# PEDAGOGICAL USE OF ICT IN SCIENCE EDUCATION IN THE LIGHT OF TECHNO PEDAGOGICAL CONTENT KNOWLEDGE (TPCK)

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**ABSTRACT**
To improve the opportunities for learning, a classroom is now turned into a well-resourced smart classroom. Integrating technology into teaching-learning maximize students' understanding of the related concepts and therefore makes it concrete. Researchers found that meaningful learning takes place where there is engagement from the part of students is more. ICT makes it possible for the students by giving those hands-on experiences through virtual reality, simulation, 3D experiences to support their learning. In this context, technology is much more important in Science Education, particularly in providing practical experiences. The core of good teaching with technology are three core components: content, pedagogy, and technology, and their relationships among and between them. This paper tries to explore how science teachers' understanding of educational technologies and Pedagogical Content Knowledge interact with one another to produce effective teaching with technology. This study adopts a descriptive survey method with a sample consists of 52 secondary school science teachers from Hyderabad. The random sampling method is used to collect the relevant sample. The questionnaire on TPCK based on understanding, integration, and assessment is used to collect the data required for the study. Percentage Analysis and Pearson's product-moment Correlation is the statistical technique used to analyze the data. The results of the study throw light on various technological, institutional, and professional factors that require attention. Findings of the current study indicated that teachers have very little knowledge about the various dimensions of TPCK. The study also throws light on the relation between teaching experience and technology integration. The results show that the more experienced teachers have a feeble connection with technology integration. Some suggestions to improve the practice is put forward in this paper.
**Keywords**: Pedagogy, Technology, Techno pedagogical content knowledge, Learning, Science Education

## INTRODUCTION

The foremost critical obligation for science instructors is to assist their students to construct a concrete foundation in science substance. Subsequently, they will pick up a much better understanding of the suggestions of science in society and they too get it the setting where science happens. Roberts (2007) states that a deductively proficient person will have the information, aptitude, and states of mind are reliable with the open understanding of science. The logical expertise advancement through conceptualizing the structure of science makes them versatile within the world. The pedagogy of science within the 21st century is enhanced with issues of culture, self-identity, assorted social implications of science instruction, teacher-student connections, students' wants, and desires, and values in science instruction. The conventional instructional method taken after our course doesn't meet the requirements of the present learners. Students engaged in science subjects implanted in a social and beneficial learning environment at that point they can reflect on the values settled in in science and science instructing. Such a kind of learning environment may upgrade students' interest in science and offer assistance to them in progressing their civic obligation (Corrigan, Dillon, & Gunstone, 2007). Within the advanced time, technology integration into the teaching-learning is unavoidable and makes that conceivable in designing the instruction learner-friendly. There's a thorough investigation into teachers' competencies with respect to the developing part of advances in instructional practices (De Rossi, 2018) which is grounded on a clear base of technological information, wide pedagogical skills, and profound information of the content.

## TECHNOLOGY IN SCIENCE EDUCATION

Science and technology have ended up the necessary portion of our financial, social, and political life (Hurd, 2000). Segregating scientific knowledge from technology implies nothing. Hodson (2010) portrayed that ordinary science

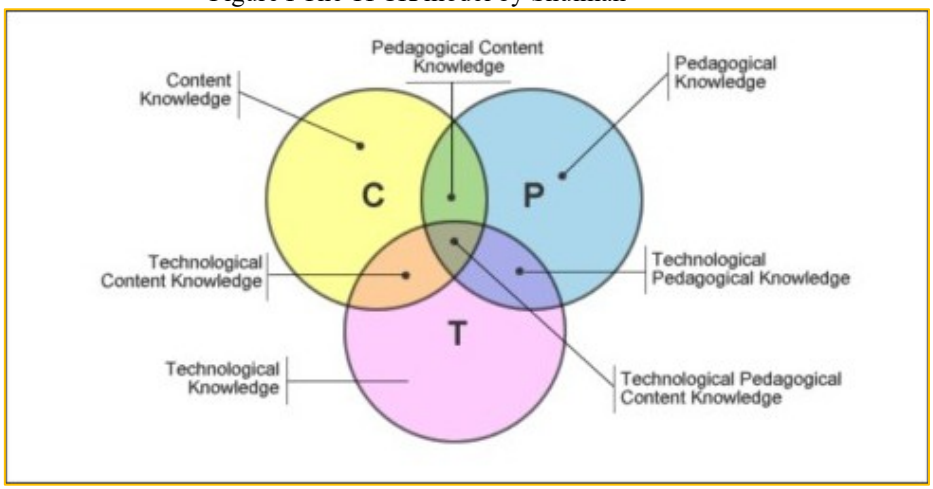
  

instruction is lacking within the current situation to meet the wants and interface of the learner. A worldview move is essential for that routine nature. For that, a clear understanding of the nature of science and technology innovation is vital for educationists. This understanding offers colossal openings to appreciate the values and morals inserted in Science (Sadler, 2011). Technology innovation influences society in an inescapable way and now and then in unforeseen ways. Advanced science instruction requires effective and all-encompassing conceptual, educational, and beneficial devices that can viably reflect on the way students develop their scientific information. Technological developments in this field offer assistance to memorize science without a blunder. It shows how learners can apply science in real-life situations. Through technological devices, instructors can exterminate any misguided judgments within the preparation of learning science. Besides, students can be spurred which is able to upgrade their interest in science, meet their versatile needs, move forward their decision-making capacities (Chowdhury, 2016). So technological innovation includes much more to the valuable considering capacity of the understudies.

**TECHNO PEDAGOGICAL CONTENT KNOWLEDGE (TPCK)**

Techno Pedagogical Content Knowledge may be a form of information that comprises content information, academic information, and technological information. Shulman (1986) analyzed that content knowledge, pedagogical knowledge, and pedagogical content knowledge" are the three categories of information that must be displayed in instructors. This will empower the educator to effectively join technology in instruction. This, in turn, helps in developing appropriate, context-specific strategies and representations. Cox (2008) suggested that Techno Pedagogic Content Knowledge involves the identification of appropriate technology to integrate it as a pedagogic strategy for a particular content area, to create students' information on a specific subject. In this way meet the instructive destinations for the learner's requirement. (Garofalo et al., 2000, Mishra & Koehler, 2006) given the Techno Pedagogical Content Knowledge (TPCK) system for educational modules arranging and tell how an instructor can successfully coordinate technology within the educational programs. TPCK is found in a supportive system for considering the improvement of teacher's information technology (Koehler et al., 2007). Agreeing to McCrory (2008), the TPCK of science instructors has four components, science, learner, instructional method, and technological information. All these four elements are combined when a teacher uses technology in the teaching process. Thus produce an effective learning experience. The TPCK model is represented in Figure I.

Figure I The TPCK model by Shulman




(Image source, flicker.com)

**SIGNIFICANCE OF THE PRESENT STUDY**

The knowledge of Technology and Science Pedagogy forms a better pair. One can't imagine science without technology. Students in today's classroom are exposed to a vast world of technology. Their learning experiences are rich compared to ours. Proper guidance for searching and selecting suitable content is required for them. Science teachers must be technological friendly because the pool of examples students get from technology must outsmart by teachers to show our essentiality in the classroom. Sensoy (2018) proved that teaching can be effective and even more successful when pedagogy and technology put together. Very few studies have been conducted to understand the teacher's technological use in instruction. Krauskopf (2018) used self-reports to know the TPCK of teachers and explained about the prior technology use attitudes. This study tries to discover how much our instructors know almost technology and technology integration. Considers around TPCK can offer assistance to know the complex intuitive among, content, Instructional method, and technology. The result will offer assistance us to know is there any ought to teach them around technology integration in science instructional method.

**OBJECTIVES**

- To find out the level of Techno pedagogical content knowledge in teachers for the total sample
- To find out the percentage of relationship between Teaching Experience and Technology Integration
- To find out the relationship between teachers TPCK and Technology Integration

**HYPOTHESIS**

- There will be a significant relationship between teachers TPCK and Technology Integration

**STATEMENT OF THE PROBLEM**

The problem is stated as "Pedagogical Use of ICT in Science Education in Relation to the Techno Pedagogic Content Knowledge among Secondary School Science Teachers"

**METHOD AND PROCEDURE**

**Method**: Survey method was adopted for the present study

**Sample**: 52 Secondary School Science teachers from Hyderabad

**Sampling**: Random sampling was adopted to select the sample

**Tool**: Questionnaire on TPCK was used to collect the data. The details of the questionnaire is given.

TPCK questionnaire: The TPCK questionnaire contained 35 close-ended items for measuring knowledge about TPCK and its components. The items are adapted from the previous TPCK questionnaires (Kadijevich, 2012 & Denise, 2009) to sync with the focus and context of the study which is having a reliability coefficient of 0.86 (Denise, 2009). A 5-point Likert scale was selected to assess the components of TPCK. The Scale Responses are as 1=Not confident at all, 2=slightly confident, 3=somewhat confident, 4=quite confident, 5=completely confident. The questionnaire 35 items for total of 7 components in the questionnaire. The components are A) Technological Knowledge (5 items); B) Pedagogical Knowledge (5 items); C) Content Knowledge (5 items); D) Technological Pedagogical Knowledge (5 items); E) Pedagogical Content Knowledge (5 items); F) Technological Content Knowledge (5 items); and G) Technological Pedagogical Content Knowledge (5 items). Content validity and face validity of the tool is ensured by experts in this field. The sample items under each dimension with the 5 point rating are shown in table I.

Table I Sample items from the dimensions of the TPCK Questionnaire

| Dimension | Items | 1 (not confident) | 2 (slightly confident) | 3(somewhat confident) | 4(quite confident) | 5(completely confident) |
|---|---|---|---|---|---|---|
| TK | Create a basic presentation using PowerPoint or a similar program. | | | | | |
| PK | Explain hands on experience about science experiments | | | | | |
| CK | Try to clarify the misconceptions to maximum | | | | | |
| TPK | Use digital technologies to motivate learners. | | | | | |
| PCK | Know about the kind of activity related to the science concepts | | | | | |
| TCK | Help to record data that of growth process | | | | | |
| TPCK | Use online animations that effectively demonstrate a specific scientific principle. | | | | | |

To get the data on Technology Integration, the investigator collected the data about the common technological tools and practices adopted by the teachers through a checklist. The common practices listed are online teaching, blended classroom, M learning, Educational apps, Collaborative tool, Social Media, Video recording delivery, e-books, Conducting research and Assessment. The scoring procedure is of Yes or No (whether they are using it or not) type and the maximum score per individual is 10.

**DATA COLLECTION PROCEDURE**

After consulting the teachers in the different schools, the investigator briefed them about the purpose of the study and about the tool. The tools were distributed and filled with tools collected afterward. The incomplete ones were discarded and a total data of 52 was used for the analysis.

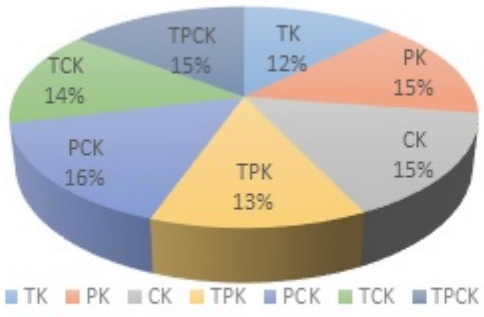
**STATISTICAL TECHNIQUES**

Percentage Analysis and Pearson's Product Moment Correlation was used as the statistical techniques in the analysis

**RESULT AND DISCUSSION**

I. Percentage analysis is done to find out the level of knowledge about TPCK. The result is shown in the figure II.

Figure II Result of Percentage Analysis of Techno Pedagogical Content Knowledge




The analysis revealed that the knowledge about TPCK and its components are below average among science teachers. For each dimensions of the questionnaire, the total score obtained by 52 teachers are calculated and find out the percentage for each dimension. The results are, A) Technological Knowledge (12%); B) Pedagogical Knowledge (15%); C) Content Knowledge (15%); D) Technological Pedagogical Knowledge (13%); E) Pedagogical Content Knowledge (16%); F) Technological Content Knowledge (14%); and G) Technological Pedagogical Content Knowledge (15%).

II. The result showing the relation between Teaching Experience and Technology Integration is given in table II.

Table II Percentage Analysis of Teaching Experience and Technology Integration

| Teaching Experience (Yrs) | No. of sample | Technology Integration (Total Score) | Percentage |
|---|---|---|---|
| 1-5 | 7 | 64 | 91 |
| 5-10 | 11 | 60 | 55 |
| 10-15 | 12 | 62 | 52 |
| 15-20 | 18 | 46 | 26 |
| >20 | 4 | 24 | 60 |

To find out the relationship between Teaching Experience and technology Integration, percentage analysis is used. The sample is divided into five strata based on the experience and the total data obtained for each stratum taken to find out the percentage. From the analysis, it is seen that the teachers whose experience ranges from 1 to 5 are showing the maximum integration of technology in the teaching-learning process. In which blended classroom teaching, M learning, and social media are the frequently used technological tools. The teachers with experience of above 20 years of age are showing outstandingly better use of technology in their instructional process. E-books, online learning, and assessment are the major tools they are familiar with. Teachers with experience range between 5 to10 and 10 to 15 shows 55% and 52 % respectively. This indicates that these teachers are using technology on average during their instruction. The teachers who are using technology in the least percentage are those with an experience of 15 to 20 years. Only 26 % of technological use. The technological tool they are familiar with and use in the classroom is e-books. Though teachers are familiar with the technological tools in today's new generation classroom, the implementation of that knowledge is very limited. It is true that technology integration requires a tremendous amount of time and energy from the part of the teacher (Liu and Szabo, 2009), but once the teacher invests there will be lifetime output for the teacher as well as for the students.

III. Pearson's product-moment correlation coefficient was find out to see the relationship between TPCK knowledge and Technology Integration.

Pearson's relationship decides the degree to which a relationship is direct. So it decides whether there's a direct component of the relationship between two continuous factors. Result showing the relation between TPCK knowledge and Technology Integration is given in Table III.

Table III The Relation between TPCK knowledge and Technology Integration

| Technology Integration | 'r' |
|---|---|
| TK | .6 |
| PK | .4 |
| CK | .1 |
| TPK | .3 |
| CPK | .4 |
| TCK | .5 |
| TPCK | .3 |
| Total | .3 |

From the analysis, it is seen that the relationship between TPCK and Technology Integration is ranging from 0.1 to 0.6. The strong correlation is seen in Technological knowledge and Technology Integration (0.6). The weakest correlation is between content knowledge and Technology Integration (0.1). The coefficient of correlation ('r) for other dimensions with that of Technology Integration is Techno-Pedagogical Knowledge (0.3), Techno-Pedagogical Content Knowledge (0.3), Pedagogical knowledge (0.4), Pedagogical Content Knowledge (0.4) and for Technological Content Knowledge, it is found to be 0.5. The overall correlation between TPCK and Technology Integration is found to be 0.3. The computed r is equal to 0.3, (r=0.3) using n=52 cases. Thus, df=n−2=50, the critical values associated with df=50 are ±0.273. If 'r' is less than the negative critical value or 'r' is greater than the tabled critical value, then 'r' is significant. Since r=0.3, it greater than >0.273, 'r' is significant and the hypothesis is accepted.

Teachers who have the knowledge in technology is found to be using or applying that knowledge in their instructional process. They deliver the content through presentations, updating their knowledge with digital technology, make use of multimedia in their classroom, and making their classroom rich with the help of technology. This is turn helping the students to learn effectively.

**CONCLUSION**

The result of the current study shown that instructors have exceptionally small information around TPCK and hence Technology Integration. Handal (2013) studied Technological Pedagogical Content Knowledge of Secondary Mathematics Teachers in Australia and the results show that teachers' lower capacity to deal with the common data and technologies objectives across the curriculum, such as creating digital assessment designs. So generally there is ample evidence from the researches that there is a feebleness on the part of the teacher in dealing with technology teaching. The experience of teachers is one of the good predictors to show the integration of technology in our classroom. To increase the efficiency of the teaching-learning process, TPCK is a must, as research shows that teachers who have a better understanding of TPCK are good at giving the maximum results. The use of technology to maximize student learning enhances teacher productivity (Voogt, 2012) also. Somehow teachers don't want to make an effort to operate the technological devices in their classroom. But that kind of attitude is very less to quote anyway. Teachers Education programs are nowadays focusing on making out students more techno-savvy, but the other side is forgotten. There is a need to empower our teachers about the TPCK and how successfully they can integrate technology into their instruction. Programs must be arranged for teachers to practically show the pedagogic use of technology. Studies shows, pre-service teacher training in educational technology courses and instructional strategies are found successful to strengthen the technological side of TPCK (Niess, 2005 & Hofer, 2012). The study by Karabuz (2020) reveals that instructional philosophy and awareness of CBL technology usage have significant impacts on their TPCK. Workshop modes programs may be conducted in connection with this to increase awareness of TPCK. Teacher orientation programs must give sufficient space to include topics related to TPCK and its implementation.

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