

## TOWARD DEVELOPING AND VALIDATING A MODEL FOR IMPLEMENTATION OF LEARNING OBJECTS

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**Abstract:** The fundamental concern of present mix method study is developing a valid model to implement Learning Objects (LO). LO is any digital resource that can be used and reused to support learning (Wiley 2003). LO is one of the most important and recent innovations in Instructional Technology which guides the next generation with the potential of reusability, adaptability, productivity and durability (travel well) of E- learning material. Investigation into Learning Object Repository (LOR) which has plenty of LOs to select from and implementing the right one need some pointwise criteria. The research presents and categories criteria to select LOs. In the first stage qualitative content analysis was adopted to develop the LOs' Implementation Model (LOIM) and the LOs' evaluation questionnaire then in order to validate the proposed model a pretest -posttest experimental design was adopted. A total number of 72 B.Ed students by purposive sampling technique were selected. Then the students were taught through LOs which were selected base on criteria proposed in the LOIM. Lisrel output of SEM technique to establish external validity of LO's implementation model indicated good fitness of LOIM on data. The models presented in the present study unlock the doors to sustainable advantages of LO.

### INTRODUCTION

E- Learning innovation in educational technology has had massive changes in the teaching- learning system, and has created a new paradigm in education. When E- Learning emerged a strange revolution occurred in storage, retrieval and sharing of instructions or information and the delivery of learning material. In this way, design, development, delivery and the implementation of educational material has changed. E-learning can customize content for different learning needs or different groups of people and can also be updated instantaneously. This benefit of E- Learning is raised in a Learning Object (LO). LOs are small but pedagogically complete segments of instructional content that can be assembled as needed to create larger units of instruction, such as lessons, modules and courses. LOs can be personalized for different learners and also the objects can be reorganized promptly by the user community who share the knowledge and the content. The fundamental idea behind LOs is that instead of traditional long courseware packages, the curriculum content can be broken down into small components and then be used and reused several times in different contexts.

#### Learning Object

Wayne Hodgins, a well-known E-learning expert coined the term LO in 1992. He was watching one of his children playing with Lego building blocks while mulling over some problems regarding learning strategies. Wayne realized right there that the industry needed building blocks to learn plug and play interoperable pieces of learning. He termed those building blocks LOs (Northrup 2007).

LOs are one of the most meaningful and effective way of producing online learning resources (Polsani 2006). Although we are not generally accustomed to reusing resources developed for one purpose for other purposes (Doiron & Davies), LOs have overcome this custom. A LO is defined as the smallest independent structural experience that contains an objective, a learning activity and an assessment (L'Allier 1997). It is the minimum meaningful pedagogical unit like an atom which is a small "thing" that can be combined and recombined with other atoms to form larger things. LO may include anything from a set of learning outcomes, learning designs or whole courses to multimedia and other forms of resources, as long as they are kept in an electronic format that has the potential to promote learning.

The use of the term "object" itself has its roots in Computer Science where the term is used to describe an entity consisting of data and related operations(Adams and Williams 2006). In object oriented programming with an LO approach, content is designed as small units of learning that support potential reuse, which can stand alone, and can be made accessible to meet the "just enough" and "just-in-time" requirements of learners. LOs are components of a course that can be reused in various avenues. An object in this context is generally understood as an amalgamation of related variables and methods. Therefore, an object that can promote learning and teaching is seen as an "LO"(Fairweather and Gibbons 2006).

The Technology Standards Committee in the IEEE states that "an LO is defined as any entity, digital or non-digital, that may be used for learning, education or training"(IEEE 2002). Cisco approaches to LO as, "A container of the learning objective, activities, and content" (Balatsoukas, Morris et al. 2008).

Wiley defines digital LOs as “any digital resource that can be reused to support learning”(Wiley 2003). His definition describes reusable digital resources and rejects non digital, non-reusable objects. Weller, (2003) defines LO as a digital piece of learning material that addresses a clearly identifiable topic or learning outcome and has the potential to be reused in different contexts.

Polsani, gives a more constrained definition: “An LO is an independent and self-standing unit of learning content that is predisposed to be reused in multiple instructional contexts” (Polsani 2006).

There are three key features of LOs that benefit a students’ learning:

- Visual supports, which help make complex ideas more easily understood by reducing working memory and cognitive load
- Motivation through increased focus, and
- Control over learning(Kay and Knaack 2008).

### Ingredients of Learning Objects

The “materials” in a learning object can be documents, pictures, simulations, movies, sounds, and so on. Structuring these in a meaningful way implies that the materials are related and are arranged in a logical order. But without a clear and measurable educational objective, the collection remains just a collection.

### Characteristics of Learning Objects

The following are the characteristics of LO:

- Reusability: A key attribute of LOs is their discrete nature. Discreteness enables LOs to be categorized and stored independently, and reused in a range of educational settings for multiple purposes. LOs consist of content and presentation. The presentation part creates an opportunity for reusability with every new multimedia environment. Content is independent of learning context. To be reusable LOs should be designed to separate the contents into presentation, structure, pedagogy and context. LOs are not rival resources because they can be utilized simultaneously by many people (Wiley 2003). Dodani (2002) referred to reusability as “the cornerstone of the promise of LOs”. Maximum reusability depends on how readily the object can be removed from any particular context.
- Granularity: Granularisation refers to the size of the LO and ‘is a necessary condition for LOs to be shared and reused’ (Duncan, 2003). Size does not refer to the physical size of the object, rather it refers to the amount of information conveyed to the learner by it (Hamel and Ryan-Jones 2002). The smaller the LOs the higher the level of granularity and also higher the level of reusability (Polsani 2006). But as Merrill mentioned LO can be as small as a drop and as big as the ocean. The Size of the LO depends on the curricular structure or technical details (Merrill 2012).
- Accessibility: LOs are generally understood to be digital entities that are accessible over the internet, meaning that any number of people can access and use them simultaneously in contrast to traditional instructional media, such as an overhead projector or a video tape, which can only exist in one place at a time. LOs can be identified and located when they are needed to meet training and educational requirements. A teacher can conduct an online search for training on a specific topic and identify LOs for specific organizational needs.
- Interoperability: LO must also be interoperable in a range of educational environments otherwise the potential for reuse is compromised, which will clearly impact the LOs’ value and use. The content functions in multiple applications, environments, hardware configurations regardless of the tools used to create it and the platform on which it is delivered.
- Interactivity: Wills (1996) states that interactivity should be more than just point-and-click. It engages the learner in a challenge based on manipulating the information. Interaction may be better defined as engagement.
- Aggregability: LOs can be grouped into larger collections of content, including traditional course structures. Currier and Campbell proposed seven levels of aggregation of learning content and LOs are at the third level.

The levels aggregation proposed are:

1. Information objects: raw data, such as an image with no learning objective.
2. Information resources: collections of information objects, such as e-book, with no educational objective.
3. LOs: aggregations of information resources that serve a specific learning objective and may facilitate the execution of a learning activity and assessment.
4. Unit of study: an aggregation of LOs and information resources or objects, such as a lesson.
5. Module: an aggregation of units of study and LOs.
6. Course: an aggregation of units of study, modules, or other LOs and resources.
7. Collection: an aggregation of modules and courses, with no educational objective assigned and merely serving as a searchable database for LOs.(Currier and Campbell 2005)

### Learning Objects' Repository

LOs require some type of receptacle for the purpose of holding and sharing them with others. The term used for these receptacles is Learning Objects Repositories (LOR). LORs enable LOs to be easily located, shared and reused in a variety of educational settings. LORs provide access to a vast store of LOs such as animation, videos, simulations, educational games, multimedia texts and music files. LORs are the libraries of the E-learning era (Richards, McGreal et al. 2002). They provide an indexing facility where users can add new LOs together with their metadata and store them in these database. LOR can make sense of distributed learning which uses network communication technologies to share LOs among repositories through well researched user interfaces and architectures that make them easy to use and permit various levels of interactivity. LORs provide the ability to locate and browse LOs as well as to continue creating versions and to perform maintenance. Storing, maintaining, and producing LOs in a digital LOR is different from a traditional one. Objects in an LOR need to be produced in ways that will permit use in multiple contexts. A successful digital LOR promotes the sharing of records along with being able to facilitate access to the LO. It must also provide mechanisms for creating multiple instances of an item to be simultaneously used by different users. It gives the users an opportunity to comment (Cervone 2012).

There are two major categories of LORs:

The first category includes those LORs that contain both the LOs as well as LOs' descriptions in the form of metadata. The repository may be used to both locate and deliver the LO.

The second category includes LORs containing only the metadata descriptions. In this case, the LOs themselves are located at a remote location and the repository is used only as a tool to facilitate searching, locating and accessing the LOs from their original location (Metros & Bennet, 2002).

### Implementation of Learning Objects

Implementation is the realization of an application, or execution of a plan, idea, model, design, specification, standard, algorithm, or policy. The best plans and programs will not work if they are not implemented. A plan, when implemented, finds its true worth. Selection of appropriate LOs and delivery of them to learners are challenging tasks of E-Learning, because the LOs' content must be provided to an acceptable level of the learner's understanding (Biletskiy, Baghi et al. 2009). Wiley (2002) proposes three components that constitute a successful LO implementation:

- An instructional design theory,
- A LO taxonomy,
- Prescriptive linking material to connect theory to taxonomy.

Stewart suggested three criteria for choosing LO viz.,

- 1) Each element should be discrete, separate and stand alone
- 2) Select homogeneous LOs
- 3) No element be a subset of another (Stewart, Stewart et al. 1981).

### LITERATURE REVIEW

SabihaYeni(2012) conducted research to determine 74 teachers' and 107 teacher candidates' use of digital materials from the internet and their awareness of LOs. The results indicated that although most of the participants frequently used internet resources, they did not know much about LOs.

Guthrie on his study demonstrated that teachers sought LOs which are dynamic, motivating, and appropriate to use on the computer and they were found to develop their students' conceptual knowledge. Kid friendly and graphic-rich LOs as well as feedback on correct and incorrect responses were characteristics sought by teachers for their English Language Learners (Guthrie 2010).

Pythagoras Karampiperis (2006) selected LO based on learners' cognitive characteristics. First they recognised the learners' cognitive characteristics by help of Cognitive Trait Model. Then they simulated different behaviors of learners for navigating in hypermedia LOs space and measured the selection success. The results showed that the proposed selection methodology could dynamically update the internal adaptation logic leading to refined selection decisions (Karampiperis, Lin et al. 2006).

Conceicao and Lehman belended LOs into traditional face-to-face classes, the LOs were used by learners at their own pace and time as instructional aids. Results indicated that some of the students were not able to solve the problems of technology issues. When the computer crashed, they became frustrated and decided not to use the LOs. In other instances, students were not familiar with downloading the required software, and rather than asking they were found to decide not to use the LOs(Conceicao and Lehman 2003).

### Need and significance of the study

E- Learning in education has elicited growing enthusiasm which has naturally been followed by extensive research, which has been conducted all over the world to examine the influence of it, on the learning process but

research into instructional material, especially the criteria in the selection and implementation of LOs is necessary. It is widely acknowledged that the role and influence of LOs on learning and teaching is optimized, especially when it is skillfully integrated into the educational experience (Schank & Cleary, 1995; Schank, 1997). While the concept of LO has received considerable attention in the educational community, there is no model to select and implement it.

Agostinho (2004) notes that we are at risk of having digital libraries full of easy-to-find LOs we do not know how to use in the classroom. Among the huge amount of objects available on the internet, recognition of a proper LO is difficult. Selection of an appropriate LO is complicated because many LOs are visually similar. Next the question of how an appropriate LO can be recognized arises. Present research study attempts to answer this question by proposing a model to implement LOs. The model for implementation of LOs that is presented in this study would be of great use to educationalists, educational technologists and students. The model that is developed herein attempts to propose methods for extraction, use and evaluation of LOs.

## METHODOLOGY

### Objectives

The study was undertaken with the following objectives:

- To develop an LOs' Implementation Model.
- To validate the LOs' Implementation Model.

### Research questions

The objective of the study is to discover the criteria for implementation of LOs. Specifically the study aims to answer the following questions:

- What is the appropriate model for implementation of LOs?
- How valid is the proposed model from the point of view of users?

### Operational definitions

Some of the key terms that are used in this study are defined operationally as follows:

**Learning Object:** LO is defined as a digital resource that can be reused to support learning. LOs are operationally defined in this study as 349 LOs which are implemented to include images, videos (animation and motion picture) and mind maps, selected based on criteria which LOIM suggests.

**Evaluation of LOs:** Evaluation of LOs refers to a systematic determination of LO's merit, worth and significance, using criteria governed by a set of standards. This study was carried out by the LO evaluation questionnaire which included these five items: technical factors, content quality, pedagogical factors, computer related issues and ease of use of LOs. Students who used LOs evaluated them by rating them via the above mentioned criteria in the LOs' evaluation questionnaire.

**LOs' Implementation Model:** A model represents concepts and relationship between the concepts. LOIM in the present study refers to the model which is developed by the researcher for implementation of LOs.

### Research method and design

Different research purposes require different research designs and analysis techniques (Knafl & Howard, 1984).

Research design is determined by the notion of fitness for purpose (Cohen, Manion et al. 2013). This research study aimed at first developing the LOIM and second validation of it. The nature and aims of the research indicate that both quantitative and qualitative methods of research need to be adopted and hence this is a mixed method research study. While qualitative methods used in the study aim at comprehensive understanding of LOs and the development of LOIM, quantitative methods are aimed at the validation of the model.

### Qualitative Methods

In this research, qualitative content analysis, which was done by the software MAXQD10, has been used for the following purposes:

- 1- To generate categories of characteristics of LOs to develop the LOIM.
- 2- To construct the LOs' Evaluation Questionnaire

Content analysis is any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings (Patton, 2002). Researchers regard it as a flexible method to analyze text data (Hsieh and Shannon 2005). Content analysis goes beyond merely counting words or extracting objective content from texts to examine meanings, themes, and patterns that may be manifest or latent in a particular text. (Zhang and Wildemuth 2009)

The stages suggested by Krippendorff (1980) in the process of Content Analysis were followed to understand the LOs characteristics, and to develop the LOIM and the LOs' evaluation questionnaire.

1. Preparing the texts (data): Articles, papers, books, and other text related to LOs, their characteristics were collected to develop LOIM. Resources collected in these areas formed the population of text that were used to carry out the content analysis.

2. Defining the unit of the analysis: The theme involving a single word, a phrase, a sentence, a paragraph, or an entire document was used as a unit of analysis.
3. Coding on a sample of text: The label tagged to each theme formed the code. To test clarity of codes a sample of text was analysed and coded. Then the coding consistency was checked through an assessment of inter-coder agreement. Revision of the text showed that the consistency in coding was high.
4. Coding all the text: Totally 460 codes were extracted while coding was checked repeatedly to prevent “drifting into an idiosyncratic sense of what the codes mean” (Schilling, 2006).
5. Developing categories and subcategories: 25 sub categories were developed by sorting similar codes based on how different codes were related and linked together. Then similar subcategories were sorted into categories based on how different sub categories are related and linked. Five categories of LOs’ characteristics were derived from theoretical construction of LOs.
6. Drawing conclusion: In this stage the researcher made inferences and presented her reconstructions of meanings derived from the data. This involved the LOIM and the LOs’ Evaluation Questionnaire.

After the LOIM was developed and tools were constructed, the LOs were selected based on the LOIM in two units of an EP course of the B.Ed degree, namely “Understanding the learner” (Growth and Development, Cognitive Development, Psycho-Social Development, Constructivism Learning Theory, Needs and Problems of Adolescents) and “Personality and Group Dynamics” (Personality, Mental Health and Mental Hygiene, Adjustment, Conflict, Frustration, Defence Mechanism and Group Dynamics).

Table No.1: Number of LOs which were selected to implement

Media asset Type of LO	Image	Video	Mind map	Total
Fact	151	7	2	160
Concept	66	18	9	93
Procedure	20	3	14	37
Principle	24	4	3	31
Process	9	15	4	28
Total	270	47	32	349

Table No.1 shows the number of LOs that were used based on the type of LO (fact, concept, process, procedure, and principle) and the type of media asset (image, video, and mind map). Cisco’s categorisation of LOs (which include fact, concept, process, procedure, and principle) were used to categorise the LOs. All the LOs have used text and this has been one of the most important ingredients of the LOs. Totally 349 LOs were implemented in this study. Table No.1 shows the number of LOs based on the type of LO and media asset.

#### Quantitative Methods

B.Ed students who had been selected by the purposive sampling technique were taught through LOs. The selected units in EP by the researcher in 16 sessions spread over a period of three months. Finally post-tests viz, Interest inventory and Achievement test in the EP and the LOs’ evaluation questionnaire were administered.

#### Sampling

The population of this research was considered from two perspectives and hence the sampling techniques were adopted accordingly.

- 1- In order to carry out content analysis to develop LOIM and construct the LO’s evaluation questionnaire, all books, articles, and papers related to LOs were indexed in scientific databases. Sampling inside this population was the purposive technique that followed gradual selection. Samples inside the resources were selected based on their potential contribution to the development of the structure. This process was repeated so that the researcher selected and analysed the text that were renowned and popular, and then more samples were selected to refine the categories and models that were emerging. This process continued until data saturation was achieved, the point at which no new insights and knowledge were achieved (Glaser and Strauss 2009). Considering that there were many resources in the LOs, sampling was done based on the fame of the resources in different databases namely, Science Direct, Elsevier, ProQuest, Emerland and Blackwell Publishing. First all text was based on the following key terms: LO, LOs’ characteristics, LOs’

evaluation. They were downloaded and disposed based on the level of fame of the resources, then content analysis was done from the most to the less important resource. When the researcher reached saturation point, where in the researcher stopped receiving new texts and ideas, the sampling was stopped.

- 2- Sample of B.Ed students: In order to conduct the experiment 72 students from B.Ed colleges affiliated to Mysore University, India were selected by purposive sampling technique.

Table No.2 presents distributions of the sample by gender, age, subject and computer knowledge.

Table No.2: Distribution of sample by Gender, Age, Subject and Computer knowledge

		Frequency	Percent
Gender	Male	31	43.05%
	Female	41	56.94%
Age	20-24	40	55.5%
	25-29	11	15.27%
	30-34	10	13.8%
	35-...	11	15.27%
subject	Biology & chemistry	10	13.8%
	History & language	28	38.88%
	Geography	11	15.27%
	Math & physics	23	31.94%
Computer knowledge	Poor	4	5.5%
	Moderate	50	69.4%
	Good	13	18.5%
	Very good	5	6.9

#### Tools

##### Learning Object's Evaluation Questionnaire

Since there were no tools available to evaluate the quality of LOs from the students' point of view, the LOs evaluation questionnaire was constructed( appendix A). The data collected from this questionnaire was also used to validate the LOIM. Items extracted through content analysis were transformed into question form. The draft of the questionnaire was constructed in two parts: Part A included demographic information (gender, age, and subject) and Part B included 81 questions which referred to the quality of LO directly or indirectly. Each question was followed by a five point scale ranging from 1-5(low to high).

In the next step, the preliminary draft of the LO's Evaluation Questionnaire was discussed with experts in the field of LO and ICT. Modifications were made to improve the language, to remove ambiguity and to make the items comprehensible to the students. This resulted in the deletion of 23 items and 58 items were retained in the final questionnaire. The students graded the implemented LOs, scores of items in the questionnaire were summed up to estimate the score given to the LOs.

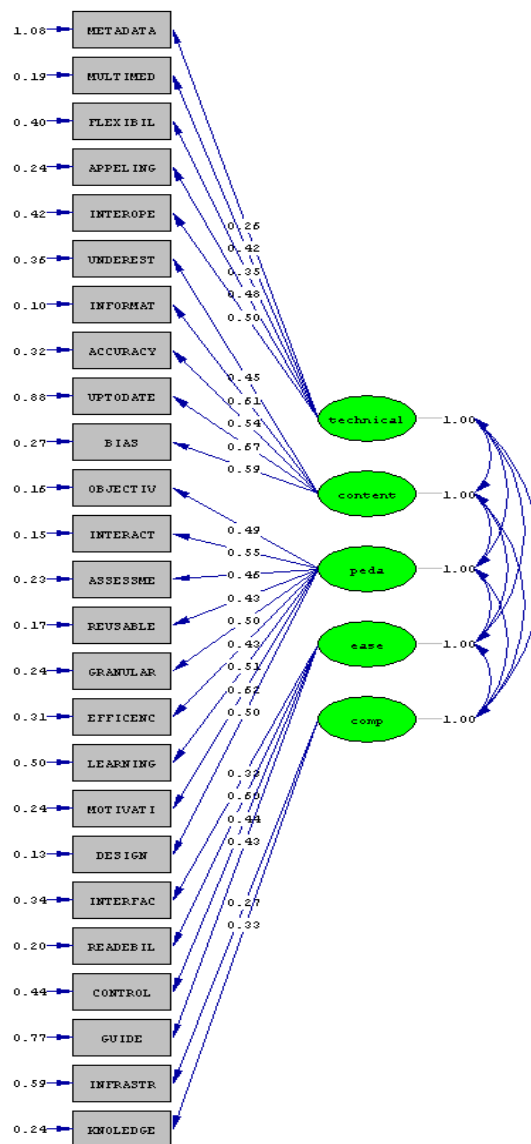
The face and content validity of the LOs' evaluation questionnaire was established by experts in the field of LO and ICT.

##### Construct validity of LOs' Evaluation Questionnaire:

Confirmatory Factor Analysis (CFA) was adopted to establish construct validity of the tool. Since it involved investigating the structure of multivariate data, each of a set of observed variables was represented as a linear combination of unobserved latent variables or factors, plus an independent error term. CFA measures the relationship between observed and latent variables or factors. A fundamental feature of CFA is its hypothesis-driven nature, which means that the researcher must have a priori sense based on past evidence and theory, of a number of factors that exist in the data and of which indicators are related to which factors(Brown 2012). A "good model fit" only indicates that the model is plausible.

Figure No.1 depicts CFA Lisrel output. It shows the path diagram and the chi-square goodness of fit test as well as the Root Mean Square Error of Approximation (RMSEA).

Figure No.1. Lisrel CFA output of LO's quality



Chi-Square= 427.46, df= 465, P-Value= 0.119, RMSEA= 0.023

- Figure No.1 shows non-significant Chi-Square with p-value of 0.119 which means that the empirical correlation matrix does not differ significantly from the fitted covariance matrix. Ideally, the chi-square statistic's p-value should be greater than 0.05
- Then the chi-square was divided by degree of freedom, Chi/df was found to be 0.919 which is less than 3 implies goodness of fit. Ideally the chi-square divided by the degree of freedom has to be as small as possible.
- Root Mean Square Error of Approximation (RMSEA): RMSEA value of 0.023 which is less than 0.05 shows a low difference ratio between the fitted covariance matrix and the empirical data-matrix indicating a close fit of the model.

Table No.3 shows additional measures of goodness-of-fit of the model. These measures of fitness indicate that the model fits the data.

Table No.3: LO's characteristics indicators fitness

Statistics	Value
Chi- square	426.46
P- Value	0.119
Df	465
Chi/df	0.919
RMSEA	0.023
GFI	0.92
RMR	0.02
AGFI	0.94

- Obtained RMSEA value of 0.023 and RMR (Root Mean Square Residual) value of 0.02 shows good fitness of the model. RMR value ranges from 0 to 1, with a value of 0.08 or less being indicative of an acceptable model while RMSEA less than 0.8 indicates an acceptable model
- Obtained GFI (Goodness of Fit Index) value of 0.92 and AGFI (Adjusted Goodness of Fit Index) value of 0.94 indicates good fitness of the model. GFI is a measure of fitness between the hypothesized model and the observed covariance matrix. AGFI corrects the GFI, which is affected by the number of indicators of each latent variable. The GFI and AGFI greater than 0.9 indicate an acceptable model fit.

Table No.4: Factor Loading for LO's Indicators

Factors	Indicator	Factor loading	% of variance	Item No.
Technical factor	Metadata	0.25	15	53
	Effective multimedia	0.42	81	8, 16, 44, 45
	Flexibility	0.35	60	18, 55
	Appealing Appearance	0.48	76	47, 48, 52
	Interoperability	0.50	58	14, 50
Content factor	Understandability	0.45	84	31, 49
	Appropriate level of information	0.61	90	342, 34, 42
	Accuracy and veracity	0.54	68	33, 36
	Up-to-date	0.57	12	38
	Free of Bias	0.59	73	39, 40
Pedagogic al factor	Learning Objective	0.47	84	9, 61
	Interaction and engagement	0.55	85	12, 11, 19, 28
	Assessment	0.46	77	10, 13
	Reusability	0.43	83	17, 51, 58
	Granularity	0.50	76	21, 27, 28
	Efficiency	0.43	69	15, 56
	Learning- oriented	0.51	50	24, 25
	Motivating	0.52	76	23, 41
Ease of use	Instructional design	0.50	87	22, 26, 46
	Interface	0.33	.66	2, 4, 6
	Readability of text	0.59	80	3, 43
	Feeling of control	0.44	56	1, 5
Computer issues	Guide for use	0.43	73	20
	IT Infrastructure	0.27	41	564
	Computer knowledge	0.33	76	2, 57

Table No.4 shows that the five factors to evaluate LOs which is depicted in Figure No.2. are:

- 1- Technical factors: include metadata, effective multimedia, flexibility, appealing appearance, and interoperability.
- 2- Content factors: include understandability, appropriateness of level of information, accuracy, and veracity, being up-to-date and free of bias.
- 3- Pedagogical factors: include Learning Objective, interaction and engagement, assessment, reusability, efficiency, granularity, learning orientedness, motivation and instructional design
- 4- Ease of use: includes interface, readability of text, feeling of control and guidance for use
- 5- Issues related to computer: include suitable infrastructure and computer knowledge.



### Reliability of LOs' Evaluation Questionnaire

To determine the reliability of the LO's evaluation questionnaire Cronbach's Alpha method was employed separately for five subscales of the questionnaire.

Table No 5: Reliability of LO's evaluation questionnaire

Subscale	Number of items	$\alpha$
Technical factors	12	0.805
Content factors	10	0.801
Pedagogical factors	23	0.919
Ease of use	8	0.766
Computer issues	3	0.71

As Table No.5 reports, Cronbach Alpha for technical factors is 0.805, content factors is 0.801, pedagogical factors is 0.919, ease of use is 0.766 and computer issues are 0.71. Cronbach Alpha which was found to be greater than 0.7 in all five subscales of the questionnaire indicates reasonable trustworthiness of all the subscales. Hence LOs' evaluation questionnaire was found to possess high reliability.

### Interest Inventory in Educational Psychology

An interest inventory was necessary to obtain insight into the students' interest in EP. There were a number of tools to measure students' interest in subjects such as science or maths, but there are no tools to measure student interest in EP. The researcher constructed an Interest Inventory in EP.

By content analysis of several books, articles and theoretical framework, factors related to the variable interest in EP were extracted and the inventory was constructed including 30 statements which included positive and negative statements. Each statement is followed by a five point Likert scales ranging from strongly agree to strongly disagree. To check on Face and Content validity of the tool the inventory was scanned and reviewed by experts in EP and Psychology. Their suggestions were incorporated and modifications were made.

#### Reliability of Interest Inventory in EP

Cronbach's Alpha was adopted to measure the reliability of the Interest Inventory in EP. The Cronbach's Alpha correlation coefficient was found to be 0.869 which indicated a high index of reliability.

### Achievement Test in Educational Psychology

An achievement test in EP was constructed by the researcher.

### Statistical Technique to Analyze Data

A brief explanation of statistical techniques are given below:

#### Factor Analysis

Factor analysis is the statistical technique that takes a lot of information and reduces this mass of information into a simple message that is easy to understand. In this research, it was used to establish construct validity of the LOs' evaluation questionnaire. This is helpful to find out whether these facets and aspects really do reflect the specific variables or not. This technique enables the researcher to identify where different variables are in fact addressing the same underlying concept.

#### Structural Equation Modeling

SEM (Structural Equation Modeling) is a multivariate analysis with latent variables for testing and estimating casual relations using a combination of statistical data and qualitative casual assumption. SEM allows both confirmatory and exploratory modeling. SEM suites both theory testing as well as theory development (Judea Pearl 2000). In this study SEM was used for the validation of LOIM.

## FINDINGS

### Development of Learning Objects' Implementation Model

Research Question 1: What is the appropriate model for implementation of Learning Objects?

To answer research question one a model (as depicted in Figure No. 2) is proposed for implementation of LOs. Elements of the model are based on indicators which are derived from the qualitative content analysis of resources in LOs.

Figure No. 2: Learning Objects' Implementation Model

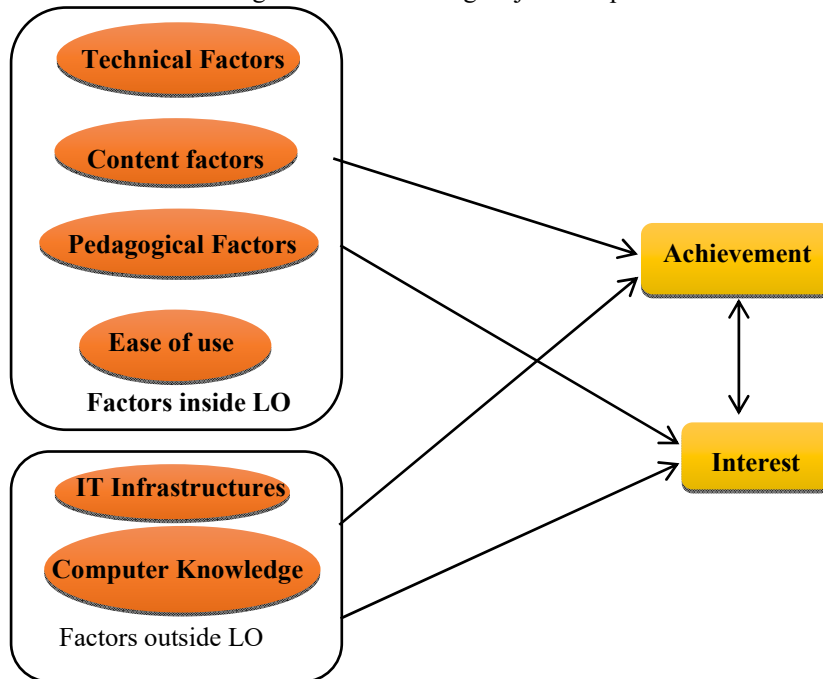


Figure No.2 shows that in general the model proposes that two main categories, namely factors inside and outside LOs, play a vital role during the implementation of LOs to achieve the targets. Well designed and produced LOs along with proper infrastructure and users with common knowledge of the computer are expected to enhance Interest and Achievement when there is an interaction between Interest and Achievement in EP.

The following four factors are related to inside LOs:

- 1- Technical factors: technical factors refer to those characteristics of LOs that pertain primarily to the engineering principles involved in producing it. The technical factors include:

**Metadata:** they are the descriptors about an LO which act as an identity card to the LO in a repository of LOs. The metadata helps the users to locate an LO easily and extract it quickly without browsing through all the individual LOs in a repository.

**Effective multimedia:** Multimedia design is related to the designing of LO. LO can be viewed as a small multimedia element. Effective media covers just one learning objective which can be used independently; it is also repurposable and may be adapted by others. Comprehensive sound, image, video, graphics, and their appropriate placement are criteria to make multimedia effective.

**Flexibility:** Flexibility relates to designing the content so that it can be used in multiple contexts. Content designed with multiple uses and contexts in mind can be reused much more easily than content that has to be rewritten for each new use.

**Appealing Appearance:** the LOs' appearance should be attractive. It is estimated based on the color scheme, material packaging, and the integration of the different parts of audio, video, text, and sound content.

**Interoperability:** the ability of a LO to be used on multiple systems, and is commonly called the "plug and play" feature. It is the consideration of different functions in application, hardware and software and a common interface between various systems. Interoperable LOs are usable in different computers and with different operating systems.

- 2- Content factors: the LO should be appropriate from the point of view of its content. Content factors include the following subcategories:

**Understandability:** the content of the LO should be simple to understand with an unambiguous and clear text. Sometimes using graphs and charts help text to be more understandable.

**Appropriate level of information:** This criterion refers to the level of adequacy of information and its detail, which should not be too easy nor too challenging. An appropriate amount of text presented on each page is also important.

**Accuracy and veracity:** According to these criteria the text should be free of grammatical and spelling mistakes and should be accurate.

**Up-to-date:** Content should be in accordance with the newest or latest techniques, ideas, standards or styles.

*Free of bias:* The text should have a neutral point of view and should not be against an individual, religion, social class, political group, or race. Content with entrenchment is not usable for different categories of learners.

3- Pedagogical factors: Pedagogical factors are criteria related to pedagogy which include the activities of educating, instructing or teaching, and activities that impart knowledge or skill. The following are the factors related to pedagogical factors in the LOIM:

**Learning Objective:** Learning objectives provide guidance of all stages from instructional content, strategies, tactics, and media to assessment. Each chunk of an LO should have a clear learning objective.

**Interaction and engagement:** Learning theories suggest that when the learner is engaged in an LO and is in interaction with it, meaningful learning occurs. Accordingly the LO should engage the learner to provide immediate feedback to an answer.

**Assessment:** To evaluate the learning progress, the LO has to include simple and flexible formative assessment procedures. Each LO should possess assessment material appropriate to the content.

**Reusability:** the ability to use the LOs in varying learning contexts and with learners from differing backgrounds. For example, teachers of different grade levels or subject matter may use the same learning object in different contexts for different learning purposes.

**Granularity:** Granularity refers to the size of the LO. The more granular an LO is, the less it is tied to a specific learning context making it more reusable.

**Efficiency:** The user should be able to use the LOs successfully without wasting time or energy. Since designing and developing an LO is time consuming, efficiency is judged by the learner's sense of learning or by the achievement test in the field.

**Learning- oriented:** an LO is learning- oriented by nature. A successful LO should concentrate on learning and not on other issues such as context and hence should follow a learning- based approach.

**Motivating:** An LO should be able to motivate and create learning interest in learners. Well- designed and produced LOs can attract and hold the attention as well as stimulate the learners' interest in the field.

**Instructional design:** instructional design is the matching and alignment of all the components. Mismatching of the components leads to incomplete instruction and the failure of the LOs. The LO's production process should follow the instructional design principle.

4- Ease of use: ease of use in general is about how user friendly the LO is. It refers to ease of navigation, predictability, and quality of the user interface, and the help features of the LOs.

**Interface:** a well-designed interface helps to control the audio and video during the use of a LO. The interface aims to produce as realistic a virtual environment as possible. There should be suitable links wherever necessary.

**Readability of text:** refers to the font, along with the proper color of the font with enough contrast with the background to make the text readable.

**Feeling of control:** feeling of control originates with LO flexibility, which helps the learner to modify the LOs to their personal preferences.

**Guide for use:** There is a need for clear instruction to help the learner when he faces problems in using the LOs. The review of the user guide helps in eliminating difficulties and solving the problems faced by learners during the use of the LO.

#### Factors outside LO

The LOs' inside competencies along with its outside factors to implementation guarantee its success. External factors include suitable infrastructure and the degree of computer knowledge of the user. The sub factors related to the LO's outside factors are:

- 1- IT Infrastructure: It is clear that without the availability of computers and network facilities, LOs are not usable. Hence basic hardware and software facilities are necessary for the operation of LOs.
- 2- Computer knowledge: A computer literate person is one who is able to use a computer and any related technology which enables the use of an LO. Computer literacy level covers a range of skills from elementary to advanced and also the level of comfort the user has when using it because he understands how computers work and operate. Fortunately, to apply LOs, a high level of computer knowledge is not required but rather a medium level of knowledge as found in regular users is sufficient. In the present study the researcher asked the students the current level of their knowledge in computer as a regular user.

#### Validation of LOs' Implementation Model

Research Question 2: How valid is the proposed model for Learning Objects implementation?

The internal validity of the model was established by experts in the field of LO and required modifications were made according to their suggestions.

In order to establish the external validity of the LOIM, experimental research was conducted and data was collected from the B.Ed students. In the experiment the responses of participants to the LOs' evaluation

questionnaire was used in order to establish the external validity of the LOIM. Seventy two students formed the evaluation team for the LOs. They graded the LOs from 1 to 5, with 1 being the lowest and 5 being the highest score. Table No.6 shows the students' evaluation of LOs.

Table No.6: Result of Students' Evaluation of Los

Indicator	Mean	Standard deviation
Metadata	3.7	0.92
Effective multimedia	4.1	0.59
Flexibility	4.06	0.68
Appealing appearance	4.2	0.64
Understandability	4.43	0.78
Level of information	4.41	1.67
Accuracy & veracity	4.1	0.78
Up to date	3.9	1.15
Free of bias	4	0.76
Learning objective	4.2	0.63
Interaction & engagement	4.07	0.61
Assessment	4.05	0.66
Reusability	4.2	0.55
Efficacy	4.06	0.65
Granularity	3.79	0.61
Learning oriented	3.9	0.87
Motivating	4.1	0.69
Instructional design	4.1	0.61
Interface	4.04	0.67
Readability	4.3	0.71
Feeling of control	3.9	0.71
Guidance to use	3.7	0.92
Infrastructure	4.04	0.65

As it is clear from the table understandability of content got the highest score (4.43) while metadata and guidance to use got the lowest score (3.7).

The SEM (Structural Equation Modelling) technique was used to establish the external validity of the model. According to the LOIM, two groups of factors affect successful implementation of LOs: LO's inside factors include: technical factors, content factors, pedagogical factors, and ease of use and LOs outside factors include: computer knowledge of the user and IT infrastructure. Well designed and produced LOs along with the computer knowledge of the learner increase Interest and Achievement while these two variables also have a mutual effect on each other.

Figure N0.3: Lisrel output of LOIM

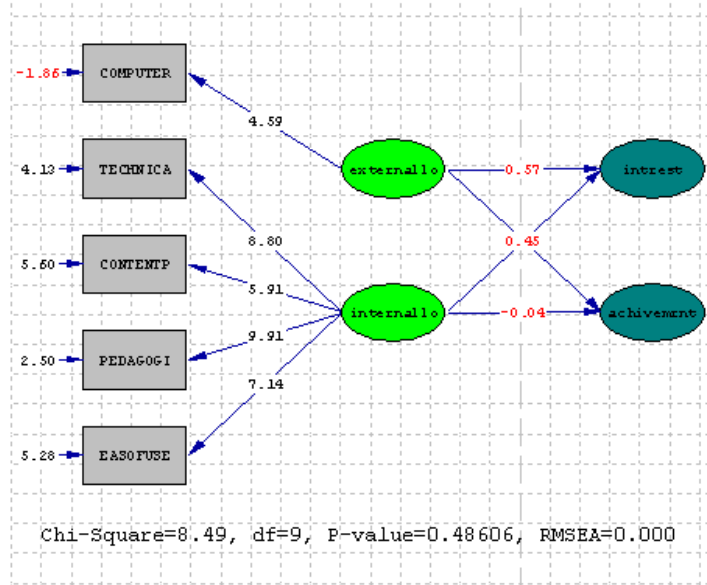


Figure No.3 shows the Lisrel output of the LOIM. Non-significant chi- square and RMSEA less than 0.05 indicate a good model fit.

- Non-significant Chi- Square with p-value of 0.48606 showed that the empirical correlation matrix does not differ significantly from the fitted covariance matrix. Ideally, the chi-square statistics p- value should be greater than 0.05
- Figure No.3 also shows that the chi- square when divided by the degree of freedom is 0.94 which shows goodness of fit. The chi- square divided by degree of freedom has to be as small as possible. If it was greater than 3 this would have implied “no goodness of fit”.
- *Root Mean Square Error of Approximation (RMSEA)*: RMSEA value of 000 shows a low difference between the fitted covariance matrix and the empirical data-matrix and hence indicates a close fit of the model. A value of the RMSEA about 0.05 or less indicates a close fit of the model.

Table No.7 shows additional measures of Goodness-of-Fit (GFI) of the LOIM. This indicates that the LOIM fits the data collected through the LOs’ Evaluation Questionnaire.

Table No.7: Fitness of LOIM

Statistics	Value
Chi- square	8.49
P- Value	0.48
df	9
Chi/df	0.94
RMSEA	0.000
GFI	0.91
RMR	0.03

GFI greater than 0.9 and RMR less than 0.05 shows good fitness of the LOIM on data. Establishing the conditions as shown in Table No.6 confirm the external validity of the LOIM, which means that the LOIM is able to justify its application.

## CONCLUSION

A structural equation model namely Learning Objects’ Implementation Model (LOIM) (depicted in Figure No. 2) and its validation is the concern of this research. As there is no guarantee that a well written book will lead to learning, producing good LOs is also not a guarantee to lead a student to learning. Other factors may play an important role. Though there are plenty of E- learning materials available on the net, this does not mean that all of them are useful. Rather learners should select the appropriate and useful LOs within the huge repositories of LOs.

Results indicate that both internal and external factors of the LOs are important to achieve the targets. The contents of an LO should be accurate, up to date and comprehensible. In each granule the appropriate level of information should be presented. Text-intensive instructions must be avoided, especially on initial screens. Since LOs have mass users they should be free of bias.

The LOIM suggests pedagogically that LOs include Learning Objective and Assessment. They should be able to motivate the learners and develop their interest. They are reusable in different contexts because they are learning-oriented. The pedagogical factors of an LO drive the learner to use it.

Technical criteria suggest that LOs should be tagged with information about them which will help the user to locate the material with ease. The principles of multimedia creation must be adhered to. Graphics, voice and animations must be used in preference to or in conjunction with the text. Sound should be available wherever necessary. Sound can be toggled on and off.

An LO is interoperable if it is useable with different operating systems. If an LO has been prepared using a font of a particular language then that particular font needs to be added to the LO for it to be interoperable. In general, LOs should be selected such that they can be run in different computer systems.

LOIM also suggests LOs should be easy to use and the user needs to have computer knowledge, which means he should know about computers and working with them as a common user. This is a strength of the LO as it shows that a high level of computer literacy is not necessary to use LO and a moderate level of computer literacy by a user is sufficient. Since mining in an LOs' repository takes a lot of time, LOIM can reduce search time. The LOIM saves teachers' time and improves confidence to achieve targets with produced LOs which are tried out and validated rather than having to produce a new one.

LOs' users should know that not all material available on the net is not worth using; finding a suitable LO is a challenge. The LOIM is a scale to identify effective LOs. It helps educators to increase the pedagogical impact of an LO in the classroom since it offers guidance to teachers who wish to select appropriate LOs. The items of the LOs' Evaluation Questionnaire available in Appendix-A present practical guidance on key features to be focussed on while selecting an LO. LOs that possess good content, sound pedagogy, and high quality multimedia increase students' performance and also lead to higher satisfaction among teachers and students. LOIM suggests that teachers assess LOs based on four criteria namely: content factors, pedagogical factors, technical factors, and ease of use before using them in their teaching-learning process.

## REFERENCES

- Adams, A. and S. Williams (2006). "Customer-Driven Development for Rapid Production of Assessment Learning Objects." *Electronic Journal of e-Learning* 4(1).
- Balatsoukas, P., A. Morris and A. O'Brien (2008). "Learning Objects Update: Review and Critical Approach to Content Aggregation." *Journal of Educational Technology & Society* 11(2).
- Biletskiy, Y., H. Baghi, I. Keleberda and M. Fleming (2009). "An adjustable personalization of search and delivery of learning objects to learners." *Expert Systems with Applications* 36(5): 9113-9120.
- Brown, T. A. (2012). *Confirmatory factor analysis for applied research*, Guilford Press.
- Cervone, H. F. (2012). "Digital learning object repositories." *OCLC Systems & Services* 28(1): 14-16.
- Cohen, L., L. Manion and K. Morrison (2013). *Research methods in education*, Routledge.
- Conceição, S. and R. Lehman (2003). An evaluation of the use of learning objects as an instructional aid in teaching adults, Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.
- Currier, S. and L. M. Campbell (2005). "Evaluating 5/99 content for reusability as learning objects." *VINE* 35(1/2): 85-96.
- Fairweather, P. and A. Gibbons (2006). "Introduction to special issue on learning objects." *Educational Technology, the magazine for managers of change in education*, 46 (1): 7-9.
- Fox, R. J. (1983). *Confirmatory factor analysis*, Wiley Online Library.
- Glaser, B. G. and A. L. Strauss (2009). *The discovery of grounded theory: Strategies for qualitative research*, Transaction Publishers.
- Guba, E. G. (1979). "Naturalistic inquiry." *Improving Human Performance Quarterly* 8(4): 268-276.
- Guthrie, P. A. (2010). An Investigation into Digital Media: Characteristics of Learning Objects Which K-12 Teachers Determine Meet Their Instructional Needs, ERIC.
- IEEE (2002). "Learning Object Metadata Working Group. Scope and purpose." [http://ltsc.ieee.org/wg12/s\\_p.html](http://ltsc.ieee.org/wg12/s_p.html).
- Karampiperis, P., T. Lin, D. G. Sampson and Kinshuk (2006). "Adaptive cognitive-based selection of learning objects." *Innovations in Education and Teaching International* 43(2): 121-135.
- Kay, R. H. and L. Knaack (2008). "A multi-component model for assessing learning objects: The learning object evaluation metric (LOEM)." *Australasian Journal of Educational Technology* 24(5): 574-591.
- Mayer, R. E. and R. Moreno (2002). "Aids to computer-based multimedia learning." *Learning and instruction* 12(1): 107-119.

- Merrill, M. D. (2012). "Instructional transaction theory: An instructional design model based on knowledge objects." *Instructional Design: International Perspectives: Volume I: Theory, Research, and Models: volume Ii: Solving Instructional Design Problems*: 381.
- Northrup, P. T. (2007). *Learning objects for instruction: design and evaluation*, IGI Global.
- Polsani, P. R. (2006). "Use and abuse of reusable learning objects." *Journal of Digital information* 3(4).
- Richards, G., R. McGreal and N. Friesen (2002). *Learning object repository technologies for telelearning: The Evolution of POOL and CanCore*, Proceedings of the IS2002, Informing Science+ IT Education Conference.
- Stewart, V., A. Stewart and N. Fonda (1981). *Business applications of repertory grid*, McGraw-Hill London.
- Wiley, D. (2003). "Learning objects: Difficulties and opportunities." *Academic ADL Co-Lab News Report*(152-030406).
- Wiley, D. A. (2003). *Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy*.

Appendix A: Learning Objects' Evaluation Questionnaire

Dear student:

The researcher is conducting a study on learning objects that you used (learning object is defined as any digital resource that can be used and reused to support learning). The researcher would like to get your very valuable ideas about these materials. The inventory has two parts (A and B).

Part A: **Demographic Information:** 1) Gender: Male.... Female ..... 2) Age...

3) **Methods of Teaching:** Biology & Chemistry  History & Language

Geography  Math & physics  others

4) How much is your current level of knowledge about computer as a regular user?

Excellent  Very Good  Moderate  Poor  No Knowledge

Part B: Please read the following statements and rate the learning objects from 1-5 indicating the rating from low to high by putting a tick (✓) mark in the appropriate space.

Statements	1 low	2	3	4	5 high
1- I could modify the learning objects to my personal preference.					
2- The interfaces were well organized.					
3- Text font was readable.					
4- All links work.					
5- The videos play easily.					
6- The system was easy to use( plug and play).					
7- I needed support of technical person to be able to use Learning Objects.					
8- sounds were instructionally effective					
9- The learning objectives of each unit were clear.					
10- The learning objects have assessment areas.					
11- It provides opportunities to think more deeply.					
12- Learning objects gave immediate feedback to an answer.					
13- The exercises are appropriate to the content.					
14- Learning objects can be used in different learning context for different learners.					



15- This material can emulate a realistic environment.					
16- Images were instructionally effective.					
17- The learning objects are reusable.					
18- The Learning Objects could be incorporated into larger collections of content.					
19- Learners can use the Learning Objects in an interactive way.					
20- If I had a problem in using material there was clear instruction to help me.					
21- Lengths of learning units are appropriate.					
22- Learning objects produced were based on instructional design principle.					
23- Learning objects could hold my attention.					
24- Learning objects followed learning – based approach.					
25- I could proceed on my own pace, step by step.					
26- Learning environment was dynamic.					
27- Each granular emphasised one of the key concepts.					
28- These granular of material can be recombined in other format.					
29- I actively participated in learning process.					
30- These materials addressed the concepts more effective.					
31- Content was understandable.					
32- The level of content information is appropriate (not too easy; not too challenging)					
33- The text is free of grammatical and spelling errors					
34- There is an appropriate amount of text on each page					
35- The information is presented in a clear, logical order					
36- The content information is accurate and correct.					
37- The content of this Learning Object is up-to-date.					

38- Learning objects provided academic references.					
39- Glossary was useful.					
40- Learning objects were free of bias.					
41- These materials stimulate learners' interest in educational psychology.					
42- Learning objects present adequate level of details and information.					
43- The text and background colors were complimentary to maximize readability.					
44- The graphics facilitate comprehension of the content.					
45- The graphics were placed appropriately on the page in a non-distracting format.					
46- videos and animations were instructionally effective					
47- I like the colour scheme.					
48- Material packaging is appealing.					
49- Diagrams and tables help to understand the content.					
50- I can use this package at home also.					
51- Learning objects are appropriate for users of other cultures also.					
52- Different parts of video, audio, text and sounds were integrated well.					
53- All of the assets tagged by information include name, description, creator and author.					
54- My university has acceptable technical infrastructure.					
55- Learning by this system is flexible.					
56- Materials were good all around					
57- I have been using computer before					
58- This material is suitable for global sharing.					
59- I think there is need for these kinds of resources.					

Appendix A: Interest Inventory in Educational Psychology

Demographic information:

Gender: Female  Male

Age.....

Methodology of teaching:

Biology & Chemistry  History & Language

Geography  Math & physics  others

How much is your current level of knowledge about computer as a regular user?

Very good  Good  Moderate  Poor

Instructions: This inventory consists of 30 statements. Read the following statements and indicate how much do you agree from strongly disagree to strongly agree with these statements by putting tick mark in the appropriate space from 1to5. Do not leave any of the statements unanswered.

SA= strongly agree A= agree NAD= neither agree nor disagree

D= disagree SD= strongly disagree

No	Statements	1 SD	2 D	3 NAD	4 A	5 SA
1	Educational psychology is interesting.					
2	I feel I can learn Educational psychology more easily than other subjects.					
3	My Educational psychology teacher makes the subject interesting.					
4	Educational psychology is a difficult subject.					
5	Knowing Educational psychology will facilitate my future life.					
6	Educational psychology is not related to my everyday life.					
7	I would like to be an Educational psychologist.					
8	Studying Educational psychology will help me in future.					
9	I feel tense when someone talks about Educational psychology.					
10	Studying Educational psychology is essential for a teacher since it helps in understanding student's behavior.					
11	Suppose there are Educational psychology and literature books available, I would choose to read literature book.					
12	Educational psychology has thought me how to take care of my life.					
13	I try to understand, what we are doing in Educational psychology.					
14	Studying Educational psychology makes me nervous or upset.					
15	I would like to score the highest in Educational psychology.					
16	I would like to watch Educational psychology programs on TV.					
17	I avoid the reading of Educational psychology articles in magazines and newspaper.					
18	I like my other teachers more than the Educational psychology teacher.					
19	I would like to get a job where I need to apply my knowledge of Educational psychology.					
20	I enjoy studying Educational psychology.					
21	If my college had an Educational psychology club, I would participate.					
22	I would like to study Educational psychology most during my study time.					
23	I would like to specialise in Educational psychology in future.					
24	I have a lot of interest in Educational psychology.					
25	I enjoy studying Educational psychology.					

26	Being involved with Educational psychology puts me in a good mood.					
27	I enjoy discussing Educational psychology issues.					
28	I would be happy if I had additional classes in Educational psychology.					
29	It is boring to sit in an Educational psychology class.					
30	I like to begin my day at college with an Educational psychology class.					