extent the student is using proportional reasoning to think about steepness.

If we knew more about students' strategies used to solve steepness problems, in particular when and how students are using proportional reasoning to solve steepness problems, we might better understand students' difficulties with solving slope problems. The method by which this study investigates students' strategies is two-part. First, the study provides students with a variety of contexts in which steepness plays a role, to determine whether students are using relevant or irrelevant data to solve the problems. Secondly, the study provides a selection of structural difficulty levels inherent in each of the contexts to explore the degree to which proportional reasoning is a part of their solution processes.

This study compares students' strategies on steepness problems and proportion related problems in an effort to examine whether there is a positive relationship between students' solution methods on the two types of problems. Given that it appears that students who struggle with slope may have difficulties with understanding proportions (Lobato & Thanheiser, 2002), we hypothesize that students who have difficulties solving proportion related problems will also have difficulties solving steepness related problems.

During this study, we administered a pencil-and-paper Ratio and Proportion Test to students in grades 6 and 8. We then selected sixteen students to interview using a steepness test instrument to include a range of students' proportional reasoning levels as determined by the Ratio and Proportion Test. The strategies that the students used to solve the steepness problems are then analyzed in light of students' proportional reasoning levels, the contexts in which the steepness problems were situated, and the structural difficulty levels of the steepness problems.

RESEARCH QUESTIONS

The purpose of this study is to determine what relationships exist between students' strategies used to solve steepness problems and their abilities to solve proportion problems. More specifically, the study was designed to answer the following question:

    1. What strategies do students, when classified by their proportional reasoning levels, use to solve problems involving steepness?
    2. To what extent do students' strategies in solving steepness problems vary based on the:
    a. Context in which the steepness problem is situated?
    b. Structural difficulty of the problem?

METHODS

As described in more depth below, a survey consisting of two tests (a Ratio and Proportion Test and a Steepness Test) were administered to 16 students attending two middle schools.

Participants

The sample for the survey study consisted of 16 students in grades 6 and 8 who attended two private schools in the United States. Students were given the Ratio and Proportion Test in class prior to one-on-one interviews with the researcher after school. Interviewed participants were chosen such that students attaining all five levels of proportional reasoning were interviewed. The Steepness Test was given during the interview and participants were asked to think aloud as they solved the problems.

Procedure

Teachers administered participants the Ratio and Proportion Test in class. All students finished within the allotted time of 30 minutes. Participants did not receive incentives for participating in the study and were told that their participation would not impact their mathematics course grades. The author had a prior relationship with the school and the mathematics teachers; teachers mentioned to participants that this was part of a research study and they expected students to try their best.

The interviews were conducted by the author. Interviews were audiotaped and videotaped, and later transcribed. The interviews used the Steepness Test as the basis of a structured interview. The interviewer asked the participants to vocalize their thinking while they solved the problems. The interviewer only used verbalizations that were not likely to alter a participant's thinking process, as described by Ericsson and Simon (1984). Such verbalizations included encouraging the participant to keep speaking and asking the participant to articulate current and immediate past thoughts. The interviewer collected written work produced during the interview.

Instruments

To assess middle school students' levels of proportional reasoning, the Ratio and Proportion Test was developed from existing, similar assessments. The test items were adapted from the *Ratio and Proportion Test R* from the Concepts in Secondary Mathematics and Science (CSMS) Project (Brown, et al., 1981). The content validity and reliability of this test are described by Brown, et al. (1981). There were eight problem settings and a total of 20 problems on the Ratio and Proportion Test. Correct solutions received one point and incorrect solutions received zero points.

To assess middle school students' understanding of steepness, the Steepness Test was used (Author, 2013). The Steepness Test's construct validity and reliability analyses are described by Author (2013). The Steepness Test includes

24 problems that asked participants to determine which of two drawings was steeper. Each problem asked participants to compare the steepness of two objects and had three answer choices: 1) left object is steeper, 2) right object is steeper, or 3) the objects have the same steepness. There were three types of problem contexts: two situated the problem of steepness in a real-world situation and one presented it as a mathematical problem. Within each problem context there were eight problems, all grouped together. The two real-world situations were roofs and staircases. All drawings of roofs and staircases were shown on grid paper. The mathematical problems on the Steepness Test showed two lines in Quadrant 1, and each of them started at the origin. To solve these problems, participants needed to compare the steepness of the roofs, staircases, and lines. Lines were either explicitly shown, as in the case of the roofs or the lines on the coordinate plane, or not shown, as in the case of the staircases. All roofs, staircases, and lines were presented on coordinate grids with homogeneous axes. These contexts are either often used in slope problems in middle school mathematical textbooks or are often seen by students through their daily encounters with physical structures.

Within each set of eight problems (roofs, staircases, lines), the order of the problems based on structural difficulty level was randomly determined. The order in which the groups of problems based on context (roofs, staircases, lines) were arranged on the Steepness Test was not chosen at random, and may have had an effect on students' abilities to respond to the problems. Since the roof and the line problems present continuous data whereas the sets of staircase problems involve discrete data, the stairs were placed in the middle of the instrument. Hence, the eight roof problems were presented first, followed by eight staircase problems, followed by eight line problems.

Strategy Coding Scheme for Participant Responses to Steepness Test problems
Codes for strategies were created based upon the participants' responses on the Steepness Test. Strategies are the methods the participants used to solve the problems, and include implicit mathematical justifications as well as the explicit words spoken and actions taken. Strategies were assigned regardless of whether or not they were executed correctly. For example, a participant counted the correct number of horizontal and vertical boxes shown on the page, indicating that both dimensions were considered, but due to a counting error gave an incorrect answer. Some participants used more than one strategy to solve a problem, either to confirm the result of the first strategy or because they changed strategies. The response coded was the response used to produce the final answer. A total number of 384 problems were coded, produced from the sixteen participants' answers to the 24 Steepness Test problems.

The strategies that students used to describe steepness were coded using the following codes: 1) angles, 2) other, 3) irrelevant data, 4) area, 5) one measurement, 6) addition, 7) two measurements, 8) scaling, 9) norming, 10) ratio or rate. Each of the strategies is described below.

Angles The Angles strategy was coded when participants used the angles formed at the base of the staircases, at the corner of the roofs or at the base of the lines to determine steepness. Because all of the steepness problems were constructed on homogeneous axes of the same size, a comparison of angles could be used to obtain the correct answer. In some of the problems, the angles were very close in measure. Under these circumstances, it was impossible to accurately determine steepness using the Angles strategy, as measuring devices were not allowed. Participants whose responses were coded as "Comparing angles" by visual inspection; by using a benchmark angle such as 45 degrees, the horizontal line, or the vertical line; estimating angle degree measures; or by referring to parallel lines. For the staircase problems, some participants drew in auxiliary lines so that they could compare the steepness of those lines. Use of the angles strategy is beyond the scope of this article.

Other The first strategy reported in the results section of this article is the "other' strategy, coded as 0. This strategy was coded when no reasons were given or participants indicated they "guessed."

Irrelevant Data The Irrelevant Data strategy was coded when participants used data in the solution process that was not needed to determine steepness. For example, one participant compared the areas of the rectangles of the rectangular houses below each of the roofs, which is unrelated to the steepness of the roofs. Other irrelevant data given to determine steepness included the speed at which something would roll down a roof (since for two roofs that are equally steep, the longer roof will take longer for a ball to roll down), the difficulty of climbing a set of stairs (since the physical definition of work involves height alone) and the measures of the right angles forming individual steps in a staircase.

Area The Area strategy was coded when participants compared areas of roofs or the space between lines and the horizontal or vertical axes. This is a limited strategy because it will only yield a correct answer when at least one of the dimensions is held constant between two objects. None of the participants who used Area computed the area using a triangle area formula, rather, they visually compared the spaces or counted grid boxes that comprised the areas.

One Measurement The One Measurement strategy was coded when participants used only one dimension to determine steepness. Overwhelmingly, the measurement mentioned was either the horizontal or the vertical length, but it could also be the length of the diagonal formed by the side of a roof, the length of the line drawn from the top of the staircase to the base, or the length of the line drawn on the coordinate plane. This strategy is more advanced than the Irrelevant Data strategy because the measurement mentioned is partially useful in determining steepness.

Addition The addition strategy was coded when participants coordinated two measurements in an additive way. From literature on proportional reasoning, additive reasoning involves consideration of a difference between two

measurements. Participants who used additive reasoning often used it to incorrectly justify why two staircases had the same steepness.

Two Measurements The Two Measurements strategy was coded when participants mentioned or compared two measurements but did not explicitly relate them additively or using a ratio. This strategy is closer to using a ratio than the previously mentioned strategies because relating two measurements proportionally is one method of determining steepness. Both correct and incorrect responses were obtained using this strategy. Incorrect responses had mentions of comparisons of the vertical and horizontal measurements using terminology such as "taller" and "wider," but arrived at an incorrect solution. Correct responses mentioned the two measurements or comparisons of the two measurements, and arrived at the correct solution. Participants who used two measurements only used the vertical and horizontal measurements, although using the length of the roof (eg, the hypotenuse of a right triangle formed by the vertical and horizontal measurements) could have been correctly used as well. Qualitative as well as numeric descriptions of the two dimensions were used.

Scaling The Scaling strategy was coded when participants said that one roof/staircase/line was a smaller or larger version of the other. Participants whose strategies were coded as Scaling often described an enlargement or shrinking. Because some of the slopes drawn were very close in value, it was sometimes difficult to determine whether one object was a smaller version of the other solely by visual inspection.

Norming The Norming strategy was coded when participants compared one measurement while holding another measurement constant. For example, a participant imagined that the two roofs to be compared were overlaid on top of each other, and concluded that at one particular horizontal distance, the left roof extends vertically higher than the right roof, the left roof must be steeper. When used correctly, Norming will always produce a correct response since its use is equivalent to the norming strategy used in proportional reasoning. Pictorially, norming by finding a common horizontal distance and comparing the vertical distances can be mathematically expressed as finding the common denominator of two slopes written as fractions and comparing the values of the numerators.

Ratio or rate The Ratio or Rate strategy was coded when participants indicated a proportion or rate. Some participants mentioned a numerical scale factor comparing two objects. When used correctly, the Ratio or Rate strategy will produce a correct response because slopes are being numerically compared.

The following table (Table 1) provides a summary of the strategies used, descriptions of these strategies, and some specific examples of their use.

Table 1. Descriptions and Examples of Coded Strategies.

Strategy	Description	Examples
Angles	Participant uses a visual comparison of angles, comparison to a benchmark angle or line, a comparison of two angles or parallel lines.	**Roofs:** A roof that is more level is less steep. **Staircases:** Stairs that look more straight are steeper. **Lines:** The line that is above the 45 degree line is steeper than the line underneath.
Other	Participant used a strategy not otherwise listed.	**Roofs:** One roof looks steeper. **Staircases:** When an auxiliary line is drawn, the stairs look the same steep. **Lines:** One line is "visually" steeper.
Irrelevant data	Participant takes into account information that does not need to be considered to solve the problem, or exclusively uses non-measured information that cannot be used exclusively to solve the problem correctly.	**Roofs:** The roof with a larger rectangular house base is steeper. **Staircases:** The stairs are equally steep because the angle of each stair corner is 90 degrees. **Lines:** One line would be easier to climb up.
Area	Participant compares area or space.	**Roofs:** The larger triangle formed by the two sides of the roof and the top of the rectangular house is steeper. **Lines:** A line with larger space underneath is steeper.
One Measurement	Participant compares only one measurement between objects, without mention or consideration of the other when it should be considered.	**Roofs:** The roof that is more vertical is steeper. **Staircases:** The higher stairs are steeper. **Lines:** The line with larger vertical length is steeper (without consideration of horizontal length).
Addition	Participant finds the difference between or within length measurements, and uses that to compare steepness.	**Staircases:** There is one square difference between two vertical lengths as well as one square difference between two horizontal lengths

		so the two objects are the same steep. **Lines:** Adding two onto the horizontal and vertical dimensions of a line creates a line that is equally steep.
Two measurements	Participant describes, finds or uses two lengths that need to be taken into account, but may not relate them additively or in a ratio.	**Roofs:** The roof that is wider and taller is steeper. **Staircases:** The stairs that have the same up-and-across are equally steep. **Lines:** The line that has larger area is steeper (where the triangles do not have one of the lengths held constant).
Scaling	Participant refers to an enlargement or shrinking of an object.	**Roofs:** One roof looks like a mini one of the other, so they are equally steep. **Staircases:** One staircase is a larger version of the other, so they are equally steep. **Lines:** One graph is a larger image than the other, so they are equally steep.
Norming	Participant holds one dimension constant while comparing the other, pictorially or numerically through length or area.	**Roofs:** If the horizontal length is held constant, a roof with a larger vertical length is steeper. **Staircases:** If two sets of staircases have the same vertical height, the one that takes up more horizontal space is steeper. **Lines:** The line with larger triangular area underneath is steeper if the horizontal base is the same.
Ratio or rate	Participant writes or says a representation indicating a ratio or proportion.	**Roofs:** One roof is double the other. **Staircases:** "[horizontal]4 units, 8 units, moving up 2 units, 1 unit… They're just half the size." **Lines:** One line goes up two units for each unit it goes across, and the other line goes up one unit for each unit across, so the taller one is steeper.

A total of 384 problems were coded, which came from 24 problems responded by each of the 16 interview participants. Reliability of the coding scheme was established by 97% agreement (or 75 of 77 codes) on 20% of the data (or 77 of 384 problems) coded between the researcher and another doctoral student in mathematics education. The first author coded the remaining 80% of the data.

One strategy code was assigned to each problem solution based upon the participant's final responses. Also, a record was kept of whether the initial and final responses of the participant were correct or incorrect. The correctness of the initial responses were used to compare interview participants' scores with those of the survey participants. The correctness of the final responses was used to compute success rates for the Two Measurements, Scaling, Norming, and Ratio or Rate strategies. The codes were aggregated by proportional reasoning levels. Charts were created that present the strategies used by participants of each proportional reasoning level, frequencies of correct and incorrect responses for each strategy for students in each proportional reasoning level, and success rates of some strategies by proportional reasoning levels.

RESULTS
Frequencies of strategies used by participants in each proportional reasoning level were determined and are reported in Figure 1. The use of the Angles strategy was omitted from this analysis since using a geometric way of comparing slopes is not a focus of this research question.
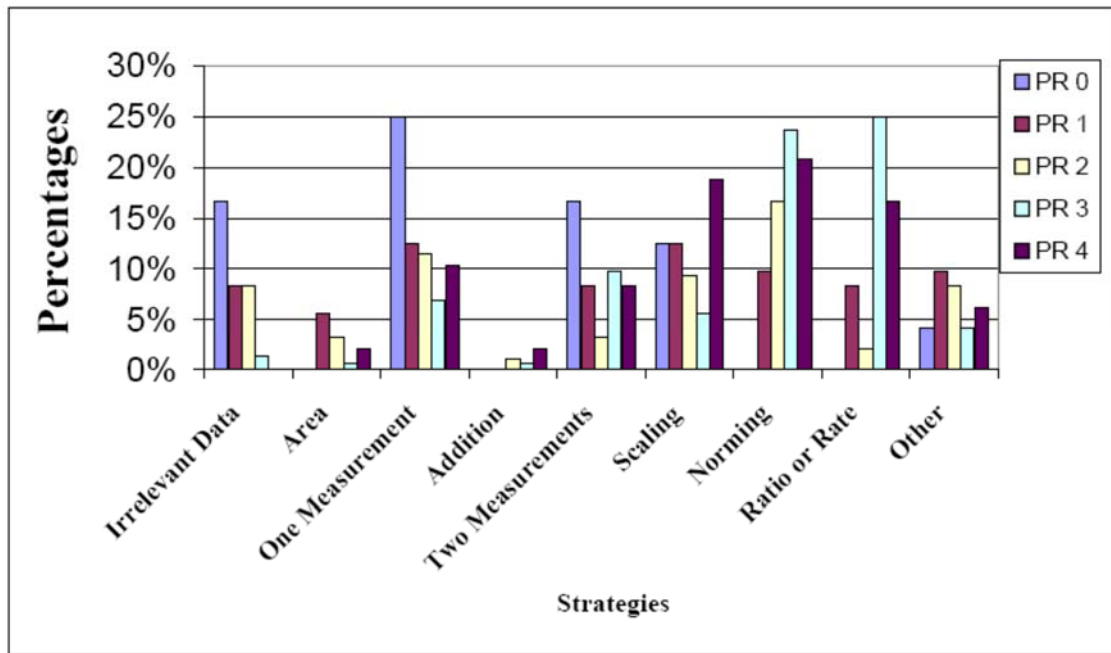
Figure 1. Participants' Solution Strategies by Proportional Reasoning Level.

From the interviews conducted, it appears that participants' strategies are somewhat related to their proportional reasoning levels. The participants who attained the higher proportional reasoning levels used the Norming and Ratio or Rate strategies more frequently, and the participants who attained the lower proportional reasoning levels used the Irrelevant Data, Area, and One Measurement strategies more frequently.

Four strategies used by interview participants involve some aspect of proportional reasoning: two measurements, scaling, norming, and ratio or rate. To investigate differences in performances using these strategies by participants in the five proportional reasoning levels, success rates were determined to indicate the percentage of correct responses yielded using each strategy. The success rates are presented in Table 2.

Table 2. Interview Participants' Success Rates for Four Strategies Most Related to Proportional Reasoning.

	Proportional Reasoning Levels				
Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Two Measurements	100%	50%	100%	90%	100%
Scaling	67%	67%	56%	60%	32%
Norming		70%	88%	88%	90%
Ratio or Rate		50%		76%	88%

The participants who attained the lower proportional reasoning levels had lower rates of success solving problems using Norming and Ratios or Rates, when these strategies were used. The Scaling strategy largely involved qualitative descriptions, and participants who attained the lower proportional reasoning levels had higher success rates solving these problems using Scaling. The Two Measurements strategy was used successfully for participants who attained Proportional Reasoning Levels 0, 2, 3, and 4, but participants who attained Proportional Reasoning Level 1 were only successful half of the time that they used this strategy.

To further investigate the relationship between participants' proportional reasoning levels and their solutions using the Two Measurements strategy, each of the problems coded as Two Measurements were also coded as qualitative or quantitative depending upon the type of descriptions that were given of the two measurements taken into account. While the Two Measurements strategy was used by research participants who attained proportional reasoning levels 0 through 4, the participants who attained higher proportional reasoning levels more often used quantitative descriptions of the two measurements, whereas participants who attained lower proportional reasoning levels more often used qualitative descriptions of the two measurements. The numbers of qualitative and quantitative descriptions for the Two Measurements strategy given by the participants in each of the proportional reasoning levels are shown below in Table 3.

Table 3.Interview Participants' Two Measurement Strategy Codes by Proportional Reasoning Level, Qualitative Description, and Quantitative Description.

Proportional Reasoning Levels	Qualitative Description	Quantitative Description	Total
PR 0	4	0	4
PR 1	6	0	6
PR 2	2	1	3
PR 3	6	8	14
PR 4	1	3	4
Total	19	12	31

According to Table 3, the participants who attained Proportional Reasoning Level 1 used only qualitative descriptions, and as Table 2 reported, half of these responses yielded incorrect responses. From Table 3, it was determined that the participants in who attained Proportional Reasoning Levels 3 and 4 used more quantitative descriptions than qualitative descriptions when they used the Two Measurements strategy, whereas participants who attained the Proportional Reasoning Levels 0, 1, and 2 used more qualitative descriptions than quantitative descriptions when they described the use of two measurements to compare steepness. Even though participants who attained Proportional Reasoning levels 0, 1, 3, and 4 had high success rates using the Two Measurements strategy (as shown in Table 2), Table 3 shows that participants who attained the higher proportional reasoning levels used more quantitative descriptions than participants who attained the lower proportional reasoning levels.

To examine the relationship between participants' proportional reasoning levels and the strategies they used on Steepness Test problems by context, percentages of Steepness Test strategies in each of the proportional reasoning levels were computed for each context. Table 4 shows the percentages of strategies used on the Steepness Test roof, staircase, and line problems.

Table 4. Interview Participants' Strategies by Proportional Reasoning Level and Steepness Test Context.

Staircase Problem Strategies	Proportional Reasoning Levels				
	PR 0	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data	37.5%	16.7%	12.5%	4.2%	
Area			6.3%		
One Measurement	50.0%	16.7%	12.5%	8.3%	25.0%
Addition			3.1%		6.3%
Two Measurements	12.5%	8.3%	3.1%	14.6%	12.5%
Scaling		8.3%	6.3%	4.2%	18.8%
Norming		4.2%	3.1%	14.6%	12.5%
Ratio or Rate		25.0%		35.4%	25.0%
Other		4.2%	21.9%	6.3%	

Roof Problem Strategies	Proportional Reasoning Levels				
	PR 0	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data		8.3%	9.4%		
Area				2.1%	6.3%
One Measurement	25.0%	8.3%	9.4%	4.2%	
Addition					
Two Measurements	37.5%	16.7%	6.3%	8.3%	6.3%
Scaling	25.0%	20.8%	18.8%	8.3%	37.5%
Norming		16.7%	21.9%	25.0%	18.8%
Ratio or Rate			3.1%	20.8%	12.5%
Other	12.5%	4.2%	3.1%		

Line Problem Strategies	Proportional Reasoning Levels				
	PR 0	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data	12.5%		3.1%		
Area		12.5%	12.5%	8.3%	6.3%
One Measurement				6.3%	6.3%
Addition				2.1%	
Two Measurements	12.5%	8.3%	3.1%	4.2%	
Scaling		8.3%	25.0%	31.3%	31.3%
Norming			3.1%	18.8%	12.5%
Ratio or Rate		16.7%	3.1%		
Other		20.8%		6.3%	18.8%

Table 4 shows the percentages of responses within each proportional reasoning level that participants used each type of strategy on the Steepness Test problems. On the staircase problems, 37.5% of the responses of the participant who attained Proportional Reasoning Level 0 used the irrelevant data strategy, whereas none of the participants who attained Proportional Reasoning Level 4 used the irrelevant data strategy on staircase problems. For roof problems, 37.5% of the responses by participants who attained Proportional Reasoning Level 4 used the scaling strategy, 18.8% used the norming strategy, and 12.5% used the ratios or rates strategy. In contrast, 25% of the responses by the participant who attained Proportional Reasoning Level 0 used the scaling strategy, whereas the norming and ratio strategies were not used at all to solve roof problems. Larger percentages of participants who attained Proportional Reasoning Levels 3 and 4 used the scaling and norming strategies on line problems than participants who attained Proportional Reasoning Levels 0, 1, and 2. Thus, more advanced strategies were used in each Steepness Test context by participants who attained higher levels of proportional reasoning.

To examine the relationship between participants' proportional reasoning levels and the strategies they used on Steepness Test problems by structural difficulty level, percentages of strategies used by participants who attained each of the five proportional reasoning levels were computed for each structural difficulty level. Table 5 shows the

percentages of strategies used by participants who attained Proportional Reasoning Levels 0, 1, 2, 3, and 4 to solve Steepness Test problems in structural difficulty levels 1, 2, 3, 4, 5, 6, 7, and 8.

Table 5. Interview Participants' Strategies by Proportional Reasoning Level and Steepness Structural Difficulty Level

	Proportional Reasoning Levels				
Level 1 Problem Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data		11.10%	8.30%		
Area					16.70%
One Measurement			33.30%	16.70%	50.00%
Addition					
Two Measurements	66.70%	22.20%	8.30%	16.70%	
Scaling					
Norming				5.60%	
Ratio or Rate				22.20%	
Other		22.20%		5.60%	16.70%

	Proportional Reasoning Levels				
Level 2 Problem Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data	33.30%	11.10%	8.30%		
Area					
One Measurement			25.00%	11.10%	16.70%
Addition					
Two Measurements	33.30%		8.30%	11.10%	
Scaling					
Norming		11.10%		22.20%	66.70%
Ratio or Rate	0.00%	11.10%		16.70%	
Other		22.20%	16.70%	5.60%	16.70%

	Proportional Reasoning Levels				
Level 3 Problem Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data	33.30%	11.10%	8.30%		
Area		33.30%		5.60%	16.70%
One Measurement	33.30%	11.10%		16.70%	16.70%
Addition					
Two Measurements					
Scaling			8.30%		16.70%
Norming		11.10%	33.30%	27.80%	16.70%
Ratio or Rate		11.10%		22.20%	
Other		11.10%	16.70%	5.60%	16.70%

Level 4 Problem Strategies	Proportional Reasoning Levels				
	PR 0	PR 1	PR 2	PR 3	PR 4
Irrelevant Data					
Area		11.10%			
One Measurement	33.30%	11.10%	8.30%	5.60%	
Addition					
Two Measurements		11.10%		16.70%	16.70%
Scaling	66.70%	33.30%	25.00%	22.20%	33.30%
Norming					16.70%
Ratio or Rate		11.10%		22.20%	16.70%
Other					

Level 5 Problem Strategies	Proportional Reasoning Levels				
	PR 0	PR 1	PR 2	PR 3	PR 4
Irrelevant Data	33.30%	11.10%	8.30%		
Area		11.10%			
One Measurement	66.70%		8.30%	5.60%	
Addition				5.60%	33.30%
Two Measurements				5.60%	
Scaling		33.30%	8.30%	5.60%	33.30%
Norming		11.10%	16.70%	27.80%	
Ratio or Rate		11.10%	16.70%	33.30%	33.30%
Other		11.10%	16.70%		

Level 6 Problem Strategies	Proportional Reasoning Levels				
	PR 0	PR 1	PR 2	PR 3	PR 4
Irrelevant Data		22.20%	16.70%	11.10%	
Area		11.10%			
One Measurement	66.70%	22.20%	16.70%	5.60%	
Addition			8.30%	5.60%	
Two Measurements	33.30%		25.00%	16.70%	16.70%
Scaling		11.10%	8.30%		16.70%
Norming		11.10%	16.70%	27.80%	
Ratio or Rate		11.10%		27.80%	50.00%
Other		11.10%	8.30%	5.60%	16.70%

	Proportional Reasoning Levels				
Level 7 Problem Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data					
Area		11.10%	16.70%	5.60%	
One Measurement	33.30%	22.20%		5.60%	
Addition		11.10%			
Two Measurements			8.30%		16.70%
Scaling		22.20%	16.70%	11.10%	33.30%
Norming			33.30%	38.90%	16.70%
Ratio or Rate		11.10%		22.20%	16.70%
Other	33.30%				

	Proportional Reasoning Levels				
Level 8 Problem Strategies	**PR 0**	**PR 1**	**PR 2**	**PR 3**	**PR 4**
Irrelevant Data	33.30%		16.70%		
Area			8.30%		
One Measurement		11.10%		5.60%	
Addition					
Two Measurements	33.30%	22.20%	16.70%		
Scaling	33.30%		8.30%	5.60%	16.70%
Norming		33.30%	33.30%	38.90%	50.00%
Ratio or Rate				27.80%	16.70%
Other		22.20%	8.30%	16.70%	

* Use of the angles strategy is not reported in these tables

On problems with structural difficulty levels 3 through 7, participants who attained Proportional Reasoning Level 0 used the one measurement strategy to solve problems much more frequently than participants who attained higher levels of proportional reasoning. To solve the problems in structural difficulty levels 4 through 8, participants who attained Proportional Reasoning Level 4 predominantly used the two measurements, scaling, norming, and ratio or rate strategies. In general, more advanced strategies were used to solve the problems with higher structural difficulty by the participants who attained higher levels of proportional reasoning.

In structural difficulty levels 4 and 5, the objects to be compared were similar, thus the use of scaling was appropriate. According to Table 5, scaling was also used by participants of all proportional reasoning levels to solve problems with structural difficulties of 7 and 8, and since the objects to be compared were not similar, incorrect responses were obtained. The differences between the angles formed by the objects in these two levels were 3.18 degrees and 1.4 degrees respectively, and visually these small angular distinctions may be difficult to make in the absence of using other measurements.

DISCUSSION
One result of this study is the observation that solution strategies used to solve steepness problems are similar to those used to solve proportional reasoning problems. In this study, there was evidence of the incorrect use of addition, which took place when participants looked at additive differences between two measurements instead of looking at multiplicative relationships between the two measurements. This error, using additive thinking to describe proportional relationships, is well documented in the literature on proportional reasoning (Hart, 1981; Lamon, 2007; Simon & Blume, 1994). In the present study, one participant used the addition strategy to incorrectly explain that two staircases have the same steepness because of a common difference of 1 between the vertical and horizontal lengths. However, the use of the additive approach was relatively infrequent – less than 1% of the problems were solved using this strategy. Perhaps participants are less likely to use additive reasoning on comparison problems than they are on missing value problems, or perhaps the context of the problem influences participants' choice of strategy. Another explanation for the infrequent use of additive reasoning could be that the contexts that were given on the Steepness Test did not encourage additive thinking. Additional research is needed to investigate the relationship between the application of additive solution strategies to comparison problems involving steepness.

In the present study, another common non-proportional strategy employed by participants was the one measurement strategy. Participants who attained lower proportional reasoning used the one measurement strategy more frequently than did participants who attained higher proportional reasoning levels. This may imply that participants who are less able to reason proportionally may need further instruction before they are able to take into account the two dimensions that are required for understanding steepness as a ratio.

Another error exhibited by participants in this study was the use of irrelevant data. Consistent with Lobato's (1996) findings when interviewing participants about ramps, participants in this study found a myriad of irrelevant data to consider while comparing the steepness of roofs, lines and stairs, including finding the area of the rectangular house underneath a roof, observing that each stair was formed by a 90 degree angle, and using the number of steps in the staircase to describe steepness. This finding shows that in order to understand steepness, participants need to understand what characteristics of objects needed to be measured in order to determine steepness. The use of irrelevant data decreased as proportional reasoning levels increased. Participants who attained proportional reasoning level 4 did not exhibit the use of irrelevant data. Future research could see whether instruction in proportional reasoning affects participants' abilities to attend to relevant data when solving steepness problems.

Some of the proportional strategies that participants used to solve Steepness Test problems are similar to strategies often used to solve missing value proportional reasoning problems. The norming strategy was used on approximately 17% of the problems. Norming to solve comparison proportional problems has been described by Lamon (2007) as fixing one quantity in a proportional reasoning problem so that the other quantity could be compared independently of other quantities. On steepness problems, norming involves pictorially holding constant one dimension, either vertical or horizontal, and comparing the other dimension alone. For example, some participants superimposed one roof on top of another and compared vertical heights at the same horizontal distance to determine the steeper roof. The norming strategy is classified as a more advanced strategy than simply using one measurement. By holding one measurement constant, participants who used the norming strategy demonstrated understanding that it is necessary to consider both the vertical and horizontal dimensions. Participants who attained Proportional Reasoning Levels 3 and 4 used the norming strategy much more frequently than participants who attained Proportional Reasoning Levels 1 and 2. Future research could investigate whether being able to norm using proportions as well in physical situations leads to increased understanding of functional situations that could involve norming.

The scaling strategy involved a qualitative description that one object was an enlarged version of the other, or that one object was a smaller version of the other. The scaling strategy was relevant only for problems with structural difficulty levels 4 and 5, whose objects were similar to each other. As reported in Table 5, the scaling strategy was used by participants of all proportional reasoning levels on some of the Steepness Test problems in structural difficulty levels 6, 7, and 8. Success using the scaling strategy to solve steepness problems ranged from 32% to 67%, indicating that this strategy was not well understood or implemented. Future research could involve interviews during which participants who start using the scaling strategy are prompted to provide quantitative justifications for their qualitative observations, to gain a better understanding of what participants determine to be a measure of steepness.

In this study, participants who attained higher proportional reasoning levels identified ratios or rates such as scale factors more frequently than participants who attained lower levels of proportional reasoning. An example of a Proportional Reasoning Level 4 interview participant's use of a rate on Steepness Test line problems is a participant's labeling the axes distance and time, and then comparing speeds. The participant applied knowledge about distance-rate-time graphs that she learned from science class to steepness problems. The ratio or rate strategy was used by participants who attained Proportional Reasoning Level 1 at a success rate of 50%, indicating that these participants did not have a reliable way of implementing this strategy. Proportional Reasoning Levels 3 and 4 participants used the ratio or rate strategy more often than other participants, and were able to attain success rates of over 75% using this strategy. A future study could investigate students' understanding of the procedures involved in solving proportional reasoning problems and their abilities to apply this knowledge.

Another finding of this study is that there is a relationship between participants' proportional reasoning abilities and the strategies that they employ to solve steepness problems. In this study, participants with lower proportional reasoning abilities used non-proportional strategies more often, and participants with higher proportional reasoning abilities used more proportional strategies more frequently to solve steepness problems. Participants who attained higher levels of proportional reasoning also tended to have higher success rates on solving the problems using advanced strategies and tended to use more quantitative data to support their claims. It was also determined that participants who attained higher levels of proportional reasoning tended to use more advanced strategies to solve steepness problems by context and by structural difficulty level. Possible explanations for participants' differing performances on the Steepness Test contexts and structural difficulty levels will be offered in light of the results of other research studies that have been conducted. The strategies which the participants used to solve Steepness Test problems are discussed.

Several research studies show that the ability to reason proportionally is highly dependent upon context, and that some tasks facilitate students' reasoning proportionally more than others (Chletsos, De Lisi, & Turner, 1989; Tourniaire & Pulos, 1985). Researchers have also found that students' familiarity with contexts tends to help them solve proportional reasoning problems (Bright, Joyner, & Wallis, 2003). However, there is a dearth of literature that investigates students'

abilities to reason about steepness in various contexts. Results of this study reveal that participants whose proportional reasoning abilities were higher used the two measurements, scaling, norming, and ratio/rate strategies to solve steepness problems more often than participants with lower proportional reasoning abilities. Thus, reasoning about steepness was dependent upon context and proportional reasoning abilities.

Students' familiarity with contexts may guide them to pay attention to relevant data from visual pictures. On roof and staircase problems, participants may have been unclear as to what physical features to look for in determining relative steepness. Based on the interview study, it was seen that some survey participants with lower proportional reasoning abilities compared the areas underneath the roofs or drew an incorrect auxiliary line for the staircases. Mitchelmore and White (2000) hypothesized that the sloping edges of a hill depicted in their diagrams helped their grades 2-8 research participants identify similarities between the hill and a standard angle. A similar effect may have taken place in the present study. The staircase problems did not explicitly contain lines whose steepness could be compared, whereas the roof and line problems did contain lines whose steepness could be directly compared. Additionally, roof problems contained more lines than necessary (e.g., the rectangular houses underneath the roofs) whereas the line problems only depicted relevant lines. The extra lines on the roof drawings confused some of the interview participants with lower proportional reasoning abilities and they unsuccessfully used the irrelevant data strategy in their solutions. Perhaps in the development of proportional reasoning abilities, students gradually become accustomed to sorting out relevant from irrelevant data.

In addition to an investigation of participants' performances on context, an investigation of participants' performance on structural difficulty levels was conducted. In studies that investigated the cognitive demands for solving tasks of various structural difficulties, researchers have found that taking into account four quantities simultaneously, which is required for proportional reasoning, is cognitively more complex than only taking into account one quantity (Halford, Andrews, Dalton, Boag, & Zielinski, 2002; Siegler, 1976). The findings of the present study are consistent with the findings of research on relational complexity. During interviews, the one measurement strategy was appropriately used by participants who attained Proportional Reasoning Levels 2, 3, and 4 to solve Steepness Test Level 2 problems, but this strategy was used heavily by the participants who attained Proportional Reasoning Levels 0 and 1 on other steepness problems for which taking into account only one measurement would not suffice.

Another finding that is consistent with relational complexity theory is that approximately 26% of the strategies used to solve Steepness Test problems by the interview participants were coded as the angle strategy. Since the angle is one quantity that can be considered alone to determine relative steepness, participants may have resorted to that comparison even when a visual comparison of angles may have been difficult, since the differences between the angle measures decreased as structural difficulties increased. This result suggests that participants may have had an easier time comparing one quantity rather than two. An extension of this study could explore other factors which might contribute to students' success on steepness problems, including students' intuitions about angles.

Prior to this study, no investigations were conducted to determine whether a relationship existed between participants' proportional reasoning abilities and their abilities to solve steepness problems. Streefland (1985) notes that the ability to reason proportionally can help students to solve problems in a variety of domains, such as physics (e.g., density, pressure), chemistry (e.g., concentrations), and biology (e.g., cross section of muscles and forces exerted). In a related study, Fischbein, Pampu, and Manzat (1970) also found that the ability to reason proportionally helps participants to solve problems in other domains. Fischbein and his research team taught 9 and 10 year old research participants how to compare ratios, and they were able to apply this knowledge to solve problems involving probabilities and chance.

This study suggests that in order for proportionality to be successfully used in slope work, it may be necessary for students to have a strong ability to reason proportionally, understand proportionality's relevance in solving steepness problems, and be able to correctly coordinate relevant data. This study also suggests that there may be a developmental progression in the use of strategies to solve steepness problems that can be influenced by proportional reasoning abilities. The interview study included at most six participants who attained each proportional reasoning level. Further study with a larger sample size is necessary, however, before further generalizations can be made about participants' solution strategies on steepness problems based upon their proportional reasoning levels.

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SOCIAL FOUNDATIONS OF EDUCATION AND TEACHER EFFICACY

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Abstract
There are no studies of efficacy that examine the political context affecting teachers hence this article asks: how can the study of efficacy be expanded to include the contingencies new teachers face and how can education foundation courses include the context new teachers need to reach high levels of efficacy? By focusing on teacher roles, expectations, and social relations, efficacy can become the new framework for education foundations. Teacher preparation will then refocus on social foundations and address the current needs of teachers, schools and society.

Introduction

There are many reasons for teacher educators to be focused on efficacy. Efficacy is linked to student achievement. Teachers with a high level of efficacy feel a sense of responsibility for student achievement (Hoy, 2000). There are researchers who assert that no other characteristic is as highly correlated to student achievement as teacher self-efficacy (Ashton, Buhr, & Crocker, 1984, p. 28). Most important is that efficacy impacts motivation and performance. In studies of efficacy, teachers with a high level of efficacy believed they could control, or at least strongly influence student learning and motivation (Tschannen-Moran, Hoy, & Hoy, 1998). Beyond the student aspect, research demonstrates that percieved levels of efficacy are central to teacher effectiveness, attrition rates, and job satisfaction.

Prior surveys found that subtle variations in pre-service teacher preparation significantly impact teachers' perceived ability to maintain a high level of teaching efficacy. So what exactly is teacher efficacy? There is debate in the psychological community over whether or not efficacy is a trait, and debate over the extent to which efficacy can be accurately measured. This study sets these questions aside. It addresses the larger issues complicating teacher efficacy research, focusing on the impact of context. For example, how efficacy needs to be refined to capture more aspects of teachers' self-efficacy.

Although a significant number of studies have examined the relation between external contingencies and perceived levels of efficacy, there are no studies that examine the political context affecting the teaching profession. Aspiring teachers have extensive preperation on how to teach, but their access to knowledge and ability to contemplate the issues facing teachers is limited. In other words, they are prepared to address their student's needs, but not their own. Teacher efficacy needs to include the impact of contemporary political policies affecting teachers.

Background

Studies on efficacy originated in the 1970s (Tschannen-Moran et al., 1998). Specifically, teacher efficacy was first discussed as a concept when the following two items were included in studies conducted by researchers at the Rand Corp: *"When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment."* And *"If I try really hard, I can get through to even the most difficult or unmotivated students."* (Rand study cited in Hoy, 2000).

Since the Rand study, contemporary researchers have formulated more extensive surveys of efficacy. Early studies defined the concept of efficacy as a teacher's perception of his/her capacity to influence how well students learn. In more recent times the conception has shifted to the notion of how well teachers can affect teaching. Teacher efficacy is often understood as a teacher's confidence in their ability to promote students' learning (Hoy, 2000). Self-efficacy is often defined as teacher perception of their capacity to influence how well students learn, but some authors argue it needs to be conceived as how well teachers can affect teaching (Tschannen-Moran et al., 1998). Others define efficacy as a teacher's perception of their influence on "how well students learn" (Dimopoulou, 2012).

This contemporary foundation for self-efficacy is situated in social cognitive theory developed by Albert Bandura. The theoretical framework for understanding the role of teacher efficacy grew out of the work of Bandura, identifying teacher efficacy as a type of self-efficacy--or cognitive process in which people construct beliefs about their capacity to

perform at a given level of attainment. For Bandura self-efficacy is a cognitive process, in which we construct beliefs about effort, persistence, resilience, and stress. Bandura defined perceived self-efficacy as "*people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves, and behave*" (Alfred Bandura, 1994, p. 1). For Bandura self-efficacy is a belief in one's capabilities to organize and execute the courses of action required to produce expected attainments.

Self-efficacy is different from conceptions of self-worth, self-concept, and self-esteem. In short, efficacy is not an evaluation of self. Though efficacy is detached from our self-conception, very competent people do not feel efficacious because they have high standards for completing a task. It is about the capability to complete a task, and efficacy allows us to perform without worrying about our sense of worth being affected by the outcome, such as when young children are learning to walk. Teachers able to separate the myriad tasks of teaching from their personal self-worth will experience less stress and be able to maintain higher levels of efficacy throughout their careers.

Bandura's work suggests belief in our ability to alter our behavior affects our motivation and ultimately our success or failure. His social cognitive theory emphasizes human agency within a multi-directional model where our capacity to positively impact our situation influences our thoughts and behaviors. Beliefs about our capacity to positively impact our situation influence how much effort we put forth, how long we will persist in the face of obstacles, our resilience in dealing with failures, and how much stress or depression we experience in coping with demanding situations (Albert Bandura, 1997). It is these demanding situations, the contingencies of modern teaching, which are not fully addressed in studies of efficacy.

Efficacy research is one of the few areas in social psychology that differentiates between perceptions of competence and contingency. Contingencies are external factors influencing teacher effectiveness. Examples of changing factors impacting teachers are: student demographics, parent engagement, teacher support systems, and the public perception of the teaching profession. Specifically, this changing professional climate includes merit pay based on state mandated testing, a law that limits collective bargaining rights, and new policies for evaluation and teacher tenure. These external factors profoundly affect teachers, especially those new to the profession. All the previous studies of efficacy have centered on the percieved capacity to impact student success and did not address teacher needs. Therefore this study completed survey research examining how educational foundations coursework addresses efficacy. This study specifically asks: how can the study of efficacy be expanded to include the contingencies new teachers face and how can education foundation courses include the context new teachers need to reach high levels of efficacy?

External Factors Affecting Teaching

Contingencies are external factors influencing teacher effectiveness. In the research these are primarily focused on teachers in low-income areas affected by parent engagement. Because of such factors, future studies of efficacy should consider the changing political climate facing teachers today. Teachers can also benefit by learning from each other how roles have evolved, especially through the lens of efficacy. Multiple studies suggest that self-efficacy can be positively affected by vicarious experiences. Therefore, learning about successful political reform movements led by teachers in the context of educational foundations classes would have a positive impact. Studies of efficacy should reflect how today's testing movement, the standards and accountability movement, merit pay, the attack on teacher organization, and other factors impact the teaching profession in unprecedented ways.

It stands to reason that policies, such as evaluating teachers on the basis of standardized tests, affect perceived levels of personal efficacy, and those policies that limit teacher autonomy impact levels of self-efficacy. In addition, self-efficacy is presumed to decrease if teachers believe factors external to teaching are more important to the students learning than the influence that a teacher might have. In other words, external control impacts perceived levels of personal efficacy.

Researchers believe that efficacy is specific to a given context, and an important aspect is what's known as the 'teacher locus of control' (Knoblauch & Hoy, 2008). This means the extent to which teachers believe they have control over their profession. Efficacy is contingent on the roles, expectations, and social relations facing teachers. This occurs to the extent that the environment affects teachers' levels of efficacy.

There is an element of reinforcement in a teacher self-efficacy; specifically, whether or not one perceives control of reinforcement as residing internally or externally. Feelings of autonomy, actually predicted teacher self-efficacy positively (Skaalvik & Skaalvik, 2010, p. 1064). Though, as discussed, outside factors greatly affect efficacy and teachers rarely perform in autonomy. There is also a cycle of reinforcement. The teacher reinforces student learning, and student learning reinforces teacher behavior and motivation (Tschannen-Moran & Hoy, 2007; Tschannen-Moran et

al., 1998). Teachers with a high level of efficacy believe they can control, or at least strongly influence student learning and motivation.

Teachers weigh their perception of self-efficacy in the light of assumed requirements and anticipated tasks. Teacher standards affect efficacy, creating one example of collective efficacy (Tschannen-Moran et al., 1998, p. 20). Collective efficacy in terms of teacher autonomy, most strongly relates to supervisory support. Subsequently, positive school administrators and positive teachers tend to influence others. The notion of collective efficacy has been examined in various studies. Collective efficacy means shared perceptions of teacher impact are in one sense contagious. A low sense of teacher efficacy can be contagious. The few available studies on efficacy suggest a moderate positive relation between perceived collective self-efficacy and individual teacher self-efficacy (Skaalvik & Skaalvik, 2010). The real question becomes how to prepare new teachers to face the contingencies and create a high level of collective efficacy. Refocused education foundation courses can do just that.

Refining Education Foundation Courses

Kathleen deMarrais writes, 'there is a sense within the field that our work is slipping away from us, pushing social foundations faculty further to the margins of teacher education' (Hytten, 2007, p. 278). By focusing on efficacy through the social and political context impacting teachers' educational development could refine the focus that is needed. Many researchers in educational foundations note the challenge in defining the field of study. Dan Butin, for example asks, *'is it a curricular emphasis? A theoretical orientation?* (Hytten, 2007, p. 278). Because of this vagueness, educational foundations is often conflated with fundamentals and then can turn into an introduction to teaching course (Hytten, 2007). Instead, courses should focus on efficacy as studies show that efficacy is most malleable during the early years of a prospective teacher's career. Efficacy is linked to student teaching and early career success. Teacher education programs, therefore, affect an individual's sense of efficacy.

Aspiring teachers with higher efficacy, are more likely to question the behavior of supervising teacher (Hoy, 2000, p. 5). This is especially important as institutions can shape personnel through a variety of mechanisms designed to make the person conform to the values of the organization (Hoy, p. 4.). Lortie notes that early teacher socialization occurs through the internalization of teaching models; this socialization occurs during the years a prospective teacher spends as a student (2002). Socialization to professional norms and values continues during college preparation. This socialization to the profession, when aspiring teachers enter the actual world of teaching, will often evoke an experience of shock (Hoy, p. 4: plus 3 other studies cited). The shock occurs when organizational norms and values are out of line with what professors from teacher education programs espouse. Education foundations need to directly address how teachers can navigate socialization and identify the opportunities they have within the different organizations. Efficacy beliefs help to determine how environmental opportunities and impediments are perceived (Albert Bandura, 1997). This greatly affects how teachers are able to form their careers and continue teaching under difficult contingencies.

Studies indicate that efficacy will rise during teacher preparation, but fall with actual experience as a teacher (Hoy, 2000, p. 16). If educational foundations courses show teachers how to face the external factors then teachers can maintain higher levels of efficacy throughout their careers. Efficacy has been strongly linked to teacher burnout (Skaalvik & Skaalvik, 2010). Increased levels of efficacy have led aspiring teachers to indicate optimism over whether they would remain in the field of teaching. Retaining quality teachers and fostering professional careers is the end result of education foundation courses focused on efficacy.

The Study

The objective of this study is to understand how current educational foundation coursework and classroom structure can prepare teachers to evaluate and engage in issues relevant to their chosen profession.

The students have not yet begun their required educational foundations course focusing on the complex relationships between schools and society through sociology, history, and philosophy of education. The students surveyed are in their junior or senior year. Most have completed practicums, but have limited experience teaching.

The intention of this study is research on preparing future teachers. Baseline data was collected at the beginning of the semester through online scaled-questioner surveys. The study utilized qualtrics survey software distributed via an online campus email system. The survey consisted of multiple questions on a likert scale. Items on the survey are rated on a 1-to-5 response scale. Items were created according to an understanding of the subject matter. Surveys were administered prior to the beginning of the semester. Participants were prompted to to complete the online survey at the beginning of the semester. A secure website was used to minimize or eliminate transmission of confidential data.

Discussion of Results

Students expressed concern over future policies affecting their chosen profession. Regarding the question *"To what extent are you concerned about the effect of current policies on teaching?"* 74% of students responded 'Quite a Bit' or "A Great Deal." Only 26% of the respondents answered "some", and none of the students answered 'nothing' or 'very little'. This means all of the respondents felt current policies affecting teachers concerned them, and an overwhelming majority indicated significant concern. The graphic below depicts the response to the question above.
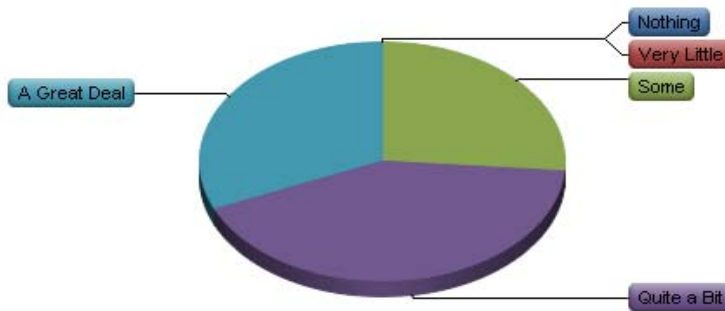
Regarding the question, *"To what extent do external issues and policies impact the teaching profession?*   63% of students felt external issues and policies impact the teaching profession quite a bit. In addition, 37% felt external issues and policies impact the teaching profession a great deal. The graphic below depicts these responses.
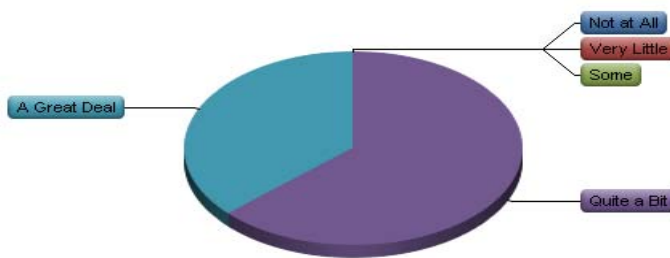
Perhaps the most significant finding came with the next question, "*To what extent can you impact education policy*?" The majority of students, 74%, answered very little or some. This means although a majority of students feel external policies will greatly impact their teaching capacity, and job satisfaction, very few students feel able to affect those policies. Furthermore, students were asked to what extent previous courses prepared them to understand the social issues and policies impacting education. The following is a representation of the responses:

A Great Deal   Not at All

Quite a Bit

Very Little

Some
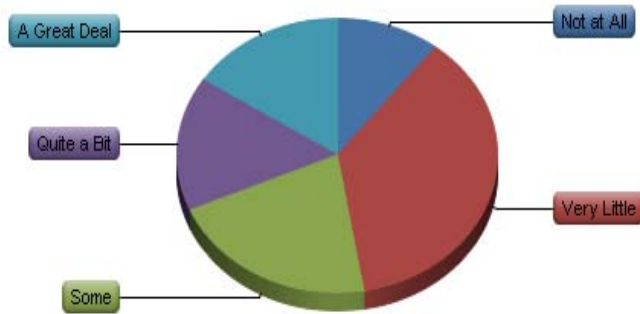
The answers to this question are revealing. The graphic above indicates while most students recognize that policies affecting education would dramatically impact their career, most feel unprepared by previous course work to understand these issues.

Students were asked, *"How well informed do you feel to make informed decisions about current education policy?"* 5% listed not at all, 16% indicated very little, while 21% indicated some, and 47% of students indicated quite a bit. Only 11% of students indicated a great deal. The graphic below depicts these responses.

A Great Deal   Not at All
Very Little
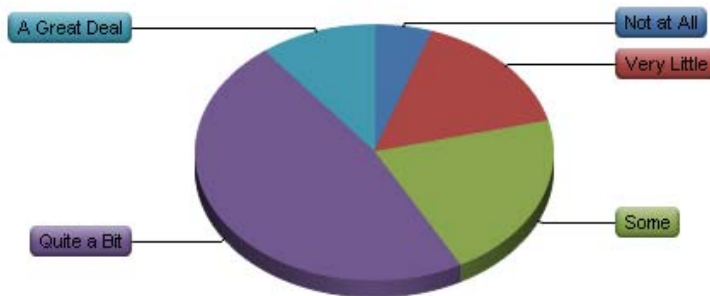
Quite a Bit

Some

Regarding educational foundations coursework, students were asked, to what extent they felt these courses covered topics relevant to their job as a teacher. 42% stated some, 26% indicated quite a bit, and 32% indicated a great deal. This clearly supports the idea that educational foundation coursework needs to be reworked to address the new contingencies affecting the teaching profession.

When asked the question, *"to what extent do teachers impact our society?"* 32% of respondents felt teachers in general have an impact on the larger society. 68% felt teachers have a great deal of influence over society. Respondents were also asked, *"To what extent is it important for teachers to understand policies impacting education, and to be politically active?"* 16% indicated some, 42% indicated quite a bit, and another 42% indicated a great deal. Therefore, educational foundation courses need to include information on new policies, understand the dynamics of social factors and show ways for teachers to engage in current issues.

Student Responses

In addition to survey data, anecdotal data was gathered. This information conveyed students concerns about the political context of teaching. A number of students wrote similar statements to this: *"I am very concerend [about current policies impacting teaching] because teaching is not only my future career, but also one of my passions."* In addition,

student responses indicated pessimism regarding their potential in influencing the political context of teaching. One student wrote, *I don't think I'll be influenceing policymakers, so not very much. I'm not informed enough.*

The more informed students were, the more they felt the potential to influence the political context of their chosen profession. The following exchange is emblematic of students who felt more informed. When asked if they felt informed regarding contemporary issues impacting the teaching profession one student wrote, "*Very much so. I've been to hear Glenda Ritz speak twice, watched all those "Waiting for Superman-esque" movies, and I keep up on many of the political aspects of education.*" Regarding the potential for teachers to influence change this student stated the following, "*I think it starts in your classroom. Grassroots policy change is what makes the whole yard grow. I can change my classroom and hopefully, my classroom can influence the yard.*" Having accessed examples of teachers affecting the political context, students were more apt to believe they could do the same.

The anecdotal evidence in the study indicates the more informed students are, the more likely they feel empowered to affect change. In other words, the more students understand the contemporary political context, the more potential self-efficacy they feel in relation to this context.

Conclusion

The pool of students surveyed was too small to make widespread conclusions. Future studies need to examine how educational foundations coursework prepares teachers to evaluate and engage in relevant issues. There are limited qualitative assessments of self-efficacy, and these have focused on the roles, expectations, and social relations. Therefore, qualitative studies of teacher efficacy in relation to educational foundations would be most fruitful.

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SOCIAL STUDIES FROM A HOLISTIC PERSPECTIVE: A THEORETICAL AND PRACTICAL DISCUSSION

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ABSTRACT
This collaborative paper describes holistic education models and explores the implications of such models for secondary Social Studies practice in Canada and New Zealand. After describing a number of features of holistic models, including attention to self-esteem, emotions, relationships and spirituality, models by Forbes, Rousseau, Robinson, and Integralism are discussed. The authors then present examples of holistic teaching practices that can be used in secondary Social Studies classrooms. After which, a review of the context and history of New Zealand sets the scene for a detailed case study exploration of the nation's new Social Studies curriculum, which is framed within holistic practice principles. The examples illustrate how holistic models focus on student learning, growth, and engagement in the classroom and promote the general well being of all students. Teachers are able to meet curriculum standards and expectations while at the same time enhancing the learning environment of all their students in a beneficial manner.

Key Words: Social Studies, Holistic Models, Student Engagement

INTRODUCTION
Some Western discourses have split individuals' minds from their emotions, spirits, bodies, and natural environments, fragmenting humans' wholeness with themselves and their communities, with damaging consequences for these individuals and society in general. This split has connections to past Western, ideological movements such as the Scientific Revolution and Greek Rationalist Philosophy. Descartes' work, for example, helped to sever humans' intricate and complex relationship to nature as he argued for rational thinking as a means of managing and controlling the mind, and by extension, nature (Merchant, 1981). Such an attitude gave pre-eminence to the conscious, logical mind, rather than other ways of knowing and being (Belenky et al., 1986; MacIntyre, 1998; Popkewitz, 2010). Plato, similarly, argued that humans were composed of three natures (body—spirit—and mind), with the highest being the mind (Broom, 2011). An "educated" person, in Plato's view, was one who managed to overcome humans' "baser" natures through logical and rational thinking.

Traditionally, Social Studies has been dominated by these rationalized, fragmented approaches, emphasizing factual knowledge and critical thinking processes (in the mind) in a manner that can negatively affect student learning and engagement. This paper begins by describing some holistic models of practice that draw on present and past traditions and cut across cultural traditions. It then explores the implications of using these models for Social Studies teaching and learning. Holistic models aim to integrate mind, body, emotions, and spirit in learning and schools (Miller, 2007). They value the importance of logical skills and thinking processes but meld these with an expanded awareness and respect for the multiple elements of which we are composed, and which connect us to others.

KEY FEATURES OF HOLISTIC MODELS
Holistic models, found in Western and Non Western traditions, understand people to be composed of a number of interacting parts that are found both within (mind, body, heart, and spirit) and outside (social/cultural and environmental relations) of us. The goal is integrated growth. The ancient practice of Ayurveda (Collinge, 1996), for example, aims at harmony between individuals' natural makeup and their environment, life, and work. Some key components of holistic models are:

SELF ESTEEM
Imagine a house build on a faulty foundation. No matter how beautiful the house is, or its unique features or the effort put into maintaining it, the house will crumble from within, eventually. Thus it is with our self-esteem -- how we feel and understand ourselves -- if it is low. It is the foundation of our actions, beliefs, and interactions with others. Our self-esteem influences how we view our intelligence, abilities and appearance, how we perceive the events that happen to us and how we act. Our self-esteem is rooted in our childhood and significant life experiences. Positive self-esteem fosters empowerment through building belief in the possibility and efficacy of individual action.

HEALTHY RELATIONSHIPS

Having positive relationships is vital to creating conditions in which we can flourish, or actualize, ourselves. Components of healthy relationships include feeling respected and safe, feeling positive emotions, being in an enabling environment that allows you to grow, feeling understood and supported in your activities and goals, feeling you can be yourself, and being responsible for yourself (Bancroft & Patrissi, 2011). Features of unhealthy relationships include unrealistic expectations, lack of trust, attempting to manipulate or control others, lack of common goals, poor communication, and lying, cheating or misrepresenting. These can foster toxic environments that lead to unhappiness, poor behaviour, and disengagement (Pawlik-Kienlen, 2008).

EMOTIONAL HEALTH/INTELLIGENCE

Emotional health involves the ability to recognize our feelings and manage them effectively. Feelings reflect the confluence of how we process a number of internal and external factors, such as, our self-esteem, philosophy, and life events. Emotions play an important role in creating our perceived reality (Cherry, 2013). Emotional health is illustrated when we have purpose, resilience, and self-efficacy. We frame our reality in a constructive way, manage the good and bad in our lives, and recognize what we can and cannot control (Smith et al., 2013).

SPIRITUALITY

Another component of holistic models is the spirit. Spirituality encompasses individuals' values, morals, life purposes and connections to and between themselves, others, and places. Including it in education is a "missing link" between traditional Western and native educational systems (Doige, 1997). Spirituality engages students in exploring the connections between their experiences and thoughts and other people, societies, and natures (Doige, 1997). It highlights and extends individuals' understanding of their own identities as well as of morality, action, purpose and (in many traditional cultures) the unity and interconnectedness of living creatures (Cajete, 2002).

CONTINUOUS INTERACTION AND GROWTH

Many holistic approaches value productive connections between the multiple, interacting parts of which individuals are composed and our interior and exterior worlds for full health, or flourishing (Broom, 2011). Personal growth (that is education) can occur through holistic practice. Forbes (2003) philosophically discusses holistic education using the concept of *ultimacy*, which is acting towards the highest form of human potential or development, such as love and compassion. This paper will review three holisitic models as they apply to education: Rousseau, Robinson and Integralist thought and then present a case study discussion of New Zealand's new Social Studies curricula, as an example of the effort to connect Social Studies to holistic practice.

THREE HOLISTIC EDUCATIONAL MODELS

ROUSSEAU

Rousseau (1712-78) presented a personalized, holistic educational scheme in *Emile* (1979) focused on how to educate boys (he had another program for girls). It stressed "wholeness" (Doyle and Smith, 2007) and was framed around nature, arguing that education ought to harmonize with the child's natural physical development, for the student "must remain in absolute ignorance of ideas of that estate which are not within his reach" (Rousseau, 1979, p. 178). The curriculum would develop his body, mind, emotions, and spirit (values/moral code).

Education began with the physical body. When a baby, the guardian developed the child's senses and self control. For a child up to the age of 12 in the "age of nature," the teacher focused on his physical development through games and protected him from error, society and the development of bad habits.

From the ages of 12 to 15, as the child began to think, the guardian provided the nurturing conditions that developed the student's mind through experimental science and his ability to be self-governing through reading, in particular, *Robinson Crusoe*. The student also developed technical skills and independence through learning a trade. Once the young man had developed his mind and reasoning ability, education of the spirit was to occur from the ages of 16 to 20. The guardian nurtured the student's moral and affective domains by taking him into society. Firstly, he should be taken to see the poor in order to develop compassion. Then, he should be introduced to corrupt city life and be guided through it in order to develop good taste, literature, and religion. Finally, as a young adult of twenty, his emotions and values were to mature through experiencing love and studying politics. The educational program was to end with travel, which allowed the young man him to experientially understand the world and to understand his place in it.

Rousseau believed that individuals' development is a function of individuals' interaction with the social, cultural, and physical environments that surround them (Dewey, 1916; Rousseau, 1979). Humans, in other words, are culturally and socially formed.

Developing the "best" educational program for children encompasses identifying what type of society is aimed at, what is valued, and what is considered to be human and societal "flourishing" (Broom, 2011). It also involves considering what structural systems best support such an education. For Rousseau, the aim of education was the creation of the "good" man, understood as the moral, empathetic being, developed in body, mind, and spirit. As the curriculum would be based on the student and individualized, Rousseau's educational program implied a significant valuation of the child.

Today's public schools with their large numbers of students, standardized curricula and assessments, and institutionalized structures are far from Rousseau's conception of a holistic and personalized education. However, Robinson applies some concepts similar to those of Rousseau to schools, with the hope of enriching education for students.

ROBINSON
Robinson (2011) values each student's unique potential and students' diverse intelligences and abilities. He argues against broad categorizations of students and for personalized education as a way to manage high levels of student disengagement. Education is understood as a relationship between teacher and student. It leads students to understand themselves and their strengths and talents and aims to prepare them for their lives and to address the major challenges threatening humanity today. Robinson argues that schooling today, based on standardization and efficiency, evolved from European Enlightenment thought which divided the mind (reason) from the heart (intuition and feeling). Enlightenment philosophy valued rational, logical thought and encompassed a narrow view of consciousness. It can lead teachers to "disembody" their students and to view them only as minds to be filled with knowledge, rather than as physically embodied beings influenced by their emotions and environments.

Robinson recommends a multidisciplinary and multigenerational school model that integrates mind, heart, and body. The metaphor of education is organic, not mechanistic. The Arts should be included as they engage the heart and develop creativity and imagination. Activities should be provided that allow students to delve into their own private consciousness, to understand themselves and the way in which they conceptualize and live in our physical world. This process aims to nurture self-understanding and emotional intelligence and students' consciousness of life and themselves.

INTEGRALISM
Like Rousseau and Robinson, Sorokin (2006) acknowledges the importance of emotions to individual and social health and argues that love and compassion are essential for growth. His thought links to Wilber's (1995) holistic framework. Wilber views individuals to be composed of both individual and socially/culturally constructed elements that are intricately connected within and to our external environments. These elements are usually graphically represented in four quadrants. The individual is reflected in the top two quadrants. The top, left quadrant represents the individual's interior, their subjective self-consciousness (Esbjörn-Hargers, 2006). The quadrant to the right represents the individual's exterior self, their behaviour. The lower left quadrant is the socialized, cultural and collective consciousness, and the lower left quadrant represents social systems and the environment external to the individual. The model incorporates both individual and social/cultural elements and considers their relations. The model can foster individual "transformative learning" or growth through reflection on one's self and one's cultural environment, which can lead to changed behaviour (Mezirow, 1997).

In summary, the holistic models described view students to be composed of various parts, including mind, body, heart, and spirit, that are in dynamic interaction with each other and with individuals' external social and natural environments. They have implications for educational aims and processes. Rousseau and Robinson, for example, argue for a personalized and individualized approach. Applied to Social Studies today, a lesson would involve students in conducting individual research projects on topics of personal interest. The teacher would visit students individually as they conduct research and provide them with individualized care tailored to their needs and abilities. Further, the teacher would be attuned to the importance of nurturing caring relationships and of creating positive environments. For Robinson, cross-disciplinary, Arts-based, and reflective activities would be included in the curriculum in order to foster mindfulness and engagement. For Integralism, a lesson could focus attention on both self and culture/environment and their interactions. For example, students could be asked to reflect on how their beliefs and their culture influence their general views of an issue. As the students explore the relations between themselves, their cultures, and their beliefs, and those of other people, they are given opportunities to begin to glimpse the constructed nature of their beliefs and thus to consider the possibility of different ways of being that exist outside of their own realities. They can come to identify their own, and other, cultural discourses. This promotes reflexivity, growth, and critical thinking.

Understanding Social Studies practice from a holistic perspective results in lessons that consider students' minds -- and their hearts (such as engagement), bodies (such as movement), and spirit (such as exploration of values and morals), while also attending to the interactions between the social/cultural and natural worlds. This expanded perspective aims to develop students in a manner that promotes individual and social health and flourishing. In the next section, sample lessons illustrate how these models relate to and inform practice.

GENERAL SUGGESTIONS

SELF ESTEEM
Teachers can help to develop their students' self esteem by caring for their students. They can help students understand how they are perceiving and labelling themselves, value all types of students as they are (not comparing them to false external "standards") and help students explore their values and beliefs. Teachers can design learning activities in concert with their students and help students establish and achieve realistic goals, which empowers students. Teachers can also aid their students in identifying barriers to their goals, teach students strategies to address these and help them to view mistakes as learning events. They can role model positive conflict resolution processes.

POSITIVE RELATIONSHIPS
Teachers can illustrate how behaving respectfully, being kind and building trust are important, and how students can support each other. Students can learn to communicate their feelings, laugh, appreciate and acknowledge the good features of each other, be responsible for their words and actions, provide conditions that nurture their (and other's) growth, and mutually enjoy activities together. Positive relationships embrace individual authenticity and foster positive feelings and engagement. Relationships are not peripheral to education: they are essential to it and so they should be given care and attention.

GENERAL IMPLICATIONS FOR PRACTICE
When lesson planning, the teacher with a holistic perspective will focus on more than activities that develop the mind. The latter include activities such as memorizing dates and names, doing a cause and effect analysis, conducting research or analysing a primary document. The holistic teacher will integrate individual and social beliefs, emotional engagement, and varied types of activities as well. For example, considering Rousseau's belief that affect/emotional attachment and physical development are key components, learning about sustainability and the natural environment would place conscious attention on nurturing students' love and respect for nature through enjoyable, physical experiences embedded in nature.

Esbjörn-Hargers (2006) uses the following integralist approaches in his classroom: embodied reading, engaged reading, presence, reflective dialogue, shadow work, individual (self) inquiry, perspective taking, self-authorship, witnessing, and daily meditation. These techniques engage students in mindful learning experiences that integrate conscious self-reflection on oneself and one's relations to others into the learning process through discussion, reflection and journals. A sample Social Studies lesson using these approaches could involve students in exploring various political ideologies. As the students learn the ideologies, they also maintain a "critical engagement," or on-going reflection, in which they describe their thoughts and feelings towards the various ideologies they are studying. These reflections could be guided by questions such as: what past experiences have shaped the views you have, how might different experiences change your views, what actions would illustrate your preferred ideology, and what social system best actualizes it.

In addition, the four different quadrants of integralism could be used. For example, if students were studying a unit on the environment, students could explore their views on the topic in the "internal, individual-self" quadrant. They could explore the interrelations between their physical actions and the natural environment in the "individual self, external" quadrant by filling out and discussing an environmental behaviours inventory. In the "cultural self" quadrant, students could explore how various cultural groups relate to the environment, and in the "multiple realities" quadrant, students could explore various attitudes to the environment in global cultures, past and present, and be introduced to various paradigms that structure thought.

In effect, holistic teaching practice is good teaching practice, and many nations are beginning to recognize this. In the next section, a case study example of how holistic concepts are now informing Social Studies teaching practice through curriculum reform in New Zealand (NZ) is presented.

HOLISTIC TEACHING IN SOCIAL STUDIES: A NEW ZEALAND VIEW

BEGINNINGS

Holistic teaching in Social Studies has its beginnings in the earliest educational strategies practised in New Zealand. Parallel to Rousseau's educational philosophy, pre-European Maori (*tangata whenua)* were using oral teaching methods to recount significant historical events through the use of "strong memory skills" and calls to social action through the teaching and practising of "powerful oratory" (Mitchell, 2010).

The first formal "teaching" in New Zealand was by British missionaries to Maori students in their own language (*te reo*) in "mission" schools. These schools were completely abandoned in the 1860s however, partly as a result of fighting between local Maori tribes and the British Army over land "rights," ongoing disquiet about the 1840 signing of the Treaty of Waitangi and fears of Maori unity between tribes in response to growing European immigration.

A replacement Native Schools Act in 1867 offered Maori communities the chance to set up state-controlled schools supervised by the newly formed "Native Department." This was possibly seen as a way to speed up assimilation as the schools were generally based on colonial models of teaching, generally in English. This education model was the one used by the State until well into the 20th century.

Efforts to increase the number of *te reo* speakers led to the addition of the Maori language to teacher training college curricula in the 1960s. In 1981, the first *kohanga reo* (Maori language nest or kindergarten) was established to increase bilingualism. In 1987, Maori was declared an official language of New Zealand. Starting with the introduction of *kohanga reo* and continuing with *Kura kaupapa Maori* (Maori medium schools), bilingual schools and Maori immersion classes within mainstream schools were established. In 2004 a state funded public Maori television channel, brought Maori language into the homes of the general public. In 2012, a 51% Maori language standard across all programming on this channel was introduced.

The growth in Maori political power has supported and encouraged these innovations. Since 1867 there have been four seats in the NZ House of Representatives allocated to Maori and since 2004 there have been members of the newly formed Maori Party in Parliament. The Maori Party has been part of the current coalition government since 2008.

The aspirations of a Holistic education continue today.   Due to the legacy of these strategies to embolden New Zealand's indigenous language and culture alongside an imported model of education, the development of a curriculum that was culturally responsive and therefore holistic, was almost inevitable. Holistic teaching and learning has the potential to become "mainstreamed" with the recent introduction of a compulsory, school-based curriculum which emphasizes knowing the "whole learner" and students "participating as critical, active, informed and responsible citizens" (NZ Curriculum statement, 2009).

CURRICULUM REFORM
In national curriculum reviews, Maori organisations raised concerns about the absence of reference to the Treaty of Waitangi and Maori concepts such as *manaakitanga*. As a result, the principles of the Treaty of Waitangi and the bicultural foundations of the country were included in a final draft curriculum document published in 2009. All students, including 20.3% Maori, then had the opportunity to acquire knowledge of *te reo Māori me ōna tikanga* (Maori language and protocol). The National Curriculum review views successful learning as being achieved by the "whole" student-- one who is able to experience the value of their own cultural contributions or who has significant access to affirmative confirmation of their own culture.

Up until its first comprehensive review, the New Zealand "curriculum" was specified through more than a dozen syllabuses and guidelines. Following a major public consultation in the mid-1980s (The Curriculum Review), the Department of Education began work on an overall framework for a revised school curriculum. This was to be an "outcomes"-based curriculum. In response to concerns about the fast pace and scale of curriculum change, a "stock-take" was initiated. This initiative sought input from international curriculum experts, national and international assessment data (PISA), 4000 teachers plus a range of other expert groups. This background set the stage for wholesale curriculum revision and hence Social Studies reform.

Another "driver" for curriculum reform has been student achievement and a focus on the "tail" or 5-20% of all students who are below or well-below "expected outcomes." When national secondary school results became more readily available in the early 2000s, they revealed that much of the 'tail' was made up of Maori students (40%). Professional educators sharpened their focus by researching curriculum interventions or strategies which could be implemented to minimize this tail. One key finding of this research (known as the *Te Kotahitanga* programme) was that school curricula which included teaching the "whole child," i.e. holistic education, would not only improve Maori student achievement but would improve all student achievement, regardless of ethnicity. Russell Bishop concluded, in his 2005/2006 research, that the "percentage gains in all student achievement in the Te Kotahitanga schools were higher

than in those schools not in the program" (New Zealand Ministry of Education, 2012). In 2008, this programme reached approximately 2,000 teachers and nearly 20,000 students. One result of this has been an "elevation" in the position of Maori learners, as the early part of the program emphasises the oral history of student experiences in mainstream classrooms.

THE NEW CURRICULUM

The implementation of a student-centred, "school-based curriculum" in 2009 set out to create young people who are confident and creative, connected and actively involved. The document, in its key competencies, principles and values has handed schools a mandate to embed holistic teaching strategies into the curriculum framework which enables "life-long learning." In 2011, a summary of evaluations of the initial implementation stages of the new curriculum found it to be "cherished but challenging" (Sinnema, 2008-2009, p. 2). Holistic teaching refers to "wholeness" or "meaning" discovered by students as they build connections with the community, their own cultural environment and as they develop human values such as *manaakitanga* (caring for things or others [relationships]) and *mana* (pride [self-esteem]). Teachers act as guides. Holistic learning introduces student-directed learning, meaningful goal setting and increased levels of social and academic achievement. Within the context of holism, students can lead their own and others academic and cultural learnings, making connections between school subjects, topics and concepts.

The holistic nature of the curriculum is given importance by the vision: "young people who will be confident, connected, actively involved, lifelong learners" and the values: "inquiry and curiosity…community and participation." Key Competencies also place a high importance on the holistic nature of learning, using terms such as managing self, relating to others and participating and contributing. The curriculum "principles" likewise place strong emphasis on community engagement to enable students to "make connections with their wider lives" (New Zealand Curriculum, 2009, p. 7-10).

Holism is being absorbed into Social Studies as guided by the Key Competencies, the "capabilities for living and lifelong learning" (NZ Curriculum, 2007, p. 12). Competencies such as "participating and contributing" and "managing self" emphasize the whole student learning experience rather than a focus on knowledge acquisition, with overarching statements such as, "Students…have a sense of belonging and the confidence to participate within new contexts" (NZ Curriculum, 2007, p. 13). The key competencies are strong support for academic success: "successful learners make use of the competencies in combination with all the other resources available to them" (NZ Curriculum, 2007, p. 12).

Appendix 1 illustrates the requirement that the Ministry's outcomes are to be transformed from generic to school-based. Championed by many school communities, the concept of teaching the "whole" student has been enabled by, and embedded in, the new curriculum.

Incorporating phrases such as "Confident Life-Long Learners and responsible citizens," "relating to others" and "participating and contributing," the new curriculum (The New Zealand Curriculum, 2007, pp. 12-13, 37) has handed Social Studies teachers a mandate to encompass holistic teaching. These core principles are the foundations on which teachers build their lessons. Such foundations can be found throughout the Social Studies curriculum as pedagogical innovations, supporting teachers to encompass the "whole student," by making connections to students' lives and using this information to create better educational outcomes. Raewynne, for example, engaged in the teaching inquiry process reflecting on her own pedagogy. Her learning story was how her predominantly Maori and Pasifika students learned about the concepts of cultural identity and cultural transmission by using their own family stories (TKI, 2009).

CONNECTIONS TO STUDENTS' LIVES – CONNECTIONS TO COMMUNITY:
EXAMPLES OF HOLISTIC EDUCATION PRACTICE

Identification and celebration of culture and environment supports holistic teaching. Making real connections through consistent strategic teaching is vital. Strategies include opportunities to eat together, compete with each other, seek input and feedback from the community and celebrate student successes frequently; that is, the practise of cultural responsiveness. Once connections are made, students' belonging and self-confidence improve and pathways into deeper understanding are supported.

Aranui High School (student ages 13-17) is a co-educational state secondary school located in eastern Christchurch. The ethnic composition of the school includes 30% Maori and 15% Pacific Island students. The school is divided into curriculum "departments" and Social Studies, as in all state secondary schools, is a compulsory subject in Years 9-10. Social Studies is also a compulsory subject in Years 1-8 at Primary School, although it is popular to integrate it with English and/or Science topics.

Examples of how pathways or connections are currently practised by students and Social Studies teachers at Aranui High School:

- Students designed and built 3D models about the effects of and recovery from the 2010/2011 earthquakes and presented these to Auckland schools. Students educated other students about their first-hand experiences. Students were connected to the topic and the process was important enough to them that they felt compelled to share it with others.
- In February 2013 students across the city were invited to enter a design competition which will re-imagine a part of the Central Business District into "The Amazing Place." The winning entry had the opportunity to have their design incorporated by developers into a real project. http://theamazingplace.co.nz/
- Again, using the recent earthquakes as a context, students in my class were asked to envisage what a new school might look like for a rebuilt eastern Christchurch. A "superschool" from Year 1 – Year 13 is proposed to replace four schools with falling rolls due to the earthquakes and students were given a business challenge: https://drive.google.com/file/d/0B9PLIXaTkmr3UDBwN0t1VXZMRnc/edit?usp=sharing
- Getting to know students at the start of the year happens through activities such as designing, or having students design, a series of questions that ask them about their lives outside of school.

HOLISTIC TEACHING RESPONSES

The release of a government document, "Directions for Education Renewal in Greater Christchurch" (May 2012), proposed changes to the way education is delivered in Christchurch as a response to the population changes following the earthquakes and invited public feedback. Students in my senior Geography class saw this document as directly affecting their educational futures and, as a result, became actively involved in this process. Education leaders, teachers, business leaders, stakeholders and local *iwi,* Ngai Tahu were also consulted. This Education Renewal Plan has been released and students have made connections between their input and the final outcomes. Regardless of the outcomes, at the time, students felt they were listened to and, as stakeholders, held views and opinions which they thought were important enough to share (anecdotal feedback to teacher July 2012).

Getting involved also means participating and contributing in the students' physical environment. This could mean designing a new use for a space inside school grounds such as a technology hub or an area to serve breakfast. It could also mean encouraging students to get involved in experiences outside their comfort zone, such as tramping (hiking) trips, community issues, performance poetry and music workshops with industry experts and university mentoring systems.

The local university initiated an after-school programme to create links between Maori students and university. Students travelled to university after school for two hours study/week, made connections with their mentors and gained a positive experience from the campus. As students actively participate in the cultural and social environments they live in, they are more connected to them and are more likely to remain in them or want to return to them, to "give or get back" something in return.

Another aspect of holistic teaching is experiential learning, exposing students to a range of "real-life experiences": trips to the surrounding area (the beach, the city, the local hills), visitors to the classroom who bring expertise such as flax weaving and opportunities for students to interact with providers of specialised knowledge (MPs, Travel Agents, farmers) and finally role-plays inside an historical suburb (e.g. Ferrymead) for a day. Research which places these strategies as important to making connections to students' lives is found in the New Zealand Curriculum "Best Evidence Synthesis" (Aitken & Sinnema, 2008). This substantial publication released in 2010 is a collection of best pedagogical practices in Social Studies and how these can be implemented. Teachers/leaders are encouraged in their lesson planning to explicitly make connections to students' lives, build and sustain a learning community and design experiences that interest students. In short, the priority is to teach the "whole child" including recognising, using, and building on the prior learning and experience of all students.

Culturally-responsive teaching, with its origins in holistic teaching, has also been introduced to Social Studies teachers. Cultural responsiveness is the idea that learners are empowered and enabled by genuine teacher acknowledgement that Maori learners will succeed as Maori and the strategies supporting this expression enable all students' success. Some of these strategies are already used in secondary classrooms, for example, a "getting to know you" interview sheet. Others have to be planned more specifically, for instance, including diverse learning activities for students presented visually, in written form, aurally and/or through group work. Further suggestions:

- Task choice is empowering and generally leads to high student engagement.
- Scaffolding, templates and model answers support literacy in that examples can be presented from a variety of contexts and students can respond in diverse ways.

- Role plays or "mock ---------" (e.g. elections to city council meetings) are responded to positively by students who enjoy performing. Other students can be delegated to be chairs or timekeepers.
- Competition of any sort means that students can use a range of skills to complete and excel in different contexts , e.g. group work, Education Outside the Classroom, decision-making tasks, tasks against the clock etc.

High expectations of all students and the rejection of deficit theorising (attributing the problems of educational achievement with the students themselves, or their families or cultural background, [Shields, Bishop & Mazawi 2005]) begins to address achievement inequalities between different ethnic groups, starting with a strategy of an "Ethic of Care" (knowing the learner and their culture and supporting them to experience success as a cultural learner). In practise this means getting to know students' lives, the relationships they have with other students at school, the importance of paid work in their lives and what the wages are used for (possibly supporting family). With deeper understanding of the "whole" lives of their students, teachers make connections and promote engagement in learning and success.

NZCER Chief Researcher Rosemary Hipkins, in "Curriculum Matters" publications has explored the connection between the future-focus requirement of the curriculum and the development of student identity. She makes the case that students' "selves" are an important curriculum focus to enable student participation. She also advocates that student wholeness and wellbeing allows them to engage and participate in an increasingly diverse and rapidly changing society. Learning experiences that are both "practical and academic," combined with authentic inquiry, help to meet the challenges of making students' "being" as important as "knowing." Thus, the new curriculum is open to and supportive of holistic education.

CONCLUSION: HOLISTIC EDUCATION IN NEW ZEALAND SOCIAL STUDIES

In New Zealand, holistic teaching moved into mainstream curriculum from its earliest beginnings in New Zealand society. Teachers and students are involved in the development of a holistic school-based curriculum and community members, parents and school boards have the opportunity to "feed-forward" into curriculum design and review.

The national curriculum provides the framework and common direction for all schools. It gives schools the scope, flexibility, and authority they need to design and shape their curriculum so that teaching and learning is meaningful and beneficial to their unique communities of students. In turn, the design of each school's curriculum allows teachers scope to make interpretations in response to the particular needs, interests, and talents of the students in their class. In many cases, schools include processes, strategies and concepts that align with the aspirations of Holistic education.

The curriculum aims for all New Zealand students to experience a rich and balanced education. The principles underpin and guide the design, practice, and evaluation of each school-based curriculum at every stage. The values, key competencies, and learning areas provide the basis for teaching and learning across and within schools. This learning contributes to the realisation of a vision of young people who will be "confident, connected, actively involved, lifelong learners" (New Zealand Curriculum Design and Review, 2007, p. 2).

In a relatively short time, the value of holistic methods of teaching have become embedded in curricula to such an extent that they are woven through the process of culturally-responsive teaching and are promoted as a way to address inequalities of achievement. They are believed to improve the education of all students. Deep regard for the learning and experiences of the "whole" student, their family and community drives New Zealand's new curriculum. Rousseau's emphasis on one-to-one caring and mentoring is "championed" by our curriculum (including the Maori concept of *ako* –both student and teacher as learners) as is Robinson's belief in the importance of relationships. The Integralist focus on connections between individuals and their cultural environments are also incorporated throughout the curriculum, with the use of culturally-responsive teaching strategies. In the classroom, these holistic models are demonstrated as a range of teaching methods that engage the "whole" student and so reinforce the holistic nature of current teaching practise in New Zealand. They provide students with the nurturing contexts that develop their self-esteem, relationships, emotional intelligence, and spirituality—and, thus, open students up to the possibilities of reaching *ultimacy* in their lives.

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Appendix 1: The New Zealand Curriculum. Front end of the NZ Ministry of Education document. This diagram outlines how the vision, values, key competencies, principles and learning areas are linked together and adapted for local context to design an individual school curriculum. The NZ Curriculum document is available online at http://nzcurriculum.tki.org.nz

The New Zealand Curriculum

Directions for Learning

Guidance

Vision

Young people who will be confident, connected, actively involved, lifelong learners.

Purpose and Scope

Values

Excellence;
Innovation, inquiry, and curiosity;
Diversity;
Equity;
Community and participation;
Ecological sustainability;
Integrity;
Respect.

Key Competencies

Thinking;
Using language, symbols, and texts;
Managing self;
Relating to others;
Participating and contributing.

Learning Areas

English;
The arts;
Health and physical education;
Learning languages;
Mathematics and statistics;
Science;
Social sciences;
Technology.

Official languages

Achievement Objectives

Effective Pedagogy

The School Curriculum: Design and Review

Principles

High expectations, Treaty of Waitangi, Cultural diversity, Inclusion, Learning to learn, Community engagement, Coherence, Future focus

The School Curriculum

THE PLACE OF PROBLEM SOLVING AND MATHEMATICAL THINKING IN THE MATHEMATICAL TEACHING

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ABSTRACT

The purpose of this study is to investigate the effect of problem-solving subject given for the improvement of problem-solving skills and for teaching the problem-solving strategies on primary preservice mathematics teachers' ability to use the problem-solving stages and on their mathematical thinking levels. The study is oriented to descriptive survey, which is one of the quantitative research methods. In the study that was conducted throughout 13 weeks (26 hours), the students were taught Polya's (1945) problem-solving stages, which are formed of four steps, and they were also the problem-solving strategies in order to improve their problem-solving skills. In the study, two problems developed by Posamentier and Krulik (1998) was used as data collection tool, and ''Mathematical Thinking Scale'' developed by Ersoy (2012) was used to determine whether the problem-solving lesson has an effect on mathematical thinking. The findings obtained demonstrate that problem-solving subject has a positive effect on preservice mathematics teachers' improving their problem-solving skills, and their skills of being able to choose and practise proper strategy. In addition, it was concluded that problem-solving subject has a positive effect on mathematical thinking.

Key Words: Mathematical thinking, problem solving, problem-solving stages.

INTRODUCTION

Problem and problem solving is the indispensible fact of life and an integral part of mathematics. Problem is an effort which arouses the need to solve in the individual, whose way of solution the individual does not know and which the individual tries to solve (Charles and Lester, cited by Baykul 1999). While Polya (1945) defines problem as seeking for the appropriate step to be taken in a conscious way so as to eliminate the uncertainty but failing to reach the desired one, Dewey describes as a situation leading to uncertainty confusing human intellect (Baykul 1999). According to Baki (2006), problem is a notion which arouses uneasiness in the individual and therefore leads him to seek for a solution using his own knowledge and experience. The above-mentioned definitions presents the three main characteristics of problem: it is difficult for the person who encounters it, it arouses the need to solve in the individual and the person encounters it first time at that moment and thus the individual has no preparation pertaining to its solution (Altun 2005). According to Dewey, if a problem is situation which creates uncertainty in the human intellect, then problem solving is the elimination of these uncertainties (Tanrıseven 2000). In a broader sense, problem solving is cognitive and affective process that covers devising various alternative ways and then selecting and applying the suitable one among those ways in order to cope with the uncertainty (Güçlü 2003). Solving a mathematical problem is, on the other hand, the reflection of the processes which advocate to reach a solution and to make generalization (Sağlamer 1980). Polya (1945) defines the process of problem solving in four steps: a) understanding the problem, b) determining the strategy, c) applying the selected strategy, and d) assessment.

In the stage of understanding the problem, the student is expected to understand what the problem means, to determine what are the given and what are asked and to clearly present the condition of the problem. In the stage of determining the strategy, the student is expected to determine which steps of calculations, drawings, etc. to follow in order to reach the desired outcome. In this process, teacher can write all of the strategies on the board and can promote the use of different problem-solving strategies, and can enable them to choose the suitable strategies (Miller 2000). The following stage covers the implementation of the established plan by the student. Teacher must follow the student in each stage. In the assessment stage, the student is expected to control whether his solution is correct and meaningful. Turning back to the solution and considering it again make it possible for the knowledge to become strong and for the problem-solving skills to be improved. In literature, problem-solving stage were divided by different researches into different stages (Bransford and Stein 1993; Charles, Lester, and O'Daffe 1994; Dewey 1995; Sağlamer 1980). However, in this study, Polya's four problem solving strategies were used.

One of the important components of the problem-solving process is, on the other hand, the problem-solving strategies. The use of suitable problem solving strategy is significant in terms of being successful in problem solving. Problem solving strategy is a plan made as to how a question can be solved, and a perspective and pattern in the events (Mintzberg 1994). The most common problem solving strategies included in the literature are guessing and testing, making a systematic list, finding a pattern, drawing a diagram, solving a equation inequation, estimating, solving a simplier problems, working backwards, making a table and logical reasoning. While Hatfield, Edwards and Bitter (1997) state that in the selection of problem solving strategies, individual's experience and the mathematical knowledge he possesses are effective, Willoughby (1991) advocates the idea that problem solving steps and teaching its strategies in advance will improve the individual's problem solving skills (Israel 2003). Burkhardt (1994) supports the view that the teaching of problem solving process is mathematically, pedagogically and individually difficult in terms of teachers. Therefore, it is thought that the use of appropriate problem solving steps and strategies included in the literature will ease the teachers' job in the teaching of problem solving.

NCTM (2000) advocates that all of the students, starting from the pre-school, should be made to acquire the behavior of building mathematical knowledge, being able to solve problem not only in mathematics but in every field as well, applying the proper problem solving strategies, and evaluating the problem solving by means of problem solving. Because problem solving makes it possible to structure knowledge and to bring into connection with the other knowledge, it is included in the center of mathematics programs. The targets in the programs are generally to raise individuals who can cope with various problems and to improve the problem solving skill (Şahin 2007).

In the eyes of mathematicians, mathematics is the single method of thinking that leads us to certain knowledge (Yıldırım 2004). It is required that the problem be determined for thinking to develop. The individual tries to solve the problem by correlating among the concepts for the solution of problem, and at this stage, thinking starts (Ersoy 2012). Individual's mathematical thinking skill improves in the problem solving stage.

Practicing on mathematics problems makes it possible for strategies to be developed aimed at the rational solutions of problems and enables these strategies to be adapted to all kinds of problems to encountered in life by leading to mathematical thinking (Yavuz 2006). The objective of mathematics teaching is, on the one hand, to enable individual to solve problem and to teach problem solving stages, on the other, to allow him to think mathematically. In mathematics teaching, individual's transition to thinking process should be ensured in the problem solving stages.

Students' mathematical thoughts in problem solving and creating a problem should be formed by starting out the figures in the sample. In order to solve problems, students reach the results selecting the appropriate solving strategies and making contact with each other at the solving stage (Cai 2003). The fact that the teachers who provide education to students aiming at solving problem which is an important part of mathematics education should be well-supported is significant in terms of raising individuals to be able to solve their problems in every sense. Because, students' acquisitions and skills as to problem solving will take form depending on the teacher's approach of problem solving and level of knowledge that he possesses. Therefore, this research focuses on the pre-service teachers' (who will be teachers in the future) skills of understanding the problem, determining and using appropriate strategies and evaluation, and their levels of mathematical thinking.

Problem Status

1- Does the subject of problem solving have an effect on the students' skills of understanding the problem, determining and applying the appropriate strategy for it and evaluating the strategy?

2- Does the subject of problem solving have an effect on the students' mathematical thinking levels?

METHOD

The research is oriented to descriptive survey, which is one of the quantitative research methods. According to Aggrwal (2008), it is a research method which gathers information about current conditions or situation in order to analyse, describe, interpret and compare the trends and relationships (Salaria 2012). The data obtained during the study, doing the statistical assessments and reaching a conclusion concerning the population are fundamental in quantitative research (Ersoy 2013).

In this study, several practices were made in the subject of "Problem Solving in Mathematics", which is one of the third year subjects of primary mathematics teaching, in order to improve the problem solving strategies. It was ensured that the students should analyze the problem solving phases considering Polya's (1945) problem solving stages. In the problem solving stage, the students were assessed in terms of the stages of understanding the problem, being able to select and apply the involved strategy, and being able to evaluate it. In addition, an attempt was made to determine in which way the subject of "Problem Solving in Mathematics" affects the mathematical thinking skills.

In the research, process of problem solving and its teaching was taught as a subject during the 13 weeks (26 hours). At the beginning of the term, problem solving strategies were taught to the students for two hours. After that, two problems and mathematical thinking scales were applied. At the end of the 13th week, the same problems and scale were applied again. In the course of the term, various problems were solved and some practices were made.

In the analysis of the data obtained, we tried to determine whether the students employed the problem solving stages in the solutions of the problems. In the problem solving stages, we examined the processes of understanding the problem, being able to select and apply the involved strategy, and being able to evaluate it. In the study, we attempted to determine whether the students solved the given problem using problem-solving stages and to specify their mathematical thinking levels.

Study Group

The study group was formed of randomly chosen 40 students, who take the subject of "Problem Solving in Mathematics", which is one of the third year subjects, in the Department of Mathematics Teaching in Primary Education in the Faculty of Education at a public University in Samsun, in 2013-2014 academic year. The number of students participating in the application at the beginning of the term is 23. The number of students attending the practice at the end of the term is 17.

At the stage of applying the problems and scale, all of the students taking part in the practice were ensured to answer the scales, but the students who imperfectly answered the problems and the scale were excluded from the assessment while the statistical analyses were being performed. Therefore, the number of samples differs from one another.

Data Collection Tools

Two problems, which were produced by Posamentier and Krulik (1998) and which were translated into Turkish, and "Mathematical Thinking Scale" developed by Ersoy (2012) was used as data collection tool in the study. The data collectin tools were explained below at full length.

The Problems

The problems included in the study were taken from the book named "Problem-Solving Strategies For Efficient And Elegant Solutions: A Resource For The Mathematics Teacher", which belongs to Posamentier and Krulik (1998), and was translated into Turkish. These problems are included below.

Problem 1. "There are 5 people in the same room, and what is the probability of at least two of their birthdays being same?

Problem 2. There are two peg tops below. We have two numbers at hand derived from (a) and (b). What is the probability of the sum of two numbers' being even?

Mathematical Thinking Scale

At the stage of developing the scale intended for mathematical thinking, the stages of developing scale suggested below were applied (Ersoy 2012).

The Stage of Item Pool: The questions in the created item pool were arranged on high level thinking, mathematical thinking, cognitive dimension, thinking level and individual thinking skill. Answer formats were specified on the interview form to be submitted to the expert opinion. An item pool of 32 pieces, which were formed of the first states of the items, was created. The positive items in the scale were scored from 5 to one in the ways of "I totally agree = 5", "I partially agree = 4", "indecisive = 3", "I don't agree = 2", and "I don't agree at all = 1", on the other hand, the negative expressions were scored from 1 to 5 in the ways of "I totally agree = 1" and "I don't agree at all = 5".

The Stage of Testing the Content Validity: The comparisons were evaluated in the forms that were submitted to the expert opinion. It became clear after the experts opinions that content validity of the scale is suitable.

The Stage of Factor Analysis (Construct Validity): In order to identify the factor constructs of the scale, the untransformed factor analysis method was employed at first using principal components analysis, and then Varimax vertical rotation method was employed according to principal components. The fact that the KMO value proved to be 0,759 according to the test conducted revealed that there were sufficient data in the research and that the sample size was appropriate. In addition, Bartlett test results were evaluated in order to point out that the data were applicable to the factor analysis. In consequence of the Bartlett test result (p=0,000), it became clear that the data were applicable to the factor analysis.

At first, factor analysis was carried out without using rotation. Most of the variables were included in the first factor. In the other factors, rotation was made using Varimax method because they could not explain the variables sufficiently. Therefore, the Varimax vertical rotation method was used for the items the load points of which were below 0,30 in the

Component matrix. At this stage, the 8th, 10th, 11th, 18th, 25th, 26th, and 32nd items were excluded from the scale after having made some tests. It is observed that as the result of the performed analysis of the items whose factor loads were calculated, the scale was made up of 25 items and 4 dimensions. Explanatoriness was divided into 4 factors. By taking advantage of alternate factor loads, the sub-dimensions derived considering the meaning the items in the factors bears were encoded respectively as the tendency of high level thinking, reasoning, mathematical thinking skill and problem solving.

Stage of Reliability: In consequence of the analysis performed, reliability of the scale as calculated as 0,78. The conclusion drawn proves that "Mathematical Thinking Scale" is valid and reliable. As a result of the data obtained, the mathematical thinking scale was formed of 25, including 20 positive and 5 negative, items. The negative items included in the scale were encoded reversely. The highest score to be got is 125, and the lowest one is 25. It becomes clear that as the scores got from the scale increase, the mathematical thinking level increase, but as the scores got from the scale decrease, the mathematical thinking level decreases. In the practice of the scale, the students were given 15 minutes time.

Collection of the Data
- The data were collected in the subject of "Problem Solving in Mathematics" at the first semester of 2013-2014 academic year.
- Mathematical Thinking Scale was applied to all students at the beginning of the term.
- The application period of the subject was completed in the 13 weeks.
- The students were taught the problem solving stages for a hour at the first week of the course.
- Polya's (1945) problem solving stages were taken into consideration at the problem solving stages.
- In the second week of the course, two problems developed by Posamentier and Krulik (1998).
- Various problems were solved in the class till the end of the term and it was discussed what kind of strategies these problems could be solved with.
- During the term, the students formed triple groups. They solved some problems in the primary mathematics curriculum and made presentations by considering the problem solving stages.
- Students' presentations in the classroom were performed according to Polya's (1945) problem solving stages. The presentations performed included the problems in different subjects.
- Attention was paid to the use of a different strategy in each question.
- At the end of the each solution, what kind of other strategies these problems could be solved with and their ways of solution was discussed.
- The order in the Table-1 was followed in the solution of the problems.
- Table-1 was created considering Polya's (1945) problem solving stages. Each problem was evaluated by considering the stages of understanding the problem, choosing the involved strategies, applying the strategies and evaluating it.
- The problems determined and mathematical thinking scale were applied to the students again at the end of the term.

Table 1. Evaluation Criterion Table of Problem Solving Stages
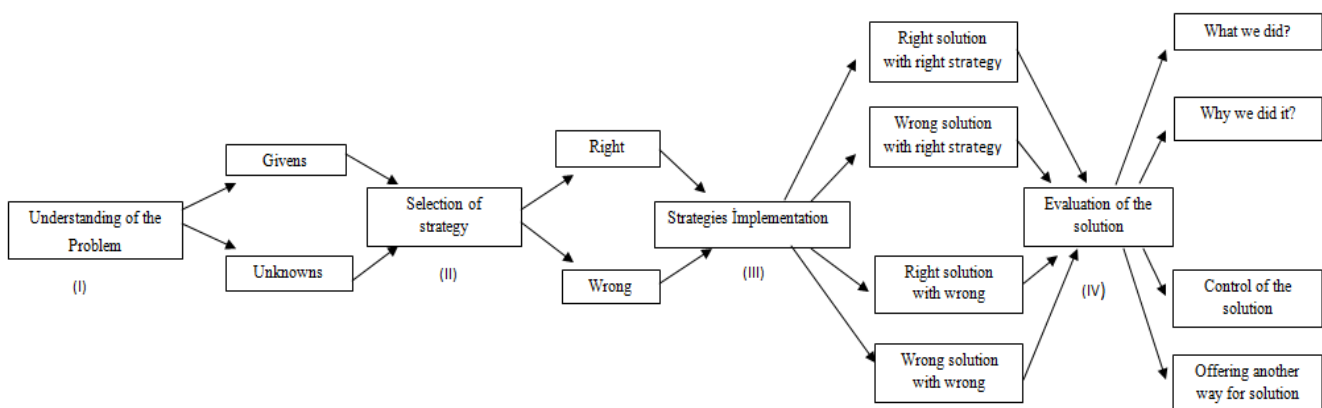
Analyses of the Data

Analyses of the problems developed by Posamentier and Krulik (1998) were analyzed according to Table-1 considering Polya's (1945) problem solving stages. Percentage and frequency values of the answers the students gave to each problem were calculated. In terms of the two problems applied at the beginning of the term and for the same problems applied at the end of the term, analyses were made with the following arrangement.

1. At the stage of understanding the problem, determining the givens and unknowns in the problem.

2. At the stage of choosing the strategy, choosing the strategy such as making a systematic list, guessing and testing, Drawing a diagram, finding a pattern, solving an equation-inequation, estimating, solving a simplier problems, studying retrospectively, Making a table, logical reasoning. The chosen strategy's being right or wrong, and making right or wrong solutions with the chosen strategy.

3. At the stage of applying the strategy, determining whether there is a suitable solution for the chosen strategy and whether the chosen strategy was used correctly.

4. At the stage of assessing the solution, the stages of what we did and where did it?, why we did it?, control of the solution, offering another way for solution were respectively were tried to be revealed.

At the stage of the solution of mathematical thinking scale, the analysis was made with the independent groups t-test.

FINDINGS AND COMMENTARIES

"Does the subject of Problem Solving have an effect on the students' skills of understanding the problem, determining and applying the strategy, and evaluating it ?" The Findings Pertaining to the Problem

The First Problem: The answers the students gave at the beginning and end of the term to the problem of "There are 5 persons in a room. What is the probability of at least two's birth days' being same?" were provided in Table-2.

Understanding of the Problem

At the stage of understanding the problem, the evaluations regarding the given and the unknowns were presented in Table-2.

Table-2. The answers given at the stage of understanding in the first problem at the beginning and end of the term.

Understanding the Problem	Answers	Beginning of Term		End of Term	
		Frequency	Percent	Frequency	Percent
Givens	Right	5	%22	17	%100
	Wrong	18	%78	0	%0
Unknowns	Right	5	%22	16	%70
	Wrong	18	%78	1	%30
Writinig of Questions text	Right	7	%30	0	%0
	Wrong	16	%70	0	%0

According to Table-2 revealed that the students who were taught the problem solving stages for two course hours at the beginning of the term had difficulty in the stage of the understanding of problem. While 22% of the students determined the given correctly, 78% of them determined them wrong. It becomes clear at this stage that the problem cannot be solved without understanding it. It was determined that most of the students (78%) stated the unknown wrong. It was established that what the students understood from understanding the problem was that the problem text had to be written as it was. However, 70% of those writing the problem text wrote the problem sentence in a wrong way. This findings shows how important the place of problem solving stage is in understanding the problem. It is difficult to solve correctly a problem which is not understood well.

All of the students (100%) stated the stage of indicating the given in a correct way. 70% of the students provided positive statements in the proposition of the unknown. When the answers at the end of the term are examined, it becomes clear that there is a positive increase in students' statements concerning the given and unknown.

<u>Selection of the Strategy</u>

At the stage of the selection of strategy, the strategies the students chose, their frequency and percentage values are presented in Table-3.

Table 3.The answers given at the selection strategies stage in the first problem at the beginning and end of the term.

Selection Strategies	Beginning of Term		End of Term	
About Strategies	Frequency	Percent	Frequency	Percent
Estimating	5	%22	3	%18
Making A Systematic List	5	%22	1	%6
Making A Table	4	%17	4	%24
Solving An Equation-İnequation	3	%13	3	%18
Guessing And Testing	3	%13	3	%18
Finding A Pattern	2	%9		
Logical Reasoning	1	%4	3	%18
Drawing A Diagram			1	%6
Solving A Simplier Problems			2	%12

Table-3 is formed of the strategies the students chose in the selection of strategies, which is one of the problem solving stages. It is understood from the percentage and frequency values that the students chose making a systematic list, guessing and testing, drawing a diagram, finding a pattern, solving an equation-inequation, estimating, solving a simplier problems, studying retrospectively, making a table, logical reasoning. It was revealed at the stage of practice whether the strategies the students chose at the beginning and end of the term were suitable for the solution of problem. The evaluation pertaining to the stage of practice is presented in Table-4.

<u>Application of the Strategy</u>

At this stage, it was checked whether the chosen strategy was applied correctly.

Table 4. The answers given at the stage of strategies implementation in the first problem at the beginning and end of the term.

Strategies İmplementation	Beginning of Term		End of Term	
	Frequency	Percent	Frequency	Percent
Right İmplementation	3	%13	8	%47
Wrong İmplementation	20	%87	9	%53

The above table revealed that at the beginning of the term, the students could not apply the strategies they chose. It becomes apparent that the students failed to apply the strategies indicated in Table-3 at the stage of solving the problem (87%). This finding is an indication that the students who cannot understand the problem will not be able to reach the solution with the strategies they randomly choose.

<u>Evaluation of the Solution</u>

The data pertaining to evaluation of the solution, which is the last of the problem solving stages are provided in Table-5.

Table-5. The answers given to the stage of evaluation of the solution in the first problem at the beginning and end of the term.

Evaluation of the solution	Beginning of Term		End of Term	
	Frequency	Percent	Frequency	Percent
Right Evaluation	3	%13	8	%47
Wrong Evaluation	20	%87	9	%53

Table-5 is the indication that the problem cannot be solved without understanding it. At the end of the term, there was a positive increase in the correct evaluation of problems. It can be clearly seen in Table-5 that the problem cannot be solved with the chosen strategy without understanding it.

The Second Problem: The answers which the students gave to the problem of "There are two peg tops below. We have two numbers at hand derived from (a) and (b). What is the probability of the sum of two numbers' being even?" at the beginning and end of the term are provided below.

Understanding of the Problem

At the stage of understanding the problem, the evaluations regarding the given and the unknowns were presented in Table-6.

Table-6. The answers given at the stage of understanding in the second problem at the beginning and end of the term.

Understanding the Problem	Answers	Beginning of Term		End of Term	
		Frequency	Percent	Frequency	Percent
Givens	Right	10	%43	17	%100
	Wrong	13	%57	0	%0
Unknowns	Right	22	%96	17	%100
	Wrong	1	%4	0	%0

The above table demonstrates that at the stage of understanding the problem, the correct answer given (43%) at the beginning of the term increased (100%) at the end of the term. It can be said that the students were efficient in correctly expressing the given for the subject taught during the term. It is reported that after solving various problems, the correct answers were 100% in the expression of the unknown.

Selection of the Strategy

Understanding the problem is the first and fundamental stage for the solution. The person who understands the problem well will reach the solution by choosing the correct strategy. Below are the evaluations aiming at choosing the strategy, which is the second stage.

Table 7. The answers given at the selection strategies stage in the second problem at the beginning and end of the term.

Selection Strategies	Beginning of Term		End of Term	
About Strategies	Frequency	Percent	Frequency	Percent
Making A Systematic List	9	%39	3	%18
Making A Table	13	%57	7	%40
Guessing And Testing	1	%4	3	%18
Solving An Equation-İnequation			2	%12
Drawing A Diagram			2	%12

When we look at the Table-7, we notice that at the beginning of the term, students chose three strategies, but at the end of the term they chose five strategies. What is important at this stage is to determine whether they use the selected strategy or not in the solution of the problem.

Application of the Chosen Strategy

Below is the evaluation of the chosen strategy.

Table 8. The answers given at the stage of strategies implementation in the second problem at the beginning and end of the term.

Strategies İmplementation	Beginning of Term		End of Term	
	Frequency	Percent	Frequency	Percent
Right İmplementation	3	%13	17	%100
Wrong İmplementation	20	%87	0	%0

While number of the students who applied the strategy correctly at the beginning of the term was 3 (13%), at the end of the term it was found that number of those who applied the strategy correctly was 17 (100%). A very marked decline was observed in the number (0%) of students who failed to apply the strategy s/he chose (87%). At this stage, the application of chosen strategy correctly will surely lead to correct solution. Below are the correct solutions and evaluation of the problem.

Evaluation of the Solution

Evaluation of the applied strategy at the beginning and end of the term is presented below.

Table-9. The answers given to the stage of evaluation of the solution in the second problem at the beginning and end of the term.

Evaluation of the solution	Beginning of Term		End of Term	
	Frequency	Percent	Frequency	Percent
Right Evaluation	3	%13	17	%100
Wrong Evaluation	20	%87	0	%0

Table-9 demonstrates that at the end of the term, 17 students (100%) made the evaluations correctly. In the evaluations made at the beginning of the term, 3 students (13%) made the evaluations correctly, and 20 students (87%) made them wrong. The increase at the end of the term reveals that the process of instruction was sustained effectively.

"Does the subject of problem solving have effect on the students' mathematical thinking levels?"

The Findings Pertaining to Problem Status
In the study, the students were subjected to "Mathematical Thinking Scale" before and after the course of "Problem Solving in Mathematics". Whether the data were suitable for normal distribution was determined before the analysis of the data obtained. Normality test of the X_i observations of n unit, which was randomly selected from the population exhibiting normal distribution, is obtained with W test statistics. W test statistics shows difference at the interval of $0 < W \leq 1$. The values close to 1 show that the variable has a normal distribution, on the other hand, the values close to 0 show that the variable does not have a normal distribution (Özdamar 2004). The Table for the normal distribution of the data is presented below.

Table 10. Normality Distribution Table

Shapiro-Wilks Test Statistics	W Statistics
Pre Test	0,928
Post Test	0,902

As can be understood from the Table-10, the data pertaining to mathematical thinking scale show a normal distribution. Because the data show normal distribution, t-test analysis was conducted in order to determine whether there is a significant difference among the mathematical thinking scores. The analysis performed is presented in Table-11 below.

Table 11. Pre Test-Post Test Mathematical Thinking Scale t-test Table

Test of sort	N	$\overline{X}$	Ss	p
Pre Test	23	91,7826	4,6412	0,000*
Post Test	17	107,4706	5,2454	

The table above brought out that the "Mathematical Thinking Scale", which was applied before and after the course of "Problem Solving in Mathematics", produced meaningful results. This meaningfulness (p<0,05) show that post-test results ($\overline{X}$ =107,4706) were higher than the pre-test results ($\overline{X}$ =91,7826). As a result, it becomes clear that the process treated in the course of "Problem Solving in Mathematics" increased the mathematical thinking level of the students.

RESULTS AND DISCUSSION

The results regarding the research in which the effect of the subject of "Problem Solving in Mathematics" on the students' problem solving skills and their mathematical thinking levels was investigated are expressed below according to each problem.

It became evident that the students had difficulty in the phase of understanding the problem at the beginning of the term. At the stage of understanding the problem, 22% of the students specify the given correctly, while 78% of them specify them wrong. The students expressed most of the unknown in a wrong way. In addition, it was determined that the students understood the stage of understanding the problem in a way that they had to write the text of problem as it is. However, 70% of those who wrote the text of problem wrote the sentence of problem wrongly. At this stage, it becomes clear that the problem cannot be solved without understanding it. This result indicates how crucial the place and importance of the problem solving stage is in the understanding of problem. It is difficult to solve correctly a problem

that was not understood well. Thus, it is necessary that the given, unknown and required be specified in a well-understood problem.

The students solved the problems, which were applied at the end of the term, by understanding the stage of understanding the problem. At the stage of stating the given, all of the students (100%) used a correct statement. 70% of the students made correct statements in the expressions of the unknown. When answers at the end of the term are examined, it becomes clear that there were increase in the students' answers in the statement of given and unknown when compared to their answers at the beginning of the term. This result reveals that the understanding of given, unknown and required would lead the students to the solution of problem.

At the stage of selecting the strategy, it was established that the number of strategies the students chose at the end of the term was more, while at the beginning of the term, they chose less strategies. It is understood from the percentage and frequency values that students making a systematic list, guessing and testing, drawing a diagram, finding a pattern, solving an equation-inequation, estimating, solving a simplier problems, studying retrospectively, making a table, logical reasoning in both application.

At the stage of applying the strategy, it became evident that at the beginning of the term, students failed to apply the strategy they chose. 87% of the students could not applied the suggested strategies at the stage of solution of the problem. This result is the indicator of the fact that the students who did not understand the problem cannot reach a solution through the strategies which they chose randomly. At the end of the term, there were positive increases in the accurate assessment of the problems.

In the consequences of the second problem, on the other hand, the accurate answers given at the beginning of the term (43%) were understood to increase at the end of the term (100%) , at the stage of the comprehension of the problem. It can be said that the lessons handled during the term were effective in terms of students in expressing the givens in an accurate way. It is understood from the frequency and percent values that after solving some problems in expressing the unknown, correct answers were 100 %.

Understanding the problem is the first and basic stage of the solution. The student who understands the problem well will reach a solution choosing the involved strategy.

At the beginning of the term, the students were observed to choose the strategies of making a systematic list, making a table, and guessing and testing, while at the end of the term they were observed to choose the strategies of making systematic list, making a table, guessing and testing, solving an equation-inequation, and drawing a diagram. The period in the term can be said to increase the selection of the strategy. What is important at this level is to determine whether the selected strategy can be used in the solution of the problem.

At the beginning of the term, it was found that the number of students who practiced the selected strategy accurately was 3 (13%), while at the end of the terms this number was found to be 17 (100%). A very clear decrease is understood in the number of students who cannot practice (87%) the selected strategy (0%). At this stage, the accurate performance of the selected strategy undoubtedly leads to the correct solution.

At the end of the term, it was revealed that 17 students (100%) accurately performed the step of problem assessment. In the evaluations made at the beginning of the term, 3 students (13%) made it correct but 20 students (87%) made it wrong. The increase in the proportions at the end of the terms disclose that the lesson course was conducted effectively.

The general conclusion of the study is that the education provided for the purpose of increasing problem solving skill has become effective in the development of this skill, and in the increase of their level of the selection and use of proper strategy. Pressley (1995) put forward that the students having received education for problem solving strategies were more successful and had higher problem solving skills than those not having informed about these strategies. The consequences of certain studies carried out similarly also showed that after having been taught several problem solving strategies, students could learn and use these strategies, their mathematical success increased and problem solving skills developed (Altun 2005; Arslan 2002; Faubion 2001; Ghunaym 1985; Lee 1982; Sulak 2005; Yaşar 2010; Yazgan 2002; Yazgan and Bintaş 2005; Yıldızlar 1999). From this point of view, the consequences of the performed studies are parallel to those of our study.

In the consequence of "Scale of Mathematical Thinking" , the results of posttest ($\overline{X}$ =107,4706) were determined to be higher than pretest results ($\overline{X}$ =91,7826) . The solutions of the problems made positive contributions to the students' skills of thinking. Students start thinking first in the process of understanding at the level of solving each problem. The students who understand the problem start to think mathematically at the level of moving on to the solution by selecting the correct strategy. As Tall stated (1995), the individual, in mathematical thinking, knows that when he looks , as a whole, at the content which he formed in the mind, it is easier for him to remember it. In the process of problem solution, the students knows that he can go the solution when he gets the solution steps of the problem.

Schoenfeld (1992) states that for the mathematical thinking to develop, the process should be evaluated well and the practices are necessary. Mathematically-thinking student, in the process of problem solving, should complete the process in the most proper way by using the problem solving steps.

Suzuki (1998) states that students generally tend to memorize the operations and the formulas while learning mathematics. Yet, a student knowing the problem solving steps will understand the problem and start the solution selecting the proper strategy. While using the mathematical knowledge, students will both start to think mathematically and solve the problems by understanding them. At this level they will get rid of the tendency of memorizing.

When the results on mathematical thinking are considered, it has been concluded that the period for the lesson of problem solving produced positive effects on the students' skills of mathematical thinking. It can be said that the applied process affected the mathematical thinking skill positively. This arrived result revealed that as the result of the problems practised in the class of problem solving and the steps of problem solving, mathematical thinking can be developed.

As a consequence, the class "Problem Solving in Mathematics" was revealed to have positive effects on students' problem solving skills and mathematical thinking levels. Also, it was determined that after students had learnt problem solving strategies, they realized that that they could use many strategies in problem solving. Therefore, it was concluded that the class "Problem Solving in Mathematics" had the students gain problem solving strategies and increased the students' level of mathematical thinking.

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THE RELATIONSHIP BETWEEN PERFECTIONISM AND BURN-OUT IN PRE-SCHOOL TEACHERS

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ABSTRACT
The purpose of this study is to investigate whether there is a relationship between preschool teachers' perfectionism and burn-out or not. The population of the study, which is a screening model of the causal-comparative type, consists of preschool teachers working in primary education schools in the central districts of the province of Konya. The sample of the study includes 82 preschool teachers working in primary schools selected from this population. "Maslach Burnout Inventory" and "Multidimensional Perfectionism Scale" were used in the study. Pearson Correlation Significance Test and Frequency Analysis were used in analyzing the data. As a result of the study, it was found that the burnout of preschool teachers was at a above medium high level whereas their perfectionism was at a high level. There was a significant relationship between the preschool teachers' burnout and perfectionism in the sub dimensions of burnout depersonalization and in terms of total scores.

Key Words: burnout, perfectionism, preschool, teacher, level, relationship

INTRODUCTION

Known as one of the leading phenomena in modern times, burnout was first used to express the professional crisis that people working in customer services in the USA experienced in the 1970s (Maslach, Schaufeli & Leiter, 2001). According to Freudenberger, who was the first person define the term burnout, burnout "occurs when one begins to burn out due to the extreme demands one their energy, power or resources " (Freudenberger, 1974; Suran & Sheridan, 1985). According to Dolan (1987), burnout causes people to feel both personal and professional dissatisfaction. Person experiencing burnout does not want to go to work, doubts his abilities and behaves in a manner that is out of character. Burnout is a factor that negatively affects employees' efficiency, thereby reducing performance (Maslach & Jackson,1986; Wright & Bonett, 1997; Özen-Kutanış & Tunç, 2010).

Maslach et al. (2001) defined burnout as a three-dimensional concept; the dimension of emotional exhaustion refers to the exhaustion of an individual's emotional and physical strength; the dimension of depersonalization refers to developing negative and firm attitudes and behaviors towards people with whom one interacts, whereas the dimension of lack of personal accomplishment refers to individuals' feeling of failure and inefficiency at work and in their interactions with people. In Maslach's model, emotional exhaustion is regarded as the cause of depersonalization, and in turn depersonalization is seen as the reason for a feeling of lack of personal accomplishment (Sağlam-Arı & Çına-Bal, 2008).

Individuals who, due to their job or their profession, have to engage in a unidirectional, that is giving-based interaction with people, begin to feel that they burn out when they think they always give or make sacrifices without getting as much in return (Tütüncü, 2007). It has been observed that individuals experiencing burnout suffer some emotional problems as well as physical ones such as exhaustion, insomnia and headaches (Wright & Cropanzano, 2000; Geurts & Gründermann, 1999; Ersoy, Yıldırım & Edirne, 2001). There are also those who define burnout as a social phenomenon, not as a clinical one like depression (Gibson, McGrath & Reid, 1989).

Burnout is defined as a syndrome that appears in individuals offering services and help to people and involves emotional exhaustion, depersonalization and decrease in personal accomplishment (Maslach & Jackson, 1981). Professional groups that operate face to face with other people, serve and help them are considered to be at risk in terms of burnout and teachers constitute one of the most important ones among these groups (Akçamete, Koner, & Sucuoğlu, 2001).

Teaching is a stressful endeavor. Daily interactions with students and colleagues and unending teaching requirements lead to pressure and stress (Frieseon, Prokop & Sarros, 1988). The results of the study indicate that teachers are in constant interaction with students throughout the day and try to meet their needs and this causes pressure and stress (Frieseon, Prokop & Sarros, 1988). There are many studies on teachers' burnout (Pines, 2002; Byrne, 1993; Kırılmaz, Çelen & Sarp, 2003; VVeisberg, 1994; Russell, Altmaier & Van Velzen, 1987). Moreover, studies conducted in the

field of education show that teachers' burnout varies with some independent variables (Sarros & Sarros, 1987; Hock, 1988; Friesen, Prokop & Sarros, 1988; Koustelios, 2001).

Teachers suffering from burnout are at high risk of facing mental and physical problems. This state of burnout may lead to problems even in their marital and family relationships (Guglielmi & Tatrow, 1998; Pierce & Molloy, 1990).

The studies that have been conducted reveal that burnout is frequently observed in developed countries. Many variables such as socio-demographic features, working conditions, workload and personality play a part in the development of burnout (Ahola & Hakanen, 2007; Spector & O'Connel, 1994).

Especially people who spend most of their lives as "workaholics" and live under heavy workload may face "burnout" (Naktiyok & Karabey, 2005) and experience an intense feeling of "life is unbearable". This feeling is often observed in people who work hard to attain success, do more than their share of the work and have no boundaries when it comes to working (Baltaş & Baltaş, 2002). According to Mermann (1990, perfectionism is one of the risk factors for burnout.

Perfectionism is a multidimensional personality trait that evaluates individuals according to personal standards they have themselves set and demands superior performance (Enns & Cox, 2002; Flett & Hewitt, 2002). There are many concepts and definitions with regard to perfectionism (Flett & Hewitt, 2002; Frost, Marten, Lahart, Rosenblate, et al., 1990; Slaney, Rice, Mobley, Trippi, & Ashby, 2001). Although there are some favorable views regarding perfectionism (personal desire, need for accomplishment), there are those that evaluate it as neurotic personality trait (Flett, Hewitt, & Dyck, 1989), and those that show it is related to depression (Blatt, 1995), obsessive compulsive disorder (McFall & Wollersheim, 1979), anxiety (Deffenbacher, Oetting, Lynch, Morris, et al., 1996), anorexia and bulimia (Halmi, Sunday, Strober, Kaplan, Woodside, Fichter, et al., 2000) and panic disorders (Iketani, Kiriike, Stein, Nagao, Nagata, et al. 2002).

Perfectionists may feel that they are under heavy pressure to succeed because they feel that both they and others are obliged to live up to high standards. Therefore, it it has been suggested that perfectionism is related to high levels of stress and burnout (Gould, Udry, Tuffey, & Loehr, 1996; Mitchelson & Burns, 1998).

METHOD
Study Model
This study is of the relational screening model, which is one of the general screening models. Relational screening models are models that aim at determining the presence and degree of change between two or more variables (Karasar, 2005).

Population and Sample
The population of the study consists of preschool teachers who work in primary education schools affiliated to the Ministry of National Education in the central districts of the province of Konya. The sample of the study, on the other hand, includes 82 preschool teachers employed in primary education schools selected from this population.

Data Collection
"Maslach Burnout Inventory" and "Multidimensional Perfectionism Scale" were used in the study.

Maslach Burnout Inventory: Maslach Burnout Inventory was developed by Christina Maslach (Maslach & Jackson, 1986). There are different forms of the scale for different occupational groups. There are 22 questions in the form that was developed for teachers. Three sub-dimensions are obtained from the burnout inventory, i.e. Emotional Exhaustion (EE), Depersonalization (D), and Lack of Personal Accomplishment (LPA). Of these sub-dimensions, emotional exhaustion consists of 9 items and involves emotional exhaustion of the individual through their occupation. Depersonalization dimension comprises 5 items and includes teachers' behaviors towards students that are devoid of emotion. Lack of personal accomplishment dimension, on the other hand, contains 8 items and determines individuals' feelings of inefficiency. The frequency of feelings about each sub-dimension is determined using a likert type scaling method. Responses are given to each item on a scale ranging from 0; Never and 5; Always. The 3 sub-dimensions of the scale are evaluated separately. In a study conducted by Girgin (1995) to test the reliability of the study, Cronbach Alpha values were determined for each of the three sub-dimensions. These values were found to be.87 for emotional exhaustion, .74 for perception of personal accomplishment, and .63 for depersonalization. Moreover, test-retest reliability coefficients were identified by administering the scale to 120 people from the same group at an interval of two weeks (EE .86, LPA .83, D .63).

Multidimensional Perfectionism Scale: Prepared by Hewitt and Flett (1991) to measure adults' perfectionist personality traits, this scale was developed to evaluate individual differences through 3 dimensions, i.e. self-oriented perfectionism, other-oriented perfectionism and socially-prescribed perfectionism. The multidimensional perfectionism scale is a 7-item likert type scale graded from 1 (I totally disagree) to 7 (I totally agree). The multidimensional perfectionism scale was translated into Turkish by Oral (1999) and its reliability and validity were again tested by Oral. In the reliability analysis, for all analyses, alpha reliability coefficient was found to be .91, whereas alpha reliability coefficient for self-

oriented perfectionism was .91, for socially-prescribed perfectionism .80 and for other-oriented perfectionism .73. Moreover, total item correlations of the sub-scales were found to be between .20 and .75 for self-oriented perfectionism, .22 and .60 for socially-prescribed perfectionism and .31 and .52 for other-oriented perfectionism. A high score obtained from the score indicates a perfectionist personality trait (Hewitt & Flett, 1991).

Analysis of the Data
Preschool teachers' perfectionism and burnout levels were given in the form of frequency analysis tables in the study while the relationship between preschool teachers' perfectionism and burnout levels was analyzed using "Pearson Correlation Coefficient Test".

Findings and Discussion
In this section, data analyses of the preschool teachers who participated in the study with regard to their perfectionism and burnout are given in tables.

Table.1 Frequency Analysis Table

Variables		F	%
Gender	**Female**	77	93,9
	Male	5	6,1
Age	**21-25**	16	19,5
	26-30	15	18,3
	31-35	19	23,2
	36-40	15	18,3
	41-and above	17	20,7
Marital Status	**Married**	50	61,0
	Single	32	39,0
Level of Income	**Low**	15	18,3
	Middle	55	67,1
	High	12	14,6

When the genders of the preschool teachers who participated in the study are taken into consideration, it is seen that 77 (93.9 %) of them are female whereas 5 (6.1 %) are male. As for age, there are 16 people in the 21-25 age range (19.5 %), 15 people in the 26-30 age range (18.3 %), 19 people in the 31-35 age range (23.2 %), 15 people in the 36-40 age range (18.3 %) and 17 peoeple at age 41 above (20.7 %). When their marital status is considered, it is observed that 50 of the preschool teachers (61.0 %) are married whereas 32 of them (39.0 %) are single. As far as their level of income is concerned, it is seen that 15 of the preschool teachers (18.3 %) have a low income level, while 55 of them (67.1 %) have a middle income level and 12 (14.6 %) have a high income level.

Table 2. Burnout Levels of Preschool Teachers

	Score Range	N	X	SS	Min	Max	Total Score	High Burnout	
								X=75-132	
								f	%
Burnout Total Score	0) 00.00-18.85 1) 18.85-37.71 2) 37.72-56.57 3) 56.58-75.43 4) 75.44-94.29 5)94.30-113.15 6)113.16-132.00	82	87,04	2,00	84,00	89,00	7137,00	42	50.6

When Table 2 is examined, it is observed that the lowest score that the preschool teachers obtained from the total burnout is 84.00 whereas the highest score is 89.00. The teachers' burnout mean score is 87.04. When these figures are compared with the score that can be obtained from the scale, the burnout level of the preschool teachers corresponds to "Once a week (4)" range. This indicated that the teachers' burnout is at a *above* medium high level.

The fact that the preschool teachers' burnout level was at a above medium high level can be explained by the fact that almost all of the preschool education teachers who were included in the sample were female (93.9 %) and, since more than half were married (61.0 %), they had a busy working life and extra responsibility at home.
Some studies indicate that female teachers experience more burnout than their male counterparts (Gonzales, 2005; Singer, 1992; Byrne, 1991, 1999).

On the other hand, other studies found that female teachers had higher professional stress and lower personal accomplishment (Rout & Rout, 2002). This is related to the social role theory and expectations of gender roles (Pines & Ronen, 2011).

Table 3. Results of Statistics about Preschool Teachers' Perfectionism Levels

	Score Range	N	X	SS	Min	Max	Total Score	High Level Perfectionism	
								X=169-224	
								f	%
Perfectionism Total Score	1) 32.00-59.42 2) 59.43-86.85 3) 86.86-114.28 4) 114.29-141.71 5) 141.72-169.14 6) 169.15-196.57 7) 196.58-224	82	155,97	4,03	149,00	167,00	12790,00	11	11

When Table 3 is examined, it is seen that the lowest score that preschool teachers received from total perfectionism is 149.00, whereas the highest score is 167.00. The teachers' mean score from perfectionism is 155.97. When these figures are compared with the scores that can be received from the scale, it is observed that the perfectionism of preschool teachers corresponded to the range "I partially agree (5)". This indicates that the teachers' perfectionism is above the average.

The perfectionism levels of the preschool teachers are above the average. Preschool education is a process of education that covers childhood years extending from birth to early primary education, provides rich stimulating environmental conditions appropriate for the individual characteristics and developmental levels of children of this age, and guides all of their development in accordance with the cultural values and properties (Poyraz & Dere, 2003).
Goals for children in different age groups are included in the preschool education program during this process of education. Preschool education constitutes the foundations to attain these goals so as to ensure that children's developmental characteristics are in the best possible state (Genç, 1999). Raising healthy children who exhibit expected behavior depends on knowing children's developmental characteristics and in accordance with these characteristics, what their needs are. Education given without knowing children's characteristics is both difficult and may lead to errors as it is based on chance and thus do harm to them though not intended (Aral & Kandır, Can-Yaşar, 2000). Preschool teachers are one of the influential and important components that are effective on children's behavior within the classroom. Teachers' professional experience, teaching style and the education they have received have an effect on their personality traits (tolerant, authoritarian, perfectionist etc.) (Aktaş-Arnas & Sadık, 2008). It is an expected result that perfectionism of preschool teachers raised with this awareness will increase.

Moreover, the fact that a majority of the teachers were female (93.9 %) may be one of the reasons why their perfectionism was high. According to Yaoar (2008), Cırcır (2006) and Hankin, Roberts & Gotlib (1997), women's perfectionism is higher than men's.

Table 4. The Pearson Correlation Coefficient Test Results Regarding the Relationship between Preschool Teachers'
Perfectionism Levels and the Sub-dimensions of Their Burnout Levels

	Preschool Teachers' Total Score for Perfectionism	
Burnout Emotional Exhaustion	Pearson Correlation	-.200
	P	.072
	N	82
Burnout Depersonalization	Pearson Correlation	-.534
	P	**.000**
	N	82
Burnout Lack of Personal Accomplishment	Pearson Correlation	.176
	P	.114
	N	82
Burnout Total	Pearson Correlation	-.380
	P	**.000**
	N	82

When Table 4 is examined, it is seen that the relationship between the preschool teachers' perfectionism and the sub-dimensions of their burnout levels, namely emotional exhaustion (r=.-200, p>.01), depersonalization (r=.-534, p<.01), lack of personal accomplishment (r=.176, p>.01) and burnout total score (r=.-380, p<.01) is high and significant. According to these results, a high and significant correlation was found between the preschool teachers' perfectionism and their burnout levels.

According to Zhang, Gan, and Cham (2007) and Leung and Lee (2006), maladaptive perfectionism is positively correlated with burnout. According to Stoeber and Rennert (2005), teachers with high adaptive perfectionism exhibit a lower level of burnout level. On the other hand, teachers with high maladaptive perfectionism have a higher level of burnout.

Self-oriented perfectionism was found to be correlated with a low level of burnout (Appleton, Hall & Hill, 2009; Hill, Hall & Appleton, 2010; Hill, Hall, Appleton & Kozub, 2008). In another study, on the other hand, it was found that teachers' perfectionism was not correlated with their burnout (Brobst & Zusho, 2008). Kremer and Hofmann (1985) revealed in their study that there was an insignificant correlation between teachers' burnout levels and their professional personality. These findings are in support of our study.

CONCLUSIONS AND SUGGESTIONS

When the results of the study are examined, it is seen that the burnout of the preschool teachers is at a moderate level whereas their perfectionism is at a high level. No significant relationship could be found between the preschool teachers' perfectionism and burnout in the sub-dimensions of burnout and total scores.

On the basis of the findings obtained, efforts should be exerted to determine factors that might lead to Preschool teachers' burnout, necessary measures should be taken to prevent burnout, teachers and pre-service teachers should be informed of positive and negative aspects of perfectionism through seminars and conferences and teachers should be provided with an awareness about the effects of this personality trait on students. Moreover, future studies may focus on the causes of burnout and perfectionism and studies can be conducted on larger samples from different regions.

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WHAT DID YOU LEARN IN SCHOOL TODAY?
A STUDY OF LEARNING ACHIEVEMENTS IN PRIMARY SCHOOLS IN NAMIBIA

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ABSTRACT
Education for all is universally seen as an end and a means for poverty eradication and for societal development in general. However, the present investment in education in many poor countries is far from meeting the expected outcomes: dropout, absenteeism and low learning achievement are problems and many leave primary education as functional illiterates. In this article the situation in Namibian primary schools is presented and school internal and external reasons for the low and uneven outcome of primary education investment are discussed. The main findings are that learner achievement in primary education in Namibia is generally low. In addition, there are striking differences between schools, regions and learners. Learners from the lower socioeconomic quartiles are far behind those coming from richer households. The Namibian primary education system is not able to reduce social inequalities; on the contrary, it amplifies inequalities that are already there. For a large number of children in Namibia enrolment in school does not mean that they achieve even the basic reading competence that is a key factor for development of other capabilities.

Key words: Learning achievements, primary schools, Namibia, development, poverty eradication.

INTRODUCTION

Development discourses have always shifted in terms of topics and priorities. However, education was always among the more prioritised areas in any development strategy and even more so today (Tarabini, 2010). Nevertheless it is important to acknowledge that there are different discourses which address the role of education in societal development, namely, the human capital approach, the poverty reduction approach, the human rights approach, the capability approach and the social justice approach. So education is both an end and a means for societal development.

For the individual participation in education is a value in its own right as well as a means to becoming economically productive. It is seen as part of the universal human rights as demonstrated in the UN Declaration of Human Rights. The importance of this was underlined in the Jomtien declaration of 1991 which stated the aim of Basic Education for All (Närmann, 1998). Literacy enables individuals to take part society and is therefore very crucial in a social justice perspective and thus for human development (Smith and Barret, 2011). Amartya Sen has launched the concept of capability as an alternative concept to the concept of poverty. Sen looks at education as the means to expand human capabilities, freedom, choice and agency (Ahmed ,2010). Thus access to universal education for all can be argued from many perspectives: a human rights perspective, social justice perspective and capability perspective.

Since the theory of human capital was formulated, universal education has been seen as an important and necessary investment in order to achieve economic growth and development (Tarabini, 2010, Dale, 1982). The catching-up process, in other words, needs an educated population. Since the Post Consensus there has also been established a link between education and the eradication of poverty. Today we find this argument in all World Bank documents on education and there seems to have been established a global consensus on the importance of investment in education as a means to fighting poverty and stimulating economic growth (Preston and Green, 2003).The Millennium Development Goals see universal primary education as a basic investment in human capital and a necessity in the fight against poverty (Ziai, 2011, UNDP ,2003). In this discourse education plays such a central role in the eradication of poverty because it creates conditions for empowerment and participation of all groups in defining developmental goals (Dhillion ,2011).

According to Tarabini (2010) the World Bank prioritises primary education in order to reduce poverty and literacy and sees the ability to read for understanding as the first and fundamental basic skill to be achieved. Nevertheless, universal quality education for all is far from being reached. In Africa alone, only 51 % of the children complete primary school according to Birdsall et al. 2005. The problems are non-enrolment in some countries, dropout and low achievement in all countries. The consequence is that many children never become literate. The present investment in education in many poor countries is therefore far from meeting the expected outcomes when so many get so little out of their years in school and leave primary education as functional illiterates(Smith and Barret, 2011, Broch-Utne, 2010).

Education results in Namibia are no exception from this general picture. Even though the country has an enrolment rate of 92 % they have severe problems with dropouts and low achievements (Miranda et al. 2011). The aim of this article, based on secondary and primary data, is to describe the situation in Namibian primary schools and discuss school internal and external reasons for the low and uneven outcome of primary education investment.

FACTORS INFLUENCING SCHOOL ACHIEVEMENT

Most researchers see learners' school achievements as a result of a complex relationship between background variables at household level, school and classroom internal factors and national contextual factors (Howie, 2008, Colclough et.al, 2003, Eie, 2003). The socioeconomic character of the household has a profound bearing on school results, enrolment, absenteeism and dropout. Children from poor households tend to succeed less often in primary education than children from more well-off households (Colclough et al. 2003). There are many reasons for this: lack of fulfilment of basic needs, need to earn an income, help with reproductive work and lack of money (Bostad, 2000). In Smith and Barrett (2011) study of 14 southern African countries they find a significant correlation between numbers of meals a day and reading scores and they argue that hungry children are more likely to achieve lower because they cannot concentrate (Avila & Gasperini, 2005). They furthermore find that absenteeism is negatively correlated with reading performance and that the main reasons for absenteeism are "need to work "and lack of paid school fees. This finding is in accordance with other research findings (Roby et al., 2009, Winger, 2003). The cost of school participation includes the direct cost of schooling – such as expenditure on books and uniforms- as well as opportunity cost of the child's time One common argument is that poor households do not send their children to school every day because they either need their labour or that the direct cost of sending them to school is too high (Mostert and Wikan, 2008, Arunatilake ,2004, ,Al-Amarrai and Zaman, 2002.) Late school entry is prevalent in many developing countries, especially in poor households, and Wils, 2004 claims that this is positively correlated with early drop out, repetition and low achievement. Parental support and educational background is also of importance for pupils' learning outcome (Smith and Barret, 2011). A characteristic of poor households is that they seldom have resources like educational level or time to support their children's homework. In addition, they less often follow up by taking part in meetings at school or taking direct contact with the teacher. Learners from poor households have a number of handicaps when starting their education compared to learners from more well-off households and it is documented that for instance the reading competence of pupils from lower socio-economic groups tends to be much lower than that of pupils from higher socio-economic groups (Makuwa, 2004).

An alternative explanation for low achievement is the lack of quality and relevance of the education offered in schools (Dale 1982). Unqualified teachers is a problem in many poor countries and more so in rural schools and schools in poorer urban suburbs. There is modest evidence indicating that learners attending well-resourced schools are likely to perform better, irrespective of their background. A positive relationship has been found between the quality and quantity of school resources and pupil performance (Colclough et. al., 2003; Zuze, 2008). The attitude of the teachers to children from poor households might add to the decision not to send or to drop out from schools. Eie (2003) noticed that teachers paid little attention to learners from poor households and sometimes treated them badly. Researchers have also observed that teacher absenteeism is a general problem in schools in poor countries and this has consequences for learning outcome (Reeves et.al.2013). Another problem Winger (2003) points to is the lack of relevance of the curriculum offered. She claims that this might be one factor affecting parents' attitude towards education. Ames (2012) also documents how indigenous children in Peru achieve lower due to a school curriculum and language policy that excludes their language and culture.

Learning achievement is also a related to the language of instruction. The majority of individuals in Africa tend to live in a multilingual setting. Many live their lives handling many languages on different levels of familiarity. According to Wolff (2010) one might talk about a multilingualism pyramid: local languages, local linguae francae, regional linaguae francae, national languages and official language. Most researchers seem to agree that the best medium for teaching is the mother tongue (Cummings, 2010, Molosiwa, 2005). Governments, however, have stated the need for a uniting language and have often chosen the language of the former colonial power (Williams and Cooke, 2002). As a result of these policy decisions, 700 million children are taught in English, a language that is not spoken in their home or in the

school playground (Gleghold and Rollick, 2002). English as a medium of instruction has in most cases favoured the better-off and/or urban elite who have the economic means to choose high- quality education. There is support in the literature that learners who are not taught in their mother tongue have more difficulties in mastering reading skills and performing well in school (Wolfaardt, 2004, Ramasamy, 2001, Harlech-Jones, 1998, Rivera, 1990).

To sum up; low learning achievement is a result of a number of factors and these factors are interlinked, and they must all be taken into consideration when explaining why many children never attend school, never fulfil basic education and have low learning outcomes. Their individual contribution to the complex situation of general low school performance will vary according to context. For poor households the direct and indirect costs mean that they often do not send all their children to school and they do not have resources to support their children's homework. Children from better-off households have none of these problems and they command resources that make it possible for them to buy a good education. A poor country will provide insufficient school places and low and variable school quality. The multilingual context in many countries adds to the problems. Nevertheless, few policy documents recommending investment in education as a remedy towards poverty does not appreciate the unfairness of educational opportunities in poor and unequal societies. Access to quality education is not for all, not even in those countries where most children enrol in school. The unfair access to quality education amplifies social inequality. In order to uncover this effect of educational investments it is necessary to look into how it is manifested at household, individual and school levels.

THE NAMIBIAN CONTEXT

Namibia is a middle-income country located in the south-western part of Africa. Since Independence from South Africa in 1990 it has had a positive economic growth and a reduction in poverty levels (World Bank 2014). In 2010, 28.7% of its population lived below the poverty line. In addition, inequality in standard of living is huge as Namibia is one of the most unequal countries in the world with a Gini-index of 63.9 (World Bank 2014).

Namibia has a population of 2.1 million comprised of different ethnic and language groups. Under South African occupation Afrikaans was the official language and lingua francas. After Independence English was chosen as the official language and medium of instruction from grade 4 although only 7 % of the populations speak English as a home language (Miranda et al.2011). There are 13 recognised national languages and these can be the language of instruction in lower grades. According to the language policy, the mother tongue should be the medium of instruction for grades 1 to 3 (Banda et. al, 2012). However, in practice, many classes have learners with different home languages and only one of these can be the medium of instruction, resulting in many pupils not being taught in their mother tongue in the first years of education.

According to national statistics there are quite large variations between the language groups with regard to home-language instruction; for example of the English speaking pupils, 80% are taught in English, whereas the figure for Oshiwambo is 64 %, for Afrikaans it is 63%(Ministry of Education 2007, Makuwa 2004). Many parents are negative to mother tongue policy in Namibia (Banda et. al 2012). They argue that English must be the language of instruction from grade 1 because this is more efficient when the aim is to be fluent in the official language. This is a view shared by parents in many other multilingual African settings (Muthwii, 2004, Mutorwa 2004, Deidre, 1997). In reality, English seems to be the only language of instruction in an increasingly number of schools, especially in urban areas. As a consequence learners from homes where they are not exposed to English are disadvantaged. Due to the colonial heritage Afrikaans is still the most common lingua francas, and in most households Oshiwambo is the most spoken language. However, an increasing number of learners are exposed to English outside school (Miranda et al.2011).

Access to quality education remains a priority in the development policy of Namibia. Primary education is 7 years and compulsory and 92% of the children enrol. Official policy documents states that "quality formal general education builds the foundation skills required for employment of trainable people who are adaptable to labour market changes, increase capacity intake to Vocational Education and Training (VET) for the development of skilled workers, and increase the number of school leavers able to enter tertiary education and training" (Miranda et al. 2011 pp 26). As this quotation demonstrates investment in primary education is agued along the human capital discourse.

THE DATA

The findings are based on two sources: the SACMEQ III results and data from two surveys conducted by researchers from the University of Namibia and Hedmark University College.The Southern and Eastern Consortium for Monitoring Educational Quality (SACMEQ) has collected data on reading and mathematics levels among grade 6 learners in three

periods starting in 1995. The survey gathers data on learning achievement, learners' background, and characteristics of schools and teachers. The present analysis is based on data collected in 2007.Two surveys were conducted in selected areas of Windhoek and in Oshakata region in the north. We used different information sources. One study was carried out as a household survey, the other one at schools surveying grade 6 learners.

In the household case study 120 households were interviewed. We used clustered sampling in four areas of Windhoek, Namibia. The settlement pattern in Windhoek is clearly stratified, mainly following income levels. Because one purpose of this study was to find out how the socioeconomic background of learners influences their progress and performance at school, we selected one very poor, one poor, one middleclass, and one wealthy area for the household interviews. For each area 30 households were selected. However, on closer investigation after data collection, it was realised that the very poor and poor areas were very similar and for the data analyses these two groups were combined and thus consists of 60 households, referred to as "poor". Only households with school-aged children were chosen, using the snowball method. After conducting the first interview, the interviewer asked to be directed to the next household within the selected area which qualified

The data was gathered using structured interviews with heads of households. All information gathered from this research is thus based on parents' or the heads of the households' points of view.

The term *achievement is* operationalised as follows: The learners' progress from one grade to the other and thus the repetition of one or more grades will be an indicator of low achievement. "Doing well or not well in school" is another indicator of achievement. The norm in Namibia is automatic progress through grades without repetition. Only in cases where the class teacher is absolutely convinced that a learner would not benefit from progressing to the next grade, should a learner repeat a grade. The promotion requirements stipulate, *"In some cases where learners do not achieve the basic competencies, repetition might be part of the solution"* (Ministry of Education 2007 pp 42). Repetition is therefore a valid indicator of the learners' achievement level.

In the school case study four schools, one rural and one urban in each district were selected. It was decided to include one school from an affluent urban area and one from a disadvantaged rural area to attempt representation of two extremes - advantaged and disadvantaged. All schools were Government schools. A total of 115 grade 6 learners were included in the sample. The method of selection was random sampling of full class groups. A quantitative survey using questionnaires was used for data collection.

The data was analysed using SPSS statistical package. Since the questionnaire contained few sensitive questions there was no reason to believe that the interviewees did not answer truthfully and thus we can claim that the data reflects high levels of reliability and validity. A limitation of both case studies is that households and classes are not selected randomly and the sample sizes are small. Thus we cannot claim that the findings are representative. Therefore one should be careful not to generalise the research results or to draw firm conclusions from these. Nevertheless, despite the limitations, the findings analysed together with the national survey give a picture of the situation in primary education in Namibia and point to some factors that might have a bearing on the results.

FINDINGS
Drop out, repetition, and low learning outcomes are common in Namibian primary schools. The official drop-out rates to subsequent phases remain high and only 75% survives to grade 7 (UNICED 2008). Figures for repetition rates are not reliable and they vary from 43% according to the Ministry of Education (2007) to 15% according to for instance Cameron (2005). Both dropout and repetition are indicators of low learning outcome. In a regional research programme SACMEQ III the Namibian school results are among the lowest in the region. 39% of the grade 6 learners were so weak readers that they could not read for meaning and only 20% reached advanced reading levels. This result implies that maybe as many as 80% were functionally illiterate. In mathematics the situation is even worse: 76% were below the level of beginning numeracy (Miranda et.al 2011).

There are regional differences, with the capital area and other urban areas getting higher scores than the rural parts of the country. For instance, in the urban region of Erongo 13% of the learners could not read for meaning, in the rural region of Omusati the corresponding figure was 55%. The pattern for mathematics skills is the same (Miranda et al. 2011).
The socioeconomic background of the learners influences the results, with learners from poorer families getting lower scores than learners from rich families (Miranda et al. 2011). In SACMEQ III the average score for the whole region is 500 points. Grade 6 learners from the 25 % poorest households got the score 458 with SD 2.87. Learners from the 25% richest quartile got the score 558, SD of 5.37. 70 % of the grade 6 learners from the richest quartile read sufficiently well that they can be said to be functionally literate: the corresponding figure for the poorest quartile is 15 % (Miranda et al., 2011, Möwes ,2004).

Table 1. Learners' background and repetition of class in primary school

Repeated class		
	Ed level head	
Less than primary		49 %
More than primary		25 %
	Socioeconomic background	
Poor		53 %
Rich		20 %
	Occupation head	
Blue collar		54%
White collar		24%
	Problems paying school fees	
Yes		49 %
No		24 %

N=120

The case study data confirm that the learners' background explains the variation in school achievement (table 1). The most notable factors influencing repetition is learners' background and parents' attitude towards education. In addition, the language of instruction seems to be a factor explaining variations in repetition between learners.

The educational level of head of household is correlated with repetition. In terms of repetition, 49% of the learners had repeated class if they came from households where the head had not fulfilled primary education (table 1). Only 13% of learners coming from homes where the head had fulfilled higher education repeated class. In the school survey 10 % had repeated if their father's educational background was higher education. Learners from rural schools more often repeated class than urban learners.

Socioeconomic background and occupation of head of household are other factors which are correlated with repetition. Learners coming from poor and blue collar background were more likely to repeat class than learners coming from richer and white collar background (table 1). Parents from the lower socioeconomic end and with low educational level also reported that few of their children were doing well in school. Findings from the school survey confirm that learners from poorer households more often repeated grades. Financial barriers are also a factor influencing school repetition. Parents who reported problems paying school fees more often also had children that repeated class. Some parents said that they sometimes had to keep their children home from school because they had not paid school fees; other said that they could not send their children to better schools because these schools had higher fees which they could not afford. The same parents also more often claimed that their children in general were not doing well in school.

A close relationship between home and school is considered to have a bearing on how well learners do in school (Cummins, 2000; Ziai,2008). Parental participation is highly encourage in Namibia and their role is institutionalised in the Education Act 16 of 2001.The parents must be the majority on school boards and parent-teacher meetings must be held at least once a year. According to SACMEQ III study 75% of the reading teachers met with parents more often than that (Miranda et al.,2011). We looked at parents' attitudes with regard to education and how that may influence achievement. We considered "help with homework"; if "parents have spoken to the teachers"; and "have been in their classrooms" as indicators of how much the parents were involved in the children's schooling. 82% of the parents claimed that they helped their children with homework. This is higher than what is reported in a national study which found that 60% of the parents make sure that the homework is done (Mukuwa, 2004). Furthermore, 82% of household heads said that they have spoken to their children's teachers but only 58% have been inside their classrooms. Parents with children not doing well in school were more likely to have spoken to their teacher than other parents. This shows that schooling matters for most parents. Further data analyses revealed that the attitudes of parents also differed across income levels. While 100% of children from both average and well-off areas received help with homework, this was the case for only 65% of those from poor households. It was also found that 67% of poor households had never been in their children's classrooms as opposed to 10% and 27% of average and well-off households respectively. In a study in Windhoek, Möwes (2004) confirms these conclusions: he found that large classes, lack of learning material, low student performance and low parental involvement are causes of low achievement.

Even though many learners are not doing well in school the parents are in general satisfied with the education their children are getting and believe that further education would benefit their children. 75 % of the parents interviewed said that they thought their children were getting a good education and 100 % wished they could continue after finished primary education. It is interesting, however, to notice that whereas 33 % of the parents with less than primary

education said that their children were not getting a good education, the corresponding figure for parents with more than primary education was 11 %, and none of the parents with higher education complained about the quality of the school. It is plausible to draw the conclusion that these findings are due to the fact that in Namibia there are quality differences between primary schools. Partly this is reflected in the cost of attending these schools. So children from better-off homes are sent to better schools where they stand a better chance of getting quality education.

Language seems also to be a factor effecting achievement but the correlation is complicated. Learners with English as their mother tongue and also learners attending English medium schools did better in school than average. Furthermore, learners with an English or Afrikaans background less often repeated class if they were instructed in their mother tongue. But learners with Oshiwambo repeated more often it they were taught in their mother tongue than if they were instructed in English or Afrikaans. This is contrary to the general idea that mother-tongue instruction is the best. In general Oshiwambo speaker were more likely to repeat than the other two language groups (table 2). Results of the schools' case study confirmed this. This might be because the best schools had either English or Afrikaans as the medium of instruction from grade 1 and many of the schools offering other mother tongues were schools of lesser quality. Data indicate that this is in accordance with parents' perception of school quality. 95% of the richer and average rich households sent their children to schools with either English or Afrikaans as a medium of instruction from grade 1 compared with only 57% of the poor households.

Table 2. Language of instruction and repetition of class

	Repeated class	
English mother tongue		
Taught in mother tongue	14 %	
Afrikaans mother lounge		
Taught in mother tongue	25 %	
Taught in English		40 %
Oshiwambo mother tongue		
Taught in mother tongue	54 %	
Taught in English		41 %
Taught in Afrikaans		43 %

N=120

The education system encounters both quantitative and qualitative problems. Investments have not been able to keep up with population growth of 2.6%, and thus the resource situation in the school has deteriorated. For instance learning materials like textbooks are less available in government schools. In 2000, 47% of the learners reported that they had their own reading book; in 2007 it was only 32 % (Miranda et.al 2011). Doing homework is difficult without textbooks. The number of unqualified teachers is another problem: the majority of grade 6 learners in 2007 were taught reading by teachers who had only up to secondary education. And 10 % were taught by teachers who had only primary education (Miranda et al., 2011).

To sum up, learner achievement in primary education in Namibia is generally low. In addition, there are striking differences between schools, regions and learners. Learners from the lower socioeconomic quartiles are far behind those coming from richer households. Another factor which might explain some of the variation is the language of instruction. It is a fact that many children are taught in a language they do not understand or speak and this puts them at a disadvantage and explains the low achievement of many Namibian learners. Often these children come from poorer families (Wikan and Mostert 2011). The fact that not only does the richest quartile get higher reading scores but the standard deviation is wider than in the poorer quartile, which indicate that richer learners are offered better education.

CONCLUSION

The factors affecting school achievements are interlinked and are furthermore correlated with the quality of the school the learners are attending. We see that learners from rural areas achieve lower than those from urban areas and we know that rural school more often have fewer resources and less qualified teachers than urban schools. Wealthier and better educated parents can afford to send their children to the better schools and they more often tend to live in urban areas. Parents in this sample mostly saw education as very important and all wanted their children to continue after primary level.

Another conclusion is that unequal access to quality education reproduces inequality in Namibian society. It is a result of a number of background variables that work to the disadvantage of children from poor households. Children from poor households repeat more often and also achieve lower than children from wealthier households. This is not only

because they attend different schools; richer parents more often speak English at home and the children therefore stand a better chance to do better in school because they are more exposed to the language of instruction. This conclusion is supported by national studies as well as case studies (Miranda et al., 2011, Wikan and Mostert, 2011, Möeves, 2004). In fact many learners from lower socioeconomic background are functionally illiterate in grade 6. Thus inequalities in access to quality education in Namibia persist despite efforts to eradicate them and this is evident in the distribution of access, learning outcomes and resource inputs to education (Marope 2005). While a small percentage of privileged children enjoy a high standard of education, the majority of children in Namibia do not receive an education of such quality (Garrouste, 2011, Government of the Republic of Namibia, 2007).

The Namibian primary education system is not able to reduce social inequalities; on the contrary, it amplifies inequalities that are already there. For a large number of children in Namibia enrolment in school does not mean that they achieve even the basic reading competence that is a key factor for development of other capabilities. This is a loss for the individual. For Namibian society it means that the return on educational investment is low and investment in education is not a motor for economic growth or poverty eradication. The situation in Namibia seems to be in line with findings in a cross-country study of poor countries done by Pritchett (2001). He concludes that educational quality has been so low that years of schooling created no human capital.

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