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CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0 Introduction
This literature review is designed to identify related research and to set the current research within a conceptual and theoretical context. The review of related literature aims to review the critical points of current knowledge including substantive findings as well as theoretical and methodological contributions to a particular topic. The researcher has attempted to present current and relevant references with consistent, appropriate referencing style; proper use of terminology; and an unbiased and comprehensive view of the previous research on the topic. In the first chapter, the background and motivation for this study were developed and described. In this chapter, a rationale for the variables used in the study is presented. The review is organized according to the aspects: the impact of ICT on education, ICT and teacher education, ICT and pedagogy, the theory of constructivism and its application, ICT and constructivism, the different models of ICT based curriculum transaction, instructional system design, evaluation methods for testing effectiveness of sessions and usability testing. Each aspect has three sections. The first section is the literature review which investigates the views thoughts and ideas of educationists in the related field. The second section of the literature review presents the discussion of researches conducted in the related field and the third section deals with contribution of the review in the present research.

2.1 Impact of ICT on Education
It is already predictable that the use of ICT in education is enriching in many ways.

‘ICT competency standards for teachers’ published in 2008 by the United Nations Educational, Scientific and Cultural Organization, UNESCO, UK. Today’s classroom teachers need to be prepared to provide technology-supported learning opportunities for their students. Teachers need to be prepared to empower students with the advantages technology can bring. Schools and classrooms, both real and virtual, must have teachers who are equipped with technology resources and skills and who can
effectively teach the necessary subject matter content while incorporating technology concepts and skills. Traditional educational practices no longer provide prospective teachers with all the necessary skills for teaching students to survive economically in today’s workplace. By crossing the three approaches to education reform based on human capacity development—technology literacy, knowledge deepening, and knowledge creation—with the six components of the educational system—policy, curriculum, pedagogy, ICT, organization, and teacher training—a curriculum framework is created for the UNESCO ICT Competency Standards for Teachers (ICT-CST) project.


ICTs provide an array of powerful tools that may induce the transformation of the present isolated, teacher-centred and text-bound classrooms into rich, student focused, interactive knowledge environments. ICT use invites and caters for a “paradigm shift” regarding teaching and learning.

1. The type of learning supported in an ICT learning environment tends to be transformative.

2. The learning tasks are: open, authentic, problem-based, interpretative, analytical, expressive and inventive.

3. Effective learning with and through ICT would result in: pupils asking more questions and offering hypothesis, as they can answer or explore them; pupils showing a willingness to take risks, because ICT allows them to correct errors; pupils becoming more autonomous, because ICT offers them tools to perform tasks; pupils showing better motivation and willingness to look for answers, because ICT makes information retrieval, data analyses and modelling easier.

4. Effective teaching through ICT would prove that: lesson objectives describe specific opportunities for developing ICT capabilities; teachers take pupils’ prior experience with ICT in account when planning lessons; activities have built-in differentiation so that the tasks match the needs and abilities of pupils; teachers use ICT to motivate and sustain pupils interest; teachers manage their classrooms to maximise the availability and use of ICT tools; teachers use the ICT expertise of colleagues to develop his own knowledge.

Cox (1997) lists a series of benefits of using ICT in lessons:
• “increased commitment to learning tasks;
• enhanced enjoyment and interest in learning and the subject;
• enhanced sense of achievement in learning and pride in the work;
• increase in self-directed learning and independence;
• enhanced self-esteem leading to expectations of achieving goals.”


This study investigated the comparative efficiency of Web-based instruction (WBI) and traditional teaching methods on pre service teachers’ fraction knowledge. Students’ knowledge of fractions was measured using a Fraction Knowledge Test. The test consisted of 32 items and was administered as pre and post tests to a total of 42 pre service teachers in two intact classes at the same university. One of the classes was randomly assigned as the experimental group ($n = 21$) and was given WBI. The other class was assigned as a control group ($n = 21$) and was given traditional instruction. Analysis of covariance was used to determine treatment effects on students’ knowledge of fractions when the pretest result was used as a covariate. The analysis of results showed a statistically significant difference between the experimental and the control groups’ posttest mean scores in favor of the experimental group.


This study attempts to find out the best instructional method out of three i.e. Conventional Instructional System (CIS), Audio-Video Instructional System (AVIS) and Multimedia Instructional System (MIS) for teaching Information Technology at the secondary level. For this purpose total 120 students were randomly selected from three CBSE affiliated schools. They were assigned to three groups on the basis of their scores
in Intelligence test. These three groups were taught by three different methods. Four tools were used in this study out of which, except for Intelligence test all other tools were developed by the researcher. After attaining the raw scores and applying different statistical techniques like ANOVA, t-test and factorial design, it was found that MIS is the best method, AVIS is the second best and CIS is the third best method for taking Information Technology at secondary level.


Objective – 1. To develop a self learning package in computer education for slow learners using video and animations. 2. To study the effectiveness of this package on slow learners.

Method – Experimental method, Design – Two group post test design, Sample selection – Purposive, 10th Std. students with less learning ability. Data collection tools – Achievement test, Statistical tools – T test and F test.

Conclusions – There was a significant difference in achievement of slow learners of control group and experimental group.


Objective – 1. To develop a CAI program in Health education for D.Ed. students. 2. To study the effectiveness of this program on D.Ed. students.


Conclusions – There was a significant difference in achievement of D.Ed. students of control group and experimental group.

Objectives: (1) To find out whether there is any significant difference between the Conventional Lecture Method and the Computer Assisted Instruction (CAI) as an individualised Instructional strategy (2) to find out significant difference among the different modes of Computer-based Instruction viz. Tutorial, Drill & Practice and Simulation (3) to find out whether there is any significant difference among the different modes of Computer-based Instruction (CBI), viz. Tutorial, Drill and Practice and Simulation in terms of their effectiveness in enhancing the retention of cognition as revealed by the learners’ performance in the retention test; (4) to develop syllabus based CAI package; (5) to assess the personality of the subjects of the control and experimental groups using Cattell’s 16 P.F Inventory with a view to study whether it has any influence on the media effectiveness in realising the instructional objectives. Method: Quasi-experimental method as well as qualitative and quantitative approach were adopted for the study. The sample was taken four groups of each having 35 students selected through probability sampling method. Findings: (1) Different modes of Computer based Instruction, viz. Drill, Practice and Simulation were more effective than conventional lecture method. (2) Effectiveness of the conventional lecture method and the different modes of the Computer-based Instruction, viz. Tutorial, Drill and Practice and Simulation were not influenced by the learner’s personality. (3) There was significant difference among the different modes of CBI (Computer-based Instruction), viz. Tutorial, Drill and Practice and Simulation in terms of their effectiveness in enhancing the retention of cognition. There was significant difference among the different modes of Computer-based Instruction in enhancing retention of what have already learnt.


In this study randomly selected 82 LD children split into two groups.(Equated group design 41+41). The experimental group who studied according to the video assisted
instruction. The control group studied the same concept in a regular convention method. The pre test conducted for both groups. After the treatment, post test conducted immediately. The retention test was conducted for both groups after a month. The investigator applied differential analysis technique. He found that VAI facilitated for the LD children in learning science concepts rather than their counterparts in conventional teaching method. His research findings summarized that the VAI can greatly enhance the learning of science concepts for LD children.


Statistics is of critical importance to engineers. However, many engineering students struggle to grasp the meaning of statistical concepts and the idiosyncrasies of statistical methodologies. Because of this problem, instructors of statistics are constantly searching for better ways to help students understand statistical concepts. The goal of this project is to design and develop web-based lessons that use graphics and animations to enhance the effectiveness of students’ learning of statistical concepts. Lessons of three important statistical concepts have been developed for this thesis - normal distribution, central limit theorem and confidence & tolerance intervals - following well-recognized instructional design development processes and principles. A between-subject experiment was conducted with 20 freshmen engineering students as research participants. The experimental results suggest that compared to the traditional instruction method, the web-based lessons can significantly enhance students’ learning outcomes (by 29.8%) and their satisfaction with the learning process (by 19.2%).


Objectives: (1) To assess the pupil’s performance in practice sessions and influence of the different instructional technologies availed on their performance in the TNPCEE; (2) to find out the relative effectiveness among different instructional strategies such as intranet with feedback from the teachers along with long term and short term entrance
coaching programme; (3) to find out the pupils’ achievement of master learning in different subjects as measured by Tamil Nadu Professional courses Entrance Examination; (4) to evaluate the Computer Assisted Evaluation Package. **Method:** The study adopted Quasi-experimental design, qualitative and quantitative approaches were adopted for the study. The sample was taken 225 Maths students, 219 Physics students, 219 Chemistry students, 108 Biology students studying in Class XII from Tamil Nadu selected through probability sample technique for the study. The tools were used such as a website with a Computer Assisted Evaluation Package, and Achievement Test. Statistical applications like Analysis of Variance’s test; correlation co-efficient and Regression were used to analyse the data. **Findings:** (1) It was found that there was significant difference among the different instructional strategies, viz. internet, intranet with feed back from teachers along with long term and short term in entrance coaching programme. (2) It was found that there was significant difference in the performance of the students under the different instructional strategies in achieving mastery in subjects Mathematics, Physics and Chemistry. (3) It was found that self-evaluation did not result in mastery with regard to subjects, viz. Mathematics, Physics, Chemistry and Biology.

Lee, Larry Dee, (1999). Ph.D., An investigation on computer-based instructional presentation modes and perceptual learning styles in concept learning. An experimental study to investigate the relationship between preferred perceptual learning styles (visual and verbal) and concepts on single dimensional tables from computer logic presented in three modalities (text only, text with static graphics, and text with animated graphics). It was hypothesized that students would perform higher on an achievement test with computer-based instruction with a presentation mode that matched the student's preferred perceptual learning style than students who were not matched. It was also hypothesized that there would be a significant interaction between preferred perceptual learning style and presentation modality. A total of 297 subjects from the population of freshman computer science students at Del Mar College participated in this study. Two instruments were used (Productivity Environmental Preference Survey and Verbalizer Visualizer Questionnaire) to identify students with a verbal or visual learning style preference. Within each group (verbal, visual), students were randomly assigned to
an instructional treatment. Students who were not identified as a visualizer or verbalizer were assigned to a control group and received only the post-test. The analysis of the data showed no significant interaction between perceptual learning style preferences (visual and verbal) and the three presentation modalities (text only, text with static graphics, text with animated graphics). The resulting scores on the achievement tests indicated that students who were matched to their preferred perceptual learning style did not perform significantly higher on performance measures than students that were not matched. The study also investigated the interaction between perceptual learning style preference and presentation modality. There was no significant interaction between perceptual learning style preference and presentation modality. The results suggest that when students who are identified as visualizers or verbalizers are presented technical information as part of a visual instructional strategy with a presentation modality matched with their preferred perceptual learning style, their achievement will not be significantly higher than individuals not matched. The findings also suggested that supplementing text narration with static graphics or animated graphics does not enhance the learning of technical concepts with students from a similar population to this study.


The purpose of this design experiment was to positively affect motivation, performance, and self-directed learning of undergraduate students enrolled in a tuition-free, public military school. A second purpose was to use new technologies to efficiently deliver these instructional strategies as supplementary course content. This empirical study was conducted during one semester with 784 students, representing approximately 20 percent of the population at the academy. The within-subjects research design used a mixed method approach involving quantitative and qualitative data. Four surveys were used to measure motivation and self-directed learning: (1) the Course Interest Survey developed by Keller; (2) the Instructional Materials Motivation Survey developed by Keller; (3) the Self-Directed Learning Readiness Scale developed by Guglielmino, and; 4) the Self-Directed Learning survey. Students in 48 participating sections were randomly divided
into control and experimental groups for each of 16 instructors. Within these courses, students in each section had identical syllabi and classroom-based content. The researcher communicated with control and experimental group students via email, and used email to direct experimental group students to the technology-mediated instructional strategies (TMIS). Strategies were designed using Keller’s ARCS model of motivation and delivered via Personal Digital Assistant (PDA), web, CD-ROM, and other technologies. For students in the experimental group, web-based post-strategy SDL surveys were administered throughout the semester, tracking participation, perceptions, and self-directed learning. To provide for a richer study, qualitative data were collected via open-ended questions on the SDL survey and via threaded discussions on web forums. Follow-up interviews also helped triangulate the data. Those students who accessed the TMIS had significantly higher levels of academic performance than control group students. There were also significant differences in motivation and proclivity to be self-directed learners, with higher levels for treatment group students than control group students. These findings suggest that systematically designed technology-mediated instructional strategies can positively effect motivation, performance, and self-directed learning. Further, new technologies such as the PDA can help improve the efficiency of delivering such strategies. Suggestions for future empirical research are presented.


WebQuests are an Internet-based technology application in which groups of students follow a specific set of steps toward the completion of a final project on a specific subject or multi-disciplinary subject. As with many other technologies and technology applications, there is a void in the published research that examines the effects that WebQuests have on students and student learning. Many educators are using technologies and technology applications, such as WebQuests, that have not been examined in depth for the effects on student learning. This results in teachers using instructional tools that have not been proven to help in learning. This current situation of teachers using technologies and technology applications which are not proven instructional methods is the basis for this research study on WebQuests and student learning. This research study
was conducted to evaluate the effectiveness of WebQuests to ensure that the teachers who are using this technology application are using an instructional method which is proven to enhance student learning. Through the use of both quantitative and qualitative data, this study begins to examine not only the effects of WebQuests on student learning but also lays the groundwork for future research on the effects of other technologies and technology applications on student learning. In this study, the students originally believed that they had learned during the completion of the WebQuest; however, after not being able to complete the transfer activity, the students changed their minds and said that they obviously had not learned the material. Students seemed to think that they had learned simply because they had completed the WebQuest, but realized that they had not retained any knowledge on the poetic literary terms presented in the WebQuest after failing to successfully apply the literary terms to a new poem. This is verified by the slight decrease in scores on the posttest compared with the pre-test. Further research needs to be conducted to see if the level of teacher involvement affects student learning with the WebQuest.

**Contribution to present research** – Study of related literature has proved that ICT has a positive influence on students learning. The aspects like open, authentic, problem-based, interpretative, analytical, expressive, inventive tasks, which enhance effective ICT use and caters for a “paradigm shift” from teaching to learning have been elaborated upon through the review of related literature.
2.2 ICT and Teacher Education

The importance of technology use in teacher education in specific and education in general has been widely acknowledged. Many researchers have posited that technology use integrated with relevant teaching methods improves student learning.

Pellegrino, J., Goldman, S., Bertenthal, M., & Lawless, K., (2007). Teacher education and technology: Initial results from the “What Works and Why” project. Researchers report that technology can not only provide authentic, engaging, and collaborative learning environments but also can enable students to learn at any time with peers outside of classrooms. Yet, the evidence is mixed, at best, that this investment of time, money, and resources has produced measurable change in student learning outcomes, or in teaching practices that effectively leverage the capabilities of technology to improve student learning. Based on these findings, it is not surprising that much of the research related to technology integration in classrooms continues to demonstrate that teachers feel inadequately prepared to use technology effectively in their classrooms, particularly to support teaching and learning activities in their disciplines. This lack of support leads teachers to use technology for low-level, supplemental tasks, such as drill and practice activities, word processing, educational games, and computer-based tutorials.


Ineffective or inadequate use of technology by teachers may be directly related to the preparation provided to preservice teachers at teacher education institutions. Some researchers believe that teacher certification programs still view technology as an add-on to their curricula. This lack of appropriate preparation perpetuates teachers’ feelings of ill-preparedness with regard to technology. As a result, they continue to use computers for lower level tasks, many of which align minimally with core academic standards.

Many times, preservice teachers are exposed to a plethora of skills-based training activities (e.g., creating multimedia presentations, creating Web sites, developing blogs and wikis, and editing video). However, insufficient effort is made to align technology with discipline-specific pedagogy. Thus, researchers have begun examining methods for developing technological pedagogical content knowledge (TPCK) among both beginning and experienced teachers. The TPCK model posits that context-neutral approaches to preparing teachers to utilize technology for pedagogical purposes will generally fail because they tend to overemphasize pure technology skills as opposed to methods of integrating technology into teaching and using technology to support pedagogical goals.


Technology integration experiences integrated with authentic teaching and learning experiences in teacher preparation are recognized as more effective than traditional stand-alone technology classes, in which technology skills and experiences are taught separate from the classroom context. Despite conclusions such as these, solid theoretical frameworks that focus on preparing teachers to leverage technology in ways that enhance teaching methods in classrooms are rare.


There is currently much debate around how best to incorporate Information and Communication Technologies (ICTs) into teacher education programs. Rapid advances in ICTs demand changes to our education systems. Computer technology has been absorbed into our schools but in many instances teachers simply deliver old lessons in a new format, and rarely fully capitalise on this technology in their practice. This article explores two issues, firstly, what are the barriers to educators embracing the new technologies, and secondly, what role do teacher education programs play in breaking down the barriers. In discussing these issues, initiatives being undertaken in Queensland
are highlighted. For students facing the challenges of the twenty first century, there is a need to replace current traditional models of education with a model that reflects the knowledge economy and the need for lifelong learning. Our teachers are experiencing reform fatigue with all of the major developments that have occurred in the last decade. Educators need to recognize the need to constantly update skills and knowledge, not only of their students but their own skills as well. In the knowledge economy, there is a new role for teachers. While teachers have the ‘reform’ mindset (the brake), they are not seeing themselves as lifelong learners (the accelerator) who are constantly updating their knowledge, skills and pedagogy. Governments are spending large amounts of money on technology and infrastructure so that powerful ICTs are available for use in schools. These ICTs have the potential to significantly influence teaching practice, students’ learning and engagement in the learning process.


**Objectives:** (i) To study the use of ICT in teacher training institutions by the teacher educators during their teaching; and (ii) to give suggestions for the better use of ICT in teacher training Institutions.

**Methodology:** The study was based on the sample of 200 teacher educators working in the different teacher training institutions of U.P. Self-developed tool called ‘Use of ICT in Teaching Inquiry Questionnaire’ was used for data collection. The data were analysed using percentage. **Findings:** (1) More than 80% teacher educators were found not using educational technologies like magic lantern, epidiascope, video camera, film projector, LCD projector, radio and DVD in their teaching. (2) 70% to 90% teacher educators did not use internet, tape recorder, T.V., overhead projector, computer and slide projector during teaching their classes (3) 68% teacher educators did not use working models during their teaching whereas only 07% teacher educators did not use calculators. The study cites sixteen references.

Objectives
1. To analyze the conventional approach of teaching Educational Teaching.
2. To plan Multimedia Instructional System for Educational Technology.
3. To design and construct Multimedia Instructional System on Educational Technology.
4. To test the effectiveness of constructed Multimedia Instructional System.
5. To compare the effectiveness of constructed multimedia instructional system with the conventional system of instruction.
6. To validate multimedia instructional system in terms of their effectiveness over conventional system of instruction.

Sample - The investigator designed a multimedia instructional system (MIS) on the bases of gathering data from all the teacher educators (50) teaching ET in 26 Colleges of Education affiliated to Shivaji University, Kolhapur and Solapur University, Solapur through a questionnaire constructed by him, and interviews with 20% (10) randomly selected teacher-educators out of these. The investigator then developed and constructed the MIS systematically by planning activity matrices, application scripts, flow charts, program storyboards, multimedia building blocks through suitable software. Alpha testing was done on the 10 teacher-educators. Focus Group Testing was done on 120 (30 male and 30 female from each College of Education) pupil teachers selected randomly from D.P.B. College of Education, Solapur and College of Education, Barshi in the year 2005-06 out of a total of 160 pupil teachers.

Experimental Design Employed - The Solaman 4 Group experimental design was very well employed in pilot study. The MIS was further developed accordingly. The experimental implementation was done on the sample of 120 pupil teachers from the above mentioned Colleges of Education in the year 2006-07, again employing the Solaman 4 Group Experimental Design. A pre-test of 50 marks was administered on the sample. The experimental group was instructed by using the MIS, while the control group was instructed by using Conventional Instructional System. A post-test of 50 marks was
administered on the experimental as well as control groups just after the treatment and also to test retention.

**Tools used** - The characteristics of all the tools constructed for the Study, namely, Questionnaire, Evaluation Forms, and Achievement Tests have been well established.

**Data Analysis** - The data have been analyzed with the help of appropriate statistical and nonstatistical techniques. F-test and t-test have been used for data analysis.

**Findings**

1. The present setting of Teaching of Educational Technology in B.Ed. Colleges is unsatisfactory for learning of the Pupil-Teachers.

2. An instructional system for ET instruction through multimedia technology can be planned, designed and constructed.

3. There is no significant difference between the performance of Pupil Teachers of Control and Experimental Groups.

4. There is significant difference between the performance of Pupil-Teachers of Control and Experimental Groups in Post-Test. It shows that the mean achievement of the Pupil-Teachers of the Experimental Group was significantly greater than the mean achievement of the Control Group on ET.

5. There is significant difference in the performance of the Pupil-Teachers of Control Group from pre over post testing. It reveals that the Conventional Instructional System was found quite effective.

6. There is significant difference in the performance of the Pupil-Teachers of Experimental Group from pre over post testing. It reveals that the Multimedia Instructional System was found quite effective.

7. There is significant difference between the gains in achievement in terms of mean scores in pre over posttest of the Pupil-Teachers from Control and Experimental Group. It reveals that the Multimedia Instructional System was found more effective than the Conventional Instructional System.

8. There is significant difference between the performance of the pupil-teachers from Control and Experimental Group in retention test.

Objectives: (1) To investigate the application of information and communication technology in teacher education with reference to certain selected variables; (2) to identify the information and communication technology needs, knowledge and skills among the teacher educators; (3) to develop a user-friendly prototype multimedia course wear package as a communication technology in teacher education (i.e. learning to learn with information technology) and produce it in a CD-ROM. Pupils taught through the interactive multimedia programme in English will have high or mean achievement than that of pupils taught through conventional method of teaching. Method: The study is an appropriate blend of positivist descriptive method with normative survey technique and experimental method of study. The sample was taken 29 District Institutes of Education and Training from Tamil Nadu, 71 English teacher, educators and 200 teacher trainees, using of probability sampling method for the study. The tools were: (1) Questionnaire, (2) Attitude scale, (3) Interviews, (4) Diary analysis used for data collection. Findings: (1) Sixty-six per cent of teacher educators do not know the basic principles of computer. (2) It is unfortunate that the ICT practices have not seen the widespread application for teacher education. (3) Attitude of teacher educators towards ICT is quite positive. (4) It reveals that the focus of computer equipment problem had both quantity problem (not enough computers) as well as quality problem. Seventy-two references were cited in the study.

Contribution to the present research

An Approach to Thinking About Technology Integration - Faced with these challenges, how can teachers integrate technology into their teaching?

An approach is needed that treats teaching as an interaction between what teachers know and how they apply what they know in the unique circumstances or contexts within their classrooms. There is no “one best way” to integrate technology into curriculum. Honoring the idea that teaching with technology is a complex, ill-structured task, we propose that understanding approaches to successful technology integration requires educators to develop new ways of comprehending and accommodating this complexity.
2.3 ICT and Pedagogy
The evidence from the research literature shows that teachers’ pedagogies and pedagogical reasoning influence their uses of ICT and thereby pupils’ attainment.

Use of ICT can enhance learning, but not simply because it is used instead of traditional methods. As John and Sutherland (2004) point out, “ICT alone does not enhance learning; rather it is the ways in which ICT is incorporated into the various learning activities that is of fundamental importance”.

Although teachers are aware of the importance of technology integration into daily process of teaching and learning, they tend to face a number of barriers when it comes to effectively integrating technology into their curricula. While some barriers are resource related, others originate from fundamental beliefs and processes of current education system. In this paper, the author first demonstrates why a systemic change is needed for effective technology integration. Finally, the stages of change that individuals tend to go through in the context of technology integration is discussed. It is necessary to change the fundamental teaching and learning process if we want to take advantage of the new technologies in education. The instructional methods, classroom activities, the content delivery formats, the role of teachers and students, etc. all need some level of modification when technology comes to play an integral part in the classroom. Effective technology integration requires much more than dealing with the technology alone. Actually it is less about technology than about pedagogy that can best assist student learning.

This paper aims to discuss the role and impact that information technology (IT) has on the future and existing style of learning and teaching. It highlights the importance of acquiring computer skills and being literate in IT. The focus is put on certain areas related
to IT and education which include pedagogy and training to build IT literacy among both educators and learners. Particularly, it covers the current trends in IT development and how it has started to change and will further influence the way learning and teaching will take place in the future. This paper also discusses various theoretical frameworks and methodologies designed to cope with progress in IT. In summary, this paper delivers a message that IT literacy is the key to today’s empowerment and that education is the best foundation for it.


This literature review has identified a range of practices which should be part of teachers’ pedagogical frameworks if they are to integrate ICT effectively into teaching, learning and the curriculum. These include the need for teachers to:

• understand the relationship between a range of ICT resources and the concepts, processes and skills in their subject
• use their subject expertise to select appropriate ICT resources which will help them meet the specific learning objectives; this includes subject-specific software as well as more generic resources
• be aware of the potential of ICT resources both in terms of their contribution to pupils’ presentation skills, and their role in challenging pupils’ thinking and extending their learning in a subject
• develop confidence in using a range of ICT resources, via frequent practice and use beyond one or two familiar applications
• appreciate that some uses of ICT will change the ways in which knowledge is represented, and the way the subject is presented to and engages pupils.
• know how to prepare and plan lessons where ICT is used in ways which will challenge pupils’ understanding and promote greater thinking and reflection.
• recognise which kinds of class organisation will be most effective for particular learning tasks with ICT, for example, when pupils should work on their own, how working in pairs and groups should be organised, and when to use ICT for whole-class teaching.
The majority of teachers, including the most innovative, require more knowledge of and confidence with ICT, and a better understanding of its potential to help pupils’ learning. This suggests that further substantial support for continuing professional development is necessary in order that teachers integrate the use of ICT and improve pupils’ attainment.


This article provides examples from teacher education materials that were developed using an approach that integrally develops teachers' understandings of content, technology, and pedagogy to prepare them to teach data analysis and probability topics using specific technology tools. A key feature in our approach to preparing teachers to teach mathematics with technology is to integrally develop teachers’ TPACK. Teachers need to understand that critical instructional decisions they make are grounded in their understandings of each domain (technology, pedagogy, and content) and influenced by their beliefs and conceptions. It was concluded that by integrally developing teachers’ understanding of mathematics, pedagogy, and technology with a focus on student thinking, we will help teachers develop a more complete picture of what is needed when teaching mathematics with technology and, in turn, be prepared to make informed decisions about appropriate uses of technology.


Teacher preparation for the 21st century deserves a front-end approach to addressing the use of technology in the learning environment. To study the effect of instructing with technology, pedagogy, and content knowledge (TPACK), teachers were asked to apply pedagogical, mathematical, and cognitive fidelity to technology used in an instructional unit they were designing. Initial results indicated that teachers were conflicted by a conceptual approach to technology use.

Through clarifying and defining pedagogy, mathematics, and cognitive fidelity within the TPACK framework, teachers became more aware of the misuse of instructional technology, what attributes of technology lead to conceptual development, and
integration of meaningful technology into instructional units. TPACK, with fidelity carefully defined, creates a research-based model by adding the qualifying features needed to maximize the potential of technology in the classroom. The purpose of this study is to look at the knowledge structures of TPACK and examine them in designing instruction units.


This paper describes strategies used by the authors to assist pre service social studies teachers with understanding and applying models and practices for effectively integrating technology into their future classrooms—thus, strengthening the link between technology and pedagogy (or technological pedagogical content knowledge). Efforts with pre service teachers described here have been informed by the authors’ successes assisting in-service teachers with understanding how technology can empower inquiry-based teaching practices in social studies classrooms, as well as efforts to more fully integrate technology into the overall teacher education programs at the authors’ institutions.

**Koehler, M. J., & Mishra, P., (2009). What is technological pedagogical content knowledge?**

This paper describes a framework for teacher knowledge for technology integration called technological pedagogical content knowledge (originally TPCK, now known as TPACK, or technology, pedagogy, and content knowledge). This framework builds on Lee Shulman’s construct of pedagogical content knowledge (PCK) to include technology knowledge. The development of TPACK by teachers is critical to effective teaching with technology. The paper begins with a brief introduction to the complex, illstructured nature of teaching. The nature of technologies (both analog and digital) is considered, as well as how the inclusion of technology in pedagogy further complicates teaching. The TPACK framework for teacher knowledge is described in detail, as a complex interaction among three bodies of knowledge: Content, pedagogy, and technology. The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use into teaching.

The integration of technology into pre service teacher education continues to be emphasized as important. The hope is that if future teachers obtain technology skills they will design meaningful technology mediated learning experiences for their students. However, gaining technology skills alone does not ensure the ability to envision and employ successful technology-mediated learning designs. Consequently, teacher education must model the connection between learning and technology. This paper examines the use of digital stories as a pedagogical tool in two undergraduate educational psychology classes. The study analyzes a constructivist learning design where technology and learning intertwine. The intention of this learning design was to engage students in a constructivist model that utilized technology as an integral part of learning. In the design, the tools such as the wiki, the storyboard, and the digital stories played important roles in mediating knowledge building. Affordances and constraints of learning within this design are explored in relation to student experiences. The design pushed students into territories of learning with and through technology that they may never have experienced. In terms of affordances, students found that the design connected them personally to their learning. In addition, they saw the tools and the multimedia representations as integral to their active involvement in learning and their understanding of the concepts. During the process, students relied on social supports by seeking assistance on how to use the technology; they questioned each other about their verbal explanations on the Web, and they gave supporting arguments related to why they chose certain images. Together the social supports and talk around the technological supports/scaffolds cohesively enhanced their learning experience. Although the experience seemed positive, students noted hesitations with this learning experience. Namely, they articulated their difficulties with open-ended assignments and their frustrations with technology.


On its own, technology does not produce intellectual engagement. Pre service experiences should be infused with technology, pedagogy, and content in order to
develop a nuanced understanding of the complex relationships between technology, content, and pedagogy for future social studies teaching (Mishra & Koehler, 2006). Students worked in pairs over the course of one semester to develop nine social studies infused modules in the creation of the class digital flexbook which operated along five distinct phases: awareness, analysis, collection, design, and reflection. Each of these phases was unique to the process but did not occur in isolation. At times students gained awareness even as they were putting the final touches on their chapters. Often, the collection of primary and secondary sources led to new discussions and connections that needed further analysis. However, these five phases provide a lens to situate the development of the digital flexbook project from its inception through its development. The digital flexbook project was centered on and around inquiry-based activities that help students understand historical processes and engage their own histories into a broader understanding. Through the five phases outlined in this paper, the students completed the course with a better understanding of the types of pedagogical praxis that are frequently privileged in the classroom, developed a more critical stance on the intersection of race, gender, and socio-economic status on the writing of history, and integrated a model for how technology can and should be used in the classroom.


The use of computers in the classroom could allow both educators and learners to achieve new capabilities. There are underlying factors, however, that are obstructing the adoption rate of computer use for instructional purposes in schools. This research focused on these problems with a view to determining which critical success factors promote a higher adoption rate of computer usage in education. To investigate the secondary school educator’s perceptions of the use of computers for teaching purposes and to analyse the effect of these strategies on their teaching pedagogies in the present environment. The nature of the study required a mixed methods approach to be employed, making use of both quantitative and qualitative data. Two questionnaires, one for the educators and one for the principals of the schools were
hand-delivered to 60 secondary schools. Exploratory factor analysis and various internal consistency measures were used to assess and analyse the data. The analyses of the data indicated that educator pedagogies were the highest predictors on the use of computers in the classroom. Although the quantitative analyses for educator support, training and attitude were the lowest predictors on the use of computers, the qualitative analysis, nevertheless, found sufficient support for it. Educationists and policy-makers must include all principals and educators when technological innovations are introduced into schools. All these role-players need to be cognisant of the implications if innovations are not appropriately implemented. Including the use of computers in educator training programs is important so that pre-service educators can see the benefits of using the computer in their own teaching. Educator pedagogy, theories and beliefs and access to computers were the highest predictors of using computers. These initiatives increase the likelihood of enhanced teaching and learning when using computers.


This study investigates the reason why teachers integrate technology into their lessons, the type of technology they use and how they integrate it into their lessons. Furthermore, this study aims to determine the indicators of technology use and the special conditions for certain applications. The data relating to teacher’s technology integrations into their lessons were obtained from classroom observations according to criteria determined after in-service training had been received. The sampling of the study comprised 32 elementary school teachers. During the observations, the observation form prepared within the scope of the project was used. Frequency tables were used to analyse the data. As a result, it was observed that the teachers who had received in service training purposefully integrated technology into their lessons and they generally understood how to select an appropriate technology for their particular teaching purpose. It was also observed that teachers new to the use of technology in the classrooms used conventional methods to integrate technology in their teaching.

Objectives: (1) To study the effectiveness of teaching concepts in mathematics through video-cassette; (2) to compare the effectiveness of teaching concepts in mathematics through video-cassette with that of traditional method; (3) to compare the effectiveness of teaching concepts in mathematics through video-cassette mixed with discussion by giving pause often with that of traditional method; (4) to study the gender difference in achievement in Mathematics. Method: Experimental method (Equivalent group design) was adopted for the study. The sample was taken 45 boys and 45 girls, using probability sampling for the study. Achievement method was used as a tool for the study. Findings: (1) It implied that the increased level of academic achievement of experimental group was due to the teaching of Mathematical concept through video-cassette. (2) There was a significant difference between boys and girls in all groups. In all the girls’ performance were superior to boys.


The study has examined the relationships among teachers' levels of technology use and a number of key factors including years of experience, ease-of use, and access to resources. Achieving meaningful technology use is a slow process that is influenced by many factors. When educators and researchers look for ways to help teachers use technology effectively, it may be important to look at what they have (in terms of equipment) in addition to what they do not have (in terms of positive technology inclinations). Understanding teachers' visions for technology use and their beliefs about teaching and learning may be necessary if we want to initiate an adoption of modern technology interventions in teaching pedagogy. Many exciting applications of information technology in classrooms validate that new technology based models of teaching and learning have the power to dramatically improve educational outcomes. But, classroom computers that are acquired as panaceas end up as doorstops. Unless other simultaneous innovations in pedagogy, curriculum, assessment, and school organization are coupled to
the usage of instructional technology, the time and effort expended on implementing these devices produces few improvements in educational outcomes – and reinforces many educators’ cynicism about fads based on magical machines. Part of the reason for this pattern of failed investments is the absence of positive role models and clear best practices. Amidst the many stories about promising opportunities or the failures of promise, few concrete models have been offered for how technology can positively enhance teaching and learning. This absence of highly visible successes and best practices increases the sense of frustration and concern and leaves institutions without a lodestar. Some institutions, however, have approached technology carefully and strategically and are successfully transforming teaching and learning. Our classes should not be merely lights and bells and whistles. As instructors, we must not succumb to the march of new technology…without clearly understanding what is needed and then how to use it. According to the Research review draft, many teacher educators, mentors, school teachers and student teachers have been examined not to use ICT in education in a versatile way. ICT can not be simply implanted to teaching and learning activities, because the goals for learning activities will probably change when ICT is used in education.


Objectives: (1) To study relative effectiveness among PBL (Peer-based Learning), ILMMP (Individualised Learning supported by Multi Media Presentation), IILMMP(Interactive Individualised Learning supported by Multi Media Presentation) in terms of development of cognitive skills at different levels of knowledge, understanding and application among the students of Class IX as measured by post-test and retention test; (2) to study whether there is any significant difference among the instructional strategies, viz. PBL, ILMMP and IILMMP with regard to computer attitude and scientific attitude. Method: Quasiexperimental method was adopted for the study. Qualitative and quantitative approaches were adopted for the study. A sample of 108 girl students from Vellalar Matriculation and Higher Secondary School, Erode district in Tamil Nadu was
taken, using probability sampling technique for the study. The Tools used for the study were an achievement test (Self-made tool), Criterion Referenced Test, Scientific Attitude Test (Bhasksrarao and Marlow Ediger), and Computer Attitude Scale (Niel Selwyn) used in the study. The ‘t’ test and ANOVA were used for data analysis in the study. **Findings:**

1. It is concluded that Interactive Individualising Learning supported by Multi Media Presentation (IILMMP) was found to be the most effective strategy among all the three different instructional strategies, viz. PBL, ILMMP and IILMMP in term of cognitive skills such as knowledge, understanding and application in realising the instructional objectives in Chemistry at Class IX. 
2. PBL was found to be coming between IILMP and ILMMP in enhancing the retention of what have already been learnt. 
3. It was inferred that irrespective of the difficulty level of the content, IILMMP was to be most effective one while ILMMP was the least effective one. 
4. It was found that while the subjects of all the three experimental groups were identical in terms of their scientific attitude, the same was found to be nonidentical in terms of their computer attitude. 
5. The results of the study indicated that the enhancement of learning Chemistry was only due to the media effectiveness. Computer Mediated Multi Media Based Instruction can be introduced in education at all level for the successful realisation of instructional objectives. One hundred two references were cited in the study.


This dissertation investigates information and communication technology (ICT) systems and their applications and use in teaching and training in universities and corporations. The aim is to identify and map studies that might shed light on the impact of ICT systems on teaching and training, and to undertake an in-depth analysis of the identified literature. The context of the study is the growing prevalence of information and communication technology (ICT) use in academic and corporate training. A closer look reveals that corporations have been focusing on technology without giving much attention to pedagogical issues of learning. This is in contrast to universities where attention is usually given to learning pedagogy without realizing the full power of ICT in enhancing and even re-creating teaching and learning practices. Moreover, managing technological
change in organizations is a challenging issue that requires further research in both academic and corporate settings. A qualitative systematic review has been conducted to develop a framework for the integration of ICTs into teaching and training in universities and corporations. Understanding technological innovations, coupled with understanding of educational principles and organizational challenges, should lead to new applications of technology that will transform the process of teaching and training. The research method used is replicable as times goes by so the study is scalable as new technologies appear and pedagogical principles adopted.


The instructional problem of a superficial understanding still prevails in current education. Many educators seek solutions from technology to remedy the shadow learning problem. But, as researchers indicate, technology alone does not cause learning. Rather, learning is influenced more by instructional interventions. An instructional design model that fulfills the aim of meaningful learning is Goal-Based Scenarios (GBSs) proposed by Schank, Fano, Bell, and Jona (1993/1994). It offers guidelines to guide the design of a computer simulation. The purpose of the present study is to evaluate the GBS model by answering following questions: 1) what are the strengths and weaknesses of the GBS model? 2) What improvements can be made? Formative research was employed to investigate the designed instance by using think aloud interview, debrief (semi-structured) interview, and a focus group interview. The result showed that a GBS might become a better instructional design model if improvements are made in these aspects: 1) provide a worked example or instruction that demonstrates the behaviors of using GBS and seeking supports in order to increase the user's lower sense of self-efficacy while pursuing mission or assuming the role, 2) employ approaches of a small group usage and open-ended question to promote learners' engagement and interaction in scenario operations, 3) carefully integrate other components in GBS to support hands-on activity, 4) provide cues in negative feedback and recapitulate the concept in positive feedback.

This mixed methods study explored young children’s understandings of targeted lunar concepts, including when the moon can be observed, observable lunar phase shapes, predictable lunar patterns, and the cause of moon phases. Twenty-one children (ages seven to nine years) from a multi-aged classroom participated in this study. Data were collected using semi-structured interviews, student drawings, and card sorting before and after an inquiry-based, technology-enhanced instructional intervention. Students’ lunar calendars, written responses, field notes, and videotaped class sessions also provided data throughout the study. Data were analyzed using codes from prior lunar studies, constant comparative analysis, and nonparametric analysis. The instructional intervention included lunar data gathering, recording, and sharing, through the use of Starry Night planetarium software and an inquiry-based instruction on moon phases (McDermott, 1996). In a guided inquiry context children worked in groups to gather and analyze nine weeks of lunar data. Findings indicated a positive change in students’ understanding of all targeted concepts. After the intervention more children understood that the moon could be observed sometimes during the day, more children drew scientific moon phase shapes, and more children drew scientific representations of the moon phase sequences. Also, more children understood the cause of moon phases.

Dean, Carol Mae, (2001). Ed.D, Preparing Preservice Teachers To Meet The Iste National Educational Technology Standards: A Case Study Of An Instructional Technology Class.

This was a case study that focused on the teacher of one instructional technology class; the class itself, the students and their perceptions of preparedness to meet the ISTE Standards for teachers and technology. Both quantitative and qualitative data were collected. This research study provided insights into the curriculum design and instructional techniques needed to help preservice teachers gain the skills and knowledge to use computers as instructional tools. The theoretical foundation of this research study was based on literature related to standards; teacher education and instructional
technology, and the theory of constructivist learning. The results of this study indicated that: 1) The instructional technology class played a critical role in preparing these preservice teachers to meet the ISTE Standards. All of the standards were covered, but not in the same depth; 2) The students' perceptions of their preparedness to implement the standards did increase; 3) The students rated themselves higher in their preparedness to meet those standards the professor emphasized in class (Standards, I, II, III); 4) The use of selectivity in standards, teachable moments; threaded discussions, asking critical thinking questions about computer technology and classroom use; modeling techniques, and hands-on opportunities for students to work with the technology, helped them become better prepared to meet the ISTE Standards; and 5) The professor's pedagogy of direct instruction and focus on constructivist learning activities combined with a variety of instructional techniques assisted students in developing skills and knowledge to use instructional technology effectively in the classrooms.


During the last decade, advances in computers have increased access to educational technology in colleges nationally. The Campus Computing Project (2001) reported that college faculty used multimedia technology in a fifth of their courses and Internet in a third of their classes. However, despite the proliferation of educational technology at the college level, there is a paucity of empirical data on what constitutes effective pedagogy. Without an understanding of the effects of Web-based instruction and learning, there is the danger that college courses employing educational technology will become prematurely driven by technology rather than pedagogy. The purpose of this investigation was to explore the influence of computer enhanced lecture formats (i.e., slideshow presentations), Virtual Learning Environments (VLE), and traditional lecture formats on short-term recall and recognition at the postsecondary level. Specifically, the aims of this project were to (1) explore which of three conditions: Traditional Lecture, Slideshow Enhanced, or VLE would demonstrate the greatest recall; (2) determine whether individual information processing preferences would influence recall, and;
(3) investigate which condition would be perceived as the most mentally taxing. Participants in the Slideshow Enhanced and the VLE conditions showed higher recall than participants in the Traditional Lecture conditions. Our sample likely reflected the presence of the newest generation of students entering college: the Millennial Generation. Relative to earlier generations, Millennials appears to possess a unique level of familiarity with computers and educational technology. The higher recall found in the Slideshow Enhanced and VLE conditions may be due to the Millennials familiarity with visual presentation and technology. However, despite their familiarity, participants in the study reported being more frustrated with the VLE than participants in the other conditions. Their increased frustration may have stemmed from the goal-directed nature of the experimental task, which required them to be active information seekers. A teacher may serve to mediate this experience by providing direction.

**Contribution to the present research**

The above review has helped in establishing the the role and impact that information technology (IT) has on the future and existing style of learning and teaching. Pre service experiences should be infused with technology, pedagogy, and content in order to develop a nuanced understanding of the complex relationships between technology, content, and pedagogy. This review investigates information and communication technology (ICT) systems and their applications and use in teaching and training and the importance of use of pedagogical theories. ICT without pedagogy is like a ship without a rudder. In order to achieve the goals of education and effective learning by the students it is essential that appropriate pedagogical theories are used in collaboration with ICT. Many educators seek solutions from technology to remedy the shadow learning problem. But, as researchers indicate, technology alone does not cause learning. Rather, learning is influenced more by instructional interventions. Gaining technology skills alone does not ensure the ability to envision and employ successful technology-mediated learning designs. Consequently, teacher education must model the connection between learning and technology.
2.4 Theory of constructivism and its application

A definition of constructivism

Thirteen Ed Online (2004)

Fundamentally, constructivism says that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences.

Constructivism: A Learning Theory

Learning theories are the ideas which educators consider while designing and applying to instruction. The theories determine what and how the learning material should be arranged and taught. Designers need to have their own personal educational philosophies and ideas about what constitutes education and learning.


Constructivism as a learning theory contends that knowledge is not merely transmitted from teacher to student, but it is actively constructed in the mind of the learners out of their experiences in the world. It mainly deals how learners build their understanding on a new experience in relation to their previous ones. Von Glasersfeld (1996) partly bases his concept on the results of Jean Piaget’s developmental psychology. In a class, which is run according to constructivist guidelines, the teacher does not act as a pure knowledge transmitter who only accepts true answer to his/her problem but as a coach or facilitator offering thought provoking suggestions for solving the tasks given. Students are expected to use their own experiences to solve a problem as a group using different ways and methods. In addition, constructivism proposes that learners are more likely to create new knowledge when they are actively involved in making some type of learning artifact upon which they can reflect and share with others. Since the emphasis of constructivism is on thinking and understanding and not on rote memorization of isolated facts, students learn how to learn and thus can relate their learning to new situations in real life. Constructivism involves children in authentic real world learning experience that are based on their own questions, thus students feel a sense of ownership for the learning.
Jonassen (1994) summarizes the following principles for knowledge construction that illustrate how knowledge construction can be facilitated:
I. Provide multiple representations of reality;
II. Represent the natural complexity of the real world;
III. Focus on knowledge construction, not reproduction;
IV. Present authentic tasks (contextualizing rather than abstracting instruction);
V. Provide real-world, case-based learning environments, rather than predetermined instructional sequences;
VI. Foster reflective practice;
VII. Enable context-and content dependent knowledge construction;
VIII. Support collaborative construction of knowledge through social negotiation.
It is true that knowledge is acquired by the learners through interaction with real world outside and the teacher if could associate the social environment of the learner with the new ideas then successful and speedy acquisition takes place. The teacher can encourage collaborative learning and peer learning techniques by putting the learners with similar background, together. It will not be possible for the teachers to use all or most of the above principles in all classes all the times, therefore he/she should critically analyze the situation in the classroom and base his/her instruction by selecting an appropriate one.

A comparison of traditional and constructivist classroom has been done. In traditional education, the role of the teacher is seen as that of a transmitter of knowledge, in the constructivist classroom a teacher’s role changes significantly. The role of the teacher in the constructivist classroom is to act as a "guide on the side" The teacher’s job becomes to provide opportunities for learners to expand their knowledge in an active and engaged format. The teacher can not assume that all learners have the same background knowledge or experiences for building new knowledge. Learners in the constructivist environment are active and not passive. They are encouraged to be independent thinkers
and problem solvers. Learners are engaged in experiences that go beyond factual responses and provide opportunities to hypothesize, to analyze, to interpret, and to predict. Another essential component for learners is to communicate and collaborate with others allowing for reinforcement and elaboration of ideas and concepts. Students are encouraged to take initiative and take ownership for their own learning, thereby developing their own intellectual identity:- Thirteen Ed Online (2004).

**Table 4. A comparison of traditional and constructivist classroom**

<table>
<thead>
<tr>
<th>Traditional Classroom</th>
<th>Constructivist Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begins with parts of the whole– emphasizes basic skills</td>
<td>Begins with the whole –expanding to parts</td>
</tr>
<tr>
<td>Strict adherence to fixed curriculum</td>
<td>Pursuit of student questions / interests</td>
</tr>
<tr>
<td>Textbooks and workbooks</td>
<td>Primary sources / manipulative materials</td>
</tr>
<tr>
<td>Instructor gives/ students receive</td>
<td>Learning is interaction-building on what students already know</td>
</tr>
<tr>
<td>Instructor assumes directive, authoritative role.</td>
<td>Instructor interacts / negotiates with students</td>
</tr>
<tr>
<td>Assessment via testing / correct answers</td>
<td>Assessment via student works, observations, points of view, tests. Process is as important as product</td>
</tr>
<tr>
<td>Knowledge is inert</td>
<td>Knowledge is dynamic / changes with experiences</td>
</tr>
<tr>
<td>Students work individually</td>
<td>Students work in groups</td>
</tr>
</tbody>
</table>
Honebein, Peter C., (1996). “Seven goals for the design of constructivist learning environments.”

Peter C. Honebein (1996) while conducting case studies on “Constructivist Learning environment” concludes that there are seven pedagogical goals for constructivist learning. These are:-

1. Provide experience with the knowledge construction process. Students take primary responsibility for determining the topics or subtopics in a domain they pursue, the methods of how to learn, and the strategies or methods for solving problems.

2. Provide experience in and appreciation for multiple perspectives. Students must engage in activities that enable them to evaluate alternative solutions to problems as a means of testing and enriching their understanding.

3. Embed learning in realistic and relevant contexts. The curriculum designers must attempt to maintain the authentic context of the learning task. Educators must ground problems within the complexity that surrounds the students outside the classroom. Students must learn to impose order on the complexity as well as solve the core problem.

4. Encourage students’ ownership and voice in the learning process. This illustrates the student-centeredness of constructivist learning. Rather than the teacher determining what students will learn, students play a strong role in identifying their issues and directions, as well as their goals and objectives. The teacher acts as a consultant only.

5. Embed learning in social experience. Intellectual development is significantly influenced through social interactions. Thus, learning should reflect collaboration between both teachers and students, and students and students.

6. Encourage the use of multiple modes of representation. Oral and written communications are the two most common forms of transmitting knowledge in educational settings. Curricula should adopt additional media, such as video, computer, photographs, and sound, to provide richer experiences to enhance learning.

7. Encourage self-awareness of the knowledge construction process. A key outcome of constructivist learning is knowing how we know. It is the students’ ability to explain why or how they solved a problem in a certain way; to analyze their construction of knowledge and processes.

The article reports the findings of a study that assessed the learning of identical course content in two individual group treatments: one group receiving traditional instruction (n=86) and another receiving student centered constructivist instruction. It is found that the constructivist treated group out-performed the traditionally taught cohort on identical evaluations.


In this qualitative and interpretive study, investigation of factors that influenced elementary preservice teachers’ self-efficacy in a constructivist, inquiry-based physics class was done. Bandura’s (1977) theory of social learning was used as a basis to examine preservice teacher’s self-efficacy. Participants included 70 female EC-4 preservice teachers enrolled in two sections of PHYS 3400. Data collected included individual and focus group interviews, pre and post-concept tests, and participant lesson plans. A model showing the impact various factors have on increasing preservice elementary teachers’ self efficacy was presented. Results show modeling of (1) grade appropriate science teaching activities, and (2) strategies and participatory experiences in inquiry-based activities were major factors influencing elementary preservice teachers’ self-efficacy and outcome expectancy expectations.


This study examines the effectiveness of constructivist-based teaching strategy on academic performance in integrated science by Junior Secondary School students in South-West Nigeria. Quasi-experimental research design was used to achieve the purpose of this study. Participants were 120 Junior Secondary School Students randomly selected from four out of the 25 co-educational Junior Secondary Schools in Ijebu-ode local
government area of Ogun state, South-west Nigeria. Findings revealed that the 
constructivist instructed students had higher scores on the post test and the delayed post 
test, compared to those exposed to conventional (lecture) method of teaching. We 
concluded that if integrated science teachers could incorporate constructivist-based 
teaching strategy into their teaching methods, there would be an improvement in 
academic performance of Junior Secondary School Students in integrated science. The 
researchers recommended that integrated science teachers should incorporate 
constructivist-based teaching strategy in their methods of teaching.

Serkan Narli, (2011). Is constructivist learning environment really effective on 
learning and long-term knowledge retention in mathematics? 
This study investigates the long-term effects of instructing Cantor set theory using 
constructivist learning approach on student knowledge retention. The participants 
included 60 first-year secondary mathematics pre-service teachers. Students were 
divided into two classes one of which was taught via traditional lecture (n = 30) and 
the other was taught using active learning approach (n = 30). A pre-test named 
“Minimum Requirements Identification Test” developed by the researcher was used 
in the determination of the groups. This test involves the concepts such as “set, 
relation, and function” which were required to be able to learn Cantor set theory. 
Student retention of Cantor set theory was measured by using a questionnaire which 
consists of open-ended questions about the topic. The test was administered to all of 
the students approximately 14 months after the first instruction. In addition, five 
students from each group were interviewed. Analyses of the data revealed that the 
students in the constructivist learning environment showed better retention of almost 
all of the concepts related to Cantor set theory than the students in the traditional 
class.

Preservice Teacher Education Students’ Performance, Retention, And Attitudes. 
The purpose of this study was to examine the impact of constructivist learning process on 
pre-service teacher education students’ performance, retention, and attitudes in
Classroom Management Course. In this study, an experimental design and a case study design were used together. The sample (n = 144) were third year preservice teachers at the Foreign Languages Education program at Middle East Technical University, Turkey. The experimental group (n = 76) was subjected to social constructivist learning process, while the control group (n = 68) was subjected to traditional instruction for eleven weeks. Data were collected through qualitative and quantitative methods. Findings show that posttest scores were not statistically different between the experimental and the control groups. However, a significant difference was found in the retention scores in favor of the experimental group. The conceptual change the learners went through was evident in their metaphorical images which tend to change from a more controlling image to images that depict leadership, sensitivity to individual differences, and student learning.

Descriptive findings indicate that retention was fostered through constructivist activities that mainly included reflective writing, critical thinking, and problem solving. Factors such as active learning, meaningful and enjoyable learning environment, and the attitudes of instructors had a positive impact on student learning. Nevertheless, the load of reflective diary writing and portfolio preparation tasks, and collaborative work could be overwhelming and discouraging and these impacted negatively on learners’ attitudes towards the course.


The present study aimed to investigate the prospective science teachers’ (pupil-teachers’), teacher educators’, school teachers’ conceptual understanding of nature and pedagogy of science and the extent to which these perceptions were aligned with the tenets of Constructivist philosophy and pedagogy.

Population and Sample Groups - The population comprised of pupil-teachers, teacher educators, and school teachers teaching science in schools of Delhi, India. Sample groups of the study comprised of 310 Pupil-teachers of Science Stream studying in various teacher-training institutes of Delhi; 110 upper primary and secondary and senior secondary school teachers teaching Science in government and unaided schools of Delhi and 30 Science teacher educators from various teacher training institutes (B.Ed) in Delhi.
**Tool of the Study** - The objectives of the present study were realized with the help of a 50–items five point rating scale (*Assessment on Nature of Science and its Pedagogical Perspectives*) comprising of two parts I and II, each having twenty five statements.

**Major Findings of the Study** - The findings of the investigation revealed that majority of participants did not demonstrate informed (constructivist) views about nature and pedagogy of science. The general neutral rankings on the Likert Scale reflected that the respondents’ had not developed adequate understanding about various elements of nature and pedagogy of science. The predominance of positivism in the views of preservice and in service teachers was also apparent from their agreement with some of the commonly established myths regarding epistemology of science. To conclude, now that we know that the science presented to learners has very little in common with the ‘real’ science, it’s time we abandon the existing traditional and obsolete notions of science and scientific knowledge.


This naturalistic case study describes the initial phases of the teacher change process resulting from the implementation of a restructured undergraduate statics engineering course. The investigation focused on the broad research question of what happens when an educator undertakes the teacher change process to allow himself to move away from what is familiar and known (i.e., the traditional pedagogy) into an unknown, new pedagogy. More specifically, the three research questions investigated by this study were: (a) what were the teacher's intentions for changing his pedagogy? (b) what were the actual teaching events over the course of the semester? (c) what were the participants’ (i.e., the instructor, students, undergraduate teaching assistant and researchers) perceptions of the pedagogical change? Data were collected from transcribed audio recordings of interviews with the instructor, selected students and the undergraduate teaching assistant, written field notes from observations, questionnaires, electronic mail exchanges, student minute papers, and other documents. The data were summarized and
coded according to recurring words, phrases, sentences and paragraphs about the instructor’s intent for his change in pedagogy, then organized into categories of three change foci: (a) experiential learning, (b) cooperative learning, and (c) interactive multimedia in order to correspond with his intent for the new statics learning environment. The results of this study are presented in terms of a descriptive analysis of the initial teacher change process portrayed through the “multiple realities” of the participants who experienced the pedagogical change. Three issues were evident: (a) the problem of the simultaneous introduction of three new innovations (experiential, cooperative learning and the interactive multimedia), (b) the frustrations of the teacher change process, and (c) difficulties of a paradigm shift in pedagogy when the instructor commences to relinquish control in the new learning environment. Articulation of these issues helps to increase our understanding of the teacher change process and the need to enact change over time. Moreover, lessons learned from this study can serve as guidelines for future researchers in their efforts to study the change process. This study increases our understanding of the teacher change process particularly when one undertakes a paradigm shift in pedagogy.

**Contribution to the present research**

The review of literature related to constructivism helped the researcher in understanding the theory of constructivism, its principles and its use in the classroom. Constructivism as a learning theory contends that knowledge is not merely transmitted from teacher to student, but it is actively constructed in the mind of the learners out of their experiences in the world thus students feel a sense of ownership for the learning. The principles for knowledge construction and the seven pedagogical goals for constructivist learning that illustrate how knowledge construction can be facilitated were established through the review. The impact of constructivism on the learning of students was established by the fact that in all researches the constructivist treated group out-performed the traditionally taught.
2.5 ICT and Constructivism


He concludes that when ICT is used in lessons, the constructivist approach is more likely to lead to successful outcomes. Furthermore, his study showed that teachers with the most constructivist philosophies tend to use computers more often and in a more challenging way both in their classrooms and as users themselves.


Technology and the use of computers is not viewed within or outside the classroom as a fad or a cure-all. It is strongly believed that our teacher candidates—and all future teachers—need to be trained in constructivist approaches to technology. They need to have hands-on experiences with technological tools that advance their own studies and educational and professional goals, as well as develop skills to be able to design appropriate learning activities for their students. Multiple perspectives, realistic and authentic tasks, activities and environments, self-analysis and reflection, experiential learning, and collaborative and cooperative learning are some of the themes associated with constructivist teaching and learning that we are relating to our discussion of how technology is incorporated in our teacher education programs. The increased reliance on technology in education is a given, whether it be communication with the administration, the collection of data, or the use of technology to improve test scores. It is the responsibility of teacher preparation programs to prepare candidates with the latest technological tools of the profession. Technology integration should not be done just on occasion, nor is it meant to be hard work that can be easily forgotten. We expect teacher candidates not to use technology for the sake of simply using it, but rather to engage in critical analysis and reflection to identify which modes of technology most complement their teaching and student learning outcomes. Through analysis and reflection we can learn how technology can be used effectively in a teacher preparation program.

A comprehensive approach for integrating technology into a TESOL teacher preparation program is described. Ten specific ways to assure constructivist technology use in teacher education are highlighted. These techniques have been synthesized into a compact model with three pillars: (a) electronic assessment system (e-portfolios for individual assessment and program evaluation), (b) teacher candidates’ technology-based course assignments and performances, and (c) Web-based instruction and communication. The authors claim that within this three-pronged model flexibility of implementation is key to success for preservice and in-service teachers.


In classrooms today, the role of the teacher needs to change from the traditional role of prescriptor to that of orchestrator of learning – which necessitates the designing of ICT integrated classrooms promoting higher order cognitive skills. The focus ought to be more on enquiry-based approaches often going beyond the prescribed curriculum to delve and seek answers to the problem under concern but now from different perspectives. This methodology is challenging both for the teacher as well as for the learner but eventually the process of self-learning ensures a more rigorous approach and deeper understanding of facts. The focus is more on the process of information acquisition, the critical and analytical thinking involved in acquiring information from multiple sources, analyzing this information and then designing the learning outcomes in aesthetic presentations. Such a model of learning focuses more on the process over the product, acquiring information from multiple sources, analytical and critical thinking and finally a comprehensive evaluation assessing different areas of student academic growth. One of the significant inputs to this method of studying are the periodic scaffolds provided to ensure a framework in which the discovery and investigation is conducted and while meaningful learning is the objective, certain curricular requirements cannot be compromised in the process of exploration.

Many different kinds of software programs can be used by students and each different kind of tool will be suitable for different goals. He used the term “Mind tools” to describe various computer software such as spreadsheet and database applications, concept-mapping programmes, multimedia and hypermedia development software. These programmes are only considered as Mind tools when students in a learning situation use them as cognitive tools. When students are actively involved in constructing a system using the software, they are engaged in many thinking tasks. Jonassen contrasts the situation of the teacher who uses the tools themselves to illustrate a point, manipulate information, solve problems, or perform other types of operation for the students, with the situation where the students create their own illustrations and examples, manipulate their own data and other information, and generally, wrestle with the tools themselves. The first situation is what he calls instructive, but the second is highly constructive.

Christopher, D. Moore, (2005). Is ICT being used to its potential to improve teaching and learning across the curriculum?

“Under the right conditions – where teachers are personally comfortable and at least moderately skilled in using computers themselves, where the school’s daily class schedule permits allocating time for students to use computers as part of class assignments, where enough equipment is available and convenient to permit computer activities to flow seamlessly alongside other learning tasks and where the teacher’s personal philosophies support a student-centred, constructivist pedagogy that incorporates collaborative projects partly defined by student interest – computers are clearly becoming a valuable and well-functioning instructional tool.”


With the current development of philosophical and educational theories, the computer technology makes it possible to realize new forms of education for the postmodern world, which are characterized as: connection, heterogeneity, flexibility and morphogenesis.
However, the Web and other multimedia technologies are merely information resources and tools, unless we provide meaningful learning content and context. The idea of intertextualizing new design learning with the Internet in this study, therefore, is important to connect and integrate useful knowledge in ways that are suited to the design learning and its activities. The purposes of this study were to reconstruct design education with a new epistemological approach, and to develop a constructivist learning theory for Web-based Design Learning (WBDL). The research processes of this study were: (1) to identify constructivist epistemology, and to investigate cognitive and social constructivist learning theories through literature review; (2) to build a conceptual framework for constructivist design learning; (3) to develop Web-Based Design Learning (WBDL) models as knowledge construction tool, and to apply them in design education; (4) to analyze the effectiveness of WBDL with a case study; and (5) to present guidelines for applying the constructivist learning theory and the WBDL to design education for the future study. The WBDL program was developed and analyzed on three factors of constructivist design learning: cognitive and meta-cognitive, social and collaborative, and technical factors. From the case analysis, the effectiveness of WBDL as a design learning tool was highly evaluated by its visualized learning pattern in cognitive and social learning contexts. Comprehension of the qualitative information such as the level of design process and time gives the rationale to study constructivist design learning for improving the quality of design education. Furthermore, the effectiveness of WBDL is not confined to the student’s learning achievement, but is extended to the students’ future work in the design industries where collaborative, communicative, and contextualized activities are strongly emphasized. The research findings support the theory of constructivist design learning that (1) conceptualizes the learner-centered, collaborative, and authentic learning theories, and (2) integrates them to solve the complex design problems emerging with the paradigm of postpositivism.


This study examined the relationship between constructivist course design and educational effectiveness in online distance education courses. Sixty-five online graduate
students completed two Web-based self-report instruments: (a) the Constructivist On-Line Learning Environment Survey (COLLES), which measured the students' perception of the learning environment and (b) the Cognitive, Affective, and Psychomotor Perceived Learning Scale (CAP Scale), which measured the students' perceived learning. The results of this study found that there was a relationship between all of the elements of constructivist course design measured by the COLLES and affective learning. A relationship was also found between the extent to which engagement in the online environment was made relevant to the student's professional worldviews and related practices and psychomotor learning. Interestingly, there was no relationship found between constructivist course design and cognitive learning. The results of this study reflect the constructivist tenets that learning is inherently social and involves emotions and feelings


The purpose of this study was to develop and pilot test a methodology to determine the relative importance and presence of constructivist elements in online learning classes. A case study method was used to assess the effectiveness of four key constructivist elements: knowledge construction, collaborative learning, authentic learning and self-regulation in an online masters level public health course. Nine subjects responded to two survey instruments, while six subjects participated in an online focus group discussion. The key constructivist elements of knowledge construction, cooperative learning and the use of authentic learning were found to positively contribute to student learning in the online environment, while the findings for the fourth key element, (4) self-regulated learning did not support this subconstruct. Collaborative activities such as working in teams was clearly the most important element cited by students as contributing to their learning, indicating that collaborative learning is a critical instructional element. Working with an actual local public health agency on a community assessment project was also cited by students as being important to their learning, suggesting that authentic learning is also effective. Evidence supporting the positive role constructivist elements can play in
student learning was supported in both co-relational analysis of the questionnaires and in the focus group discussion.

**Contribution to present research**

Through review of the related literature it was proved that when ICT is used in lessons, the constructivist approach is more likely to lead to successful outcomes. The positive relationship between constructivist course design and educational effectiveness of ICT based teaching learning was established. The present research uses the theory of constructivism for designing the ICT based model of Curriculum Transaction and this review of related literature provides the background knowledge and the Principles for designing the ICT based model of Curriculum Transaction.

**2.6 Models of ICT based curriculum transaction**


Effective integration of Information and Communication Technology (ICT) into teaching and learning is becoming an essential competency for teachers. However, teachers do not usually follow linear instructional design models when they are planning for ICT integration. This paper proposes a generic model, which consists of three fundamental elements: pedagogy, social interaction and technology. Sound design of these components should help teachers to integrate ICT into their curricula in effective ways. Constructivist learning theories, the design of interactivity and the notion of usefulness provide the theoretical foundations for the construction of this model. Some examples of applying this model are to design of Web-based learning environments, facilitation of online discussions and comparison of ICT tools.


This study introduces a “Technology Integration Model” for a learning environment utilizing constructivist learning principles and integrating new technologies namely computers and the Internet into pre-service teacher training programs. The importance of the proposed model of this study lies on offering instructors involved in teacher
preparation programs an approach of teaching/learning process that shifts them from the
dominant didactic model i.e. teacher centered teaching to a more student-centered one.
This model depends heavily on working collaboratively using internet tools i.e. e-mail
and e-group discussion as an enhancement and supplement of collaboration occurs in
classroom.

Implementing this model in a learning environment looks promising as it could achieve
different types of pedagogical goals such as:
- providing knowledge construction
- providing multiple perspectives
- providing authentic tasks and social contexts
- providing space of participation
- encouraging the use of multiple modes of representation

The learning process of the environment becomes active and engages learners in working
on tasks and activities that are authentic to their future careers. It focuses on thinking
skills rather than working for the exam. In addition, learners work for defining
problems and finding out solutions through reflection. And lastly, learning involves

Figure 1. Shaoqur Model for integrating new technologies into pre-service teachers' programs
social negotiation as learners are able to challenge their thoughts, perceptions and existing knowledge by collaborating with others thus assisting their cognitive development process.

The main characteristics of the learning environment provided by this model could be:

- more learning, understanding, and retention (Brooks and Brooks, 1993)
- more interaction and discussion (Hein, 1993).
- more engagement by learners (Jonasson 1994)
- more ways of learning (Brooks/Brooks 1993):
- more accountability for learners’ own learning (Harasim, 1995; Jonasson 1994)
- more active learning and less listening (Harasim, 1995;)
- more meaningful learning. (Jonasson, 1994)
- more use of existing knowledge. (Jonasson, 1994; Hein, 1993)
- more active knowledge construction. (Wilson, B., 1995)
- more revision of multiple perspectives. (Jonasson 1994; Cunningham1993)
- more creative and flexible problem solving. (Perkins 1992)


Research in the area of educational technology has often been critiqued for a lack of theoretical grounding. In this article we propose a conceptual framework for educational technology by building on Shulman’s formulation of “pedagogical content knowledge” and extend it to the phenomenon of teachers integrating technology into their pedagogy. This framework is the result of 5 years of work on a program of research focused on teacher professional development and faculty development in higher education. It attempts to capture some of the essential qualities of teacher knowledge required for technology integration in teaching, while addressing the complex, multifaceted, and situated nature of this knowledge. We argue, briefly, that thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge that we call Technological Pedagogical Content Knowledge (TPCK). In doing so, we posit the complex roles of, and interplay among, three main components of learning environments:
content, pedagogy, and technology. We argue that this model has much to offer to discussions of technology integration at multiple levels: theoretical, pedagogical, and methodological. In this article, we describe the theory behind our framework, provide examples of our teaching approach based upon the framework, and illustrate the methodological contributions that have resulted from this work.

What sets this approach apart is the specificity of articulation of these relationships between content, pedagogy, and technology. In practical terms, this means that apart from looking at each of these components in isolation, we also need to look at them in pairs: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and all three taken together as technological pedagogical content knowledge (TPCK).

Figure 2. Pedagogical Technological Content Knowledge. The Three Circles, Content, Pedagogy, and Technology, Overlap to Lead to Four More Kinds of Interrelated Knowledge.

The model shows that focusing technology initiatives on learning while aligning them with the institutional mission can transform teaching and learning. Over the past decade, many colleges and universities have invested heavily in information technology in the belief that it would enhance learning and enrich the student experience. Several recent high-profile reports and articles, however, argue that most investments in technology have not paid off. In their study “Thwarted Innovation: What Happened to e-Learning and Why?” The proliferation of technology has done little to improve teaching or learning at most colleges and universities. Others have pushed the criticism further, arguing that technology has actually hurt teaching and learning in many courses. Part of the reason for this pattern of failed investments is the absence of positive role models and clear best practices. Amidst the many stories about promising opportunities or the failures of promise, few concrete models have been offered for how technology can positively enhance teaching and learning. This absence of highly visible successes and best practices increases the sense of frustration and concern and leaves institutions without a lodestar. Some institutions, however, have approached technology carefully and strategically and are successfully transforming teaching and learning. DePauw University in Greencastle, Indiana, offers one story of success. Several years ago, DePauw faculty, students, and staff recognized the potential of technology to enrich learning and grasped that DePauw’s historic mission as a liberal arts college required graduating students prepared to succeed and thrive in a broadly digital culture. Consequently, DePauw established the goal of becoming a national model for using technology to enhance liberal arts education and to enrich the college experience. To set the right philosophical and procedural frame, DePauw named its initiatives 361° to capture the goal of preparing students for every path of life after graduation (the 360 degrees) and to create new paths (the additional degree of leadership and innovation). From the beginning, the programs focused on alignment with the institution’s historic culture, values, and mission—a dedication to effective teaching and learning and to a liberal arts education designed to
prepare students for life’s work. There would be no technology for technology’s sake at DePauw.

Over the past four years, the 361° programs have done much to extend, enliven, and enhance teaching and learning at DePauw. To borrow the words of one recent graduate, DePauw’s initiatives “have fostered student and faculty use of, and facility with, computers and other digital technologies to develop the skills and languages needed to learn, live, and work in an increasingly technological world.” In recognition of its successes, DePauw received the 2004 EDUCAUSE Award for Systemic Progress in Teaching and Learning, and the university was recently named the Third Most Connected University in the country by Forbes.com.

Why have DePauw’s technology initiatives and programs succeeded, while some other institutions’ investments seem to have fallen short? No one recipe will match every institution’s culture and resources, and DePauw’s model represents only one of many successful approaches, but 10 simple factors offer a well-established list of best practices.

10 Key Factors for Success

1. Put learning first.
2. Align IT with institutional mission and culture.
3. Technology fluency is the new liberal art.
4. Invest more in people and support than in hardware and software.
5. Good enough is good enough.
7. Actively involve students.
8. Collaboration is essential.
9. Use technology to remove barriers.
10. Design space to enhance learning and build community.

Pulling It All Together - DePauw’s success factors for transforming teaching and learning with technology are not complex. Pulled together by an exceptional constellation of students, faculty, staff, and administrators, these factors have created a powerful formula for success. Gary Lemon, a professor of economics at DePauw, captured the impact of
DePauw’s 361°. Speaking of his experience using DyKnow in his courses, he said, “I was a dinosaur in the classroom, but now I am a dynamo.” His students agree. One recently remarked, “I used to struggle in economics courses, but Dr. Lemon’s use of DyKnow has helped me to understand in ways that I never could before.”

When transparent, well-supported technology focused on learning aligns and integrates with an institution’s mission, teaching and learning are transformed. DePauw’s successes show that failures are not inevitable and that investments need not be wasted. Success is a matter of approach, priorities, and process, effectively applied.


Mayes states that learning with technology involves a cycle of conceptualisation, construction and dialogue. In an article written by Mayes & Fowler, Mayes examines how different learning activities support students' understanding of new concepts and the revision of erroneous concepts. This is achieved in three stages, known as the Conceptualisation Cycle.

- At the **conceptualisation stage**, students are exposed to other people's ideas or concepts (for example in traditional face-to-face sessions or accessing content on the WWW).
- At the **construction stage** students apply these new concepts in the performance of meaningful tasks.
- However, it is only at the **dialogue stage**, in the performance of tasks in which these new concepts are tested during conversation with tutors and peers, that learning takes place. The feedback provided enables students' erroneous conceptions to be resolved.

Mayes suggests that each of the three levels of learning activity can be supported by three different classifications of courseware, or online material intended to promote students learning, into three categories: Primary courseware is used to support, for example, online lecture notes, reading lists etc, which are a good way of giving students
information. Secondary courseware supports students in performing a task. For example, computer assisted assessments in which the student is asked to answer questions. Examples of this include computer-aided assessments or online tests. It is only at the level of Tertiary Courseware where there is two-way dialogue that learning can occur. Examples include online discussions, videoconferencing and shared workspaces where feedback is extrinsic and online simulations. It is useful to begin developing online materials at the primary level. However, Mayes stresses that focusing too much on primary courseware will not provide sufficient support for learning. In order to ensure that learners are supported at all three levels of the conceptualisation cycle, a variety of teaching methods need to be within the course design. High level learning will not take place until there is two-way dialogue (either tutor to students, peer student dialogue, or the sort of internal dialogue which may go on within a student's head). This can only take place at the tertiary level - either using courseware or face-to-face methods of learning which are integrated with technology enhanced teaching. Although it is useful to begin by developing primary courseware, it is important for tutors not to stop at this stage but to continue development to the level at which student learning can occur.

Laurillard, D., (2002). Rethinking university teaching, a conversational framework for the effective use of learning technologies. - Laurillard's Conversational Model.

Professor Diana Laurillard, Chair of Learning with Digital Technologies at The Institute of Education, University of London, and formally of the Open University in the UK, is one of the leading researchers in the application of technology to learning and teaching. Laurillard developed a conversational model, based on earlier theories of Vygotsky, in which dialogue between tutor and student is seen as central to learning. Laurillard stresses that, for higher level learning, dialogue must take place at both a theoretical and practical level. This not only enables students to link theory with practice (which is sometimes difficult to achieve in many subjects), but also allows the tutor to evaluate whether or not he or she has set appropriate tasks for the student.
One of the major characteristics of this model is the way in which the student and tutor interacts. In face-to-face teaching, many of these interactions are so spontaneous and intuitive that they can be overlooked in the design of technology supported teaching. Therefore Laurillard made these interactions explicit. Technology can support these interactions in the following ways. It can be:

- narrative - this involves the telling or imparting of knowledge to the learner;
- interactive - this is based on the outcome of the learning. The tutor provides feedback to students based on the outcomes of tasks students undertake in order to help consolidate learning and improve performance;
- In addition, the tutor uses this information to revise what learning has occurred and, if necessary, change the focus of dialogue (adaptive);
- Communicative/discursive - the tutor supports processes where students discuss and reflect upon their learning.
- The tutor and student agree learning goals and task goals, which can be achieved using 'productive' media, such as online presentations.


For computer-mediated communication (CMC), Salmon has proposed a highly practical five-stage model based on her own research. The first two stages of Salmon's model focus on acclimatising the learner to the online environment and developing a supportive social environment. The third stage 'information exchange' is characterised by learners interacting with course materials and activities online and providing each other with further resources. In the fourth stage, 'knowledge construction', we see learners working collaboratively sharing ideas, posing problems and challenging each other in a spirit of enquiry. The final stage leads participants to take responsibility for and reflect on their own learning. The role of the tutor - the moderator - is essential to the design and implementation - supporting, encouraging, focusing to ensure all learners meet the intended outcomes.

Faced with the need to teach English to a large number of students, the Universidad de Concepcion, Chile, has created an innovative Communicative English Program using ICT, which is made up of four modules covered in four academic terms. The English program aims to develop integrated linguistic skills with a focus on learning for authentic communication. The program has been implemented in a blended-learning (b-learning) pedagogical model that includes: (a) learners work with UdeC English Online, software conceived as the backbone of the entire Communicative English Program, (b) online monitoring, (c) face-to-face EFL teacher-led classes, and (d) conversation classes with native speakers of English. The online software is an interactive multimedia environment which houses all the materials and ICT tools that learners need in one central web platform. Some of the core concepts underlying its design are multimodal L2 input exposure, enhanced input, learner-fit content delivery, interaction (human-computer, human-human, and intrapersonal) through computer supported collaborative and individual learning tasks, as well as a more human-like dimension for positive and corrective feedback. The results obtained with the pilot group in module 1 show a substantial improvement in the students' language skills, as well as high satisfaction levels with the entire Communicative English Program. The results support the success of the b-learning model implemented and are commensurate with the efforts of the team over 4 years to create an online interactive multimedia language learning environment.


This article introduces a model that addresses how an effective combination of online and traditional classroom teaching can be obtained. The article shows how learning outcomes and preferences as well as the awareness of student characteristics and student feedback such as the perception of classroom environment can be used to enhance the quality of a combined learning environment.
Step 1: Examine Your Teaching Style - Understanding one’s personal teaching style can help to determine which traditional course components can be best enhanced with online teaching and learning technology and which tools will most comfortably match the teacher’s personal teaching style. Preferred teaching style may be identified through careful personal reflection or through use of any of a number of available instruction/teaching styles inventories.

Step 2: Assess Your Students’ Preferred Learning Styles - Understanding how students learn is imperative. Information about students’ preferred learning styles may be collected informally through discussions with students or observations of students in the classroom. Once a teacher has identified his or her teaching style and is able to identify students’ learning styles, an appropriate mix of online and traditional teaching and learning tools may be identified.

Step 3: Study Online and Traditional Teaching and Learning Tools - A good command of both online and traditional teaching and learning tools is important for the development of a successful combination of those tools. A broad array of online teaching and learning tools are available. Appropriate selection of online tools will depend not only on the instructional content but also on the quality of the available tools and the level of technical ability of teacher and students.

Once the first three steps are completed, the challenge is to balance the identified preferred learning and teaching styles against the advantages and disadvantages of available online instructional technology. This should be viewed as a problem-solving challenge with many potentially correct solutions.

Step 4: Select Online Teaching and Learning Tools - Considering the adoption of online instructional delivery methods may present opportunities to achieve learning objectives beyond the basic acquisition of content knowledge and/or skills such as enhancing students’ levels of computer literacy. The two primary indicators of the quality of instructional tools implemented into the classroom are students’ perception of the learning environment and students’ learning outcomes. Using student feedback and the results from analyses of the learning outcomes enables a teacher to make decisions on
what online learning activities best contribute to student learning and what framework best addresses pedagogical and technological issues.

**Step 5: Reflect, Implement, Reflect, and Revise** - Because this model suggests an iterative and continuous process, it will be imperative to continuously reflect, implement, further reflect on the outcomes of the implementation, and revise again the mix of online and traditional teaching and learning tools. Due to the changing nature of the online environment, only a dynamic approach to teaching and learning will maximize success.

**Conclusions** - As mentioned previously, the model suggested in this article is iterative in nature. This model is rather intended to encourage continuous experimentation with both new and traditional instructional tools and methods to achieve ongoing improvement based on trial assessment and reflection of outcomes. The goal here is to attempt to improve student learning while also promoting enhanced student satisfaction levels with the learning experiences and environment.


This article presents elements of a future vision of learning in the knowledge-based society which is enabled by ICT. It is not only based on extrapolations from trends and drivers that are shaping learning in Europe but also consists of a holistic attempt to envisage and anticipate future learning needs and requirements in the KBS. The "learning spaces" vision puts learners at the centre of learning, but, at the same time, conceives learning as a social process. The potential of ICT-enabled learning spaces can only be realised, however, if it is embedded in a social and institutional context that is open to innovation and supported by a favourable policy environment.

**Contribution to the present research**

The review of various models of ICT based curriculum transaction has given the researcher a direction and the necessary guidelines for developing an ICT based model which will result in effective curriculum transaction. It helped in providing the required insight and understanding for finalizing the principles of the model and also the stages and sequence of stages of the model.
2.7 Instructional system design

There are well over 100 different instructional systems (ISD) models and instructional design models. However, most are based on the generic ADDIE model which has the sequential steps - Analysis, Design, Development, Implementation, and Evaluation. Hence, each step produces an outcome which then feed the next step in the process.

ADDIE Instructional Design Model, (2007).

What is the ADDIE instructional design model? To begin, instructional design refers to the process of instructional program development from start to finish. Many models exist for use by different levels of instructional designers and for different instructional purposes; however, the process can be summarized into five general phases, commonly known as ADDIE (Analysis, Design, Develop, Implementation, Evaluation). These phases sometimes overlap and can be interrelated; however, they provide a dynamic, flexible guideline for developing effective instruction. These steps in ADDIE can provide an organized design approach for developing and delivering face-to-face and online instructional and training resources.

1. The Analyze phase is the foundation for all other phases of instructional design. You define the problem, identify the source of the problem and determine possible solutions. May include specific research techniques such as needs analysis, job analysis and task analysis. The outputs of this phase often include the instructional goals, and a list of tasks to be instructed. These outputs will be the inputs for the Design phase.

2. The Design phase involves using the outputs from the Analyze phase to plan a strategy for developing the instruction. You outline how to reach the instructional goals determined during the Analyze phase and expand the instructional foundation. Elements of the ADDIE instructional design model include writing a target population description, conducting a learning analysis, writing objectives and test items, selecting a delivery system, and sequencing the instruction. The outputs of the Design phase are the inputs for the Develop phase.
3. The **Develop** phase builds on both the Analyze and Design phases. The purpose of this phase of the ADDIE instructional design model is to generate the lesson plans and lesson materials. You develop the instruction, all media that will be used in the instruction, and any supporting documentation.

4. The **Implementation** phase refers to the actual delivery of the instruction, whether it's classroom-based, lab-based, or computer-based. The purpose of this phase is the effective and efficient delivery of instruction. This phase must promote the students' understanding of material, support the students' mastery of objectives, and ensure the students' transfer of knowledge from the instructional setting to the job.

5. The **Evaluate** phase measures the effectiveness and efficiency of the instruction. Should actually occur throughout the entire instructional design process - within phases, between phases, and after implementation. **Formative Evaluation** is ongoing during and between phases. The purpose is to improve the instruction before the final version is implemented. **Summative Evaluation** occurs after the final version of instruction is implemented. This type of evaluation assesses the overall effectiveness of the instruction. Data from the Summative Evaluation is often used to make a decision about the instruction (such as whether to purchase an instructional package or continue/discontinue instruction).

![Figure 3. ADDIE Instructional System Design Model](Image)
Contribution to the present research

A survey of the different instructional design models has led to the realisation that there are mainly five steps in designing known as ADDIE (Analysis, Design, Develop, Implementation, Evaluation). The review has helped the researcher in understanding how to use the ADDIE steps to develop an effective model of curriculum transaction using ICT and constructivism.

2.8 Evaluation methods for testing effectiveness of sessions


Twelve potential sources of evidence to measure teaching effectiveness are critically reviewed: (a) student ratings, (b) peer ratings, (c) self-evaluation, (d) videos, (e) student interviews, (f) alumni ratings, (g) employer ratings, (h) administrator ratings, (i) teaching scholarship, (j) teaching awards, (k) learning outcome measures, and (l) teaching portfolios. National standards are presented to guide the definition and measurement of effective teaching. A unified conceptualization of teaching effectiveness is proposed to use multiple sources of evidence, such as student ratings, peer ratings, and self-evaluation, to provide an accurate and reliable base for formative and summative decisions. Multiple sources build on the strengths of all sources, while compensating for the weaknesses in any single source. This triangulation of sources is recommended in view of the complexity of measuring the act of teaching and the variety of direct and indirect sources and tools used to produce the evidence.


Peer observation can be a very important and useful part of the data gathering process within a research cycle. Trying to evaluate your own teaching practice is useful, but can be difficult whilst you are in the process of teaching the class. Getting feedback from your students is also very useful, but your students aren’t trained as teachers and their feedback can be very difficult to interpret. Peer observation offers you the opportunity to get objective feedback from a trained professional who will be able to focus only on what’s happening within your lesson. Peer review of teaching can be viewed as the assessment of all aspects of teaching – course design, classroom practice and student...
learning. Summative peer evaluations of teaching or papers are often used to supplement student evaluations. The information collected for the evaluation by the University of Adelaide, for example, includes effectiveness, scholarship in teaching, organisational quality, assessment of student learning, contribution to departmental planning, and so on.

**Felder, and Brent, (2004). How to Evaluate Teaching effectiveness.**

Student ratings of teaching get a bad rap in some academic circles. Faculty members are repeatedly and authoritatively assured that “They’re just popularity contests,” “High ratings go to the easy graders,” and “If I get low ratings it’s only because I set high standards and students don’t like demanding teachers.” In fact, student ratings have been repeatedly shown to have a high level of validity, and those complaints about them have been debunked by research. Students are in a better position than anyone else to judge certain aspects of teaching, such as how clear, interesting, respectful, and fair a course instructor is, and they’re the only ones who can say how an instructor has influenced their attitude toward the course subject, their motivation to learn it, and their self-confidence.

For these and other reasons, student ratings should be considered an essential component of faculty teaching performance evaluation. But it makes little sense to use *only* student ratings. Few students are equipped to judge whether a course is accurate and up-to-date, the assignments and tests are appropriately challenging, and the content and learning objectives are consistent with the course’s intended role in the department. Only faculty colleagues are in a position to make such judgments. In short, a key to effective teaching evaluation is to collect data from multiple sources (*triangulation*), making sure that all education-related activities are rated by the people best qualified to rate them.

**Contribution to the present research**

An understanding of evaluation methods for testing effectiveness of sessions was gained from the review. To evaluate teaching effectiveness it was proposed to use multiple sources of evidence, such as student ratings, peer ratings, and self-evaluation. Triangulation of sources is recommended in all researches in view of the complexity of measuring the act of teaching and the variety of direct and indirect sources and tools used to produce the evidence. It helped the researcher in finalizing the methods to be used for evaluating the effectiveness of the ICT based model of curriculum transaction.
2.9 Usability testing

Usability is defined differently by different people. Most of the attributes of usability are very similar. This section reviews three major works on usability and usability testing and provides synthesized viewpoints about usability and usability testing.


Usability is “the quality of a system with respect to ease of learning, ease of use, and user satisfaction” the goal of usability testing is “to provide feedback in software development, supporting an iterative development process”. Usability testing helps designers recognize problems, understand the problems and the underlying causes of the problems in the product, and then plan changes to correct or improve the problems. They list three usability testing methods: analytic evaluation, empirical evaluation, and mediated evaluation (a mixed approach of analytic evaluation and empirical evaluation).

- Rosson and Carroll (2002) describe analytic evaluation as “investigations that involve modeling and analysis of a system’s features and their implications for use”
- Rosson and Carroll (2002) delineate empirical evaluation as “investigations that involve observation or other data collection from system users”
- The third usability testing method, mediated evaluation, is a mixed approach. Rosson and Carroll (2002) explain that analytic evaluation occurs early and is used to motivate and develop materials for empirical evaluation. Analytic evaluation discovers potential problems before empirical evaluation studies the actual use of the product.

Among example usability testing methods, Rosson and Carroll (2002) state usability specifications are “precise and testable statements of the usability characteristics required of a system” Rosson and Carroll (2002) stress that test materials should be developed prior to beginning a usability test, such as instructions, surveys, and data collection forms to be used to coordinate test sessions. Rosson and Carroll do not specify how many participants are enough to carry out useful usability testing results.

“Usability is an important goal for good system design, depending upon the dynamic interplay of the four principal components of any user-system situation: user, task, tool and environment” (p. 22-23). He further explains that “usability depends upon the design of the tool in relation to the users, the tasks and the environments, and upon the success of the user support provided” (p. 24). He proposes that usability for individual users should be judged by both the subjective assessment of the ease of the design and by the objective performance measures of effectiveness in using the product. Shackel (1991) explains that usability is not only concerned with ease of use but also involves efficacy: effectiveness in terms of measures of performance. Shackel (1991) stresses that for a system to be usable, the criteria in terms of effectiveness, learnability, flexibility, and attitude must be achieved. Shackel (1991) does not specify the number of participants needed for usability testing; however, he does mention that for simulation trials – experiments with prototypes – a limited number of subjects, but who are essentially equivalent to ultimate users, are needed for measurements of performance and attitude.


Usability is an attribute of every product, in terms of how people work with the product. The purpose of usability testing is to make sure that people can work with the product to meet their needs. They further specify that “usability means that people who use the product can do so quickly and easily to accomplish their own tasks”. Dumas and Redish (1999) articulate that usability testing is a systematic way of observing and collecting information about the actual users or potential users’ trials of the product. They state, “Usability testing is best used to diagnose problems” The participants of usability testing should be members of the group who now use or will use the product. The tasks that the participants will work on must be what they will do with the product in the future. Dumas and Redish suggest having at least “two or three people representing a subgroup of users

Virzi (1992) investigates sample size requirements for usability evaluations using three experiments to measure the rate of the number of expert-identified problems that naive participants are able to find. Virzi concludes, “(1) with between 4 and 5 subjects, 80 percent of the usability problems are detected, (2) additional subjects are less and less likely to reveal new information, and (3) more severe usability problems are easier to detect with the first few participants”.


Usability is not a single, one-dimensional property of a user interface. Usability has multiple components and is traditionally associated with these five usability attributes:

- **Learnability.** The system should be easy to learn so that the user can rapidly start getting some work done with the system.
- **Efficiency.** The system should be efficient to use, so that once the user has learned the system, a high level productivity is possible.
- **Memorability.** The system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.
- **Errors.** The system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them.
- **Satisfaction.** The system should be pleasant to use, so that users are subjectively satisfied when using it; they like it.

Nielsen and Landauer (1993) provide further support for Virzi’s (1992) finding. They find that the first five users will uncover about 70 percent of the major usability problems and that the next few users will find nearly all the remaining problems up to 85 percent.
Web Tool For Constructivist Learning – A Qualitative Perspective.

Mindtools, as critical thinking devices, are able to amplify cognitive functioning and
reorganize how learners think. Their use requires learners to make a substantial
intellectual effort in order to build knowledge. When using a Mindtool, the learner
actively engages her/his own mind and generates her/his own knowledge. Knowledge is
not passively forced upon the learner. Meaning is constructed by the mind of the learner
on the basis of experience. This study tested the usability of this web selection tool. The
first implication is that this web tool is very easy, user-friendly, and convenient, and that
it saves time. The web tool was designed without focusing on the transmission attributes
of media, rather it interacts with users and asks them to specify the critical, creative, or
complex thinking skills they want students to develop within a given content domain. The
participants revealed that this was a favorable attribute of the web tool. This web tool site
provided useful and practical lesson activities using Mindtools for constructivist teaching,
not just a constructivist learning theory or some ideas about how to use Mindtools. This
site offers lessons and guidelines to follow, which can be easily put into practice. It is
believed that practicing with the web tool first will allow for better integration into the
classroom. Thus, the integration of Mindtools can be implemented practically and easily.

Development And Its Usability Test.

Effectiveness and usefulness among the important factors that affect success of online
learning environments. During this study, a course-content management system
developed regarding effectivity and usability related concerns. One major aim of this
study is to develop effective and usable system. In this study, a course-content
management system designed and developed under the light of previous researches. In
the design phase, effective design strategies and characteristics of effective and usable
learning systems were explored, and system was designed considering these strategies.
Then, development phase applied. After system developed, usability techniques was
explored, and heuristic evaluation method was choosed as a usability method to measure
usability of the system. During the study, modified version of a checklist that was prepared considering usability heuristics. Applied checklist contains total 108 questions under 13 heuristics (major usability problem). Heuristic evaluation is an expert review method. Therefore, this study should have been evaluated by experts. 8 experts enrolled in this study. All experts are either Ph.D. or graduate students at instructional technology departments and they have enrolled in web-based studies. They investigated the usability of the course-content management system according to the usability related criteria on the checklist. When test results were considered, a course-content management system developed during this study was found usable. Results of this study may enlighten the way of future studies.

**Contributions to the present research**

The review helped in clarifying the following points regarding usability. Usability testing is used to measure users’ preference (satisfactions or attitudes) and performance (ease of learning, ease of use, or ease to accomplish the required tasks) of the product. The testing results are used to improve or fix the problems found in the product. Applying different usability testing techniques to fit testing needs will result in better data collection processes. These reviews favor setting up usability goals and concerns, including the actual or potential users as participants, using scenario tasks, observing and recording the participants’ actions, avoiding unnecessary intervention, quantifying the performance measurements, and preparing survey questionnaires. The proper number of participants to be included in the testing is still questionable. However, it is suggested that four to five participants, or two to three participants in each subgroup, be used to discover the majority of the usability problems.

**2.10 Conclusion**

The review of related literature helped the researcher to avoid repeating previous works. It offered the researcher the conceptual frameworks, debates and issues about the topic - ICT based curriculum transaction, to foresee significant directives and issues (how to treat variables), to see how the intended/planned research can contribute to existing body of knowledge or research agenda. But, for any specific research to occupy the place in the development of a discipline, the researcher must be thoroughly familiar with both
previous theory and research. To assure this familiarity a thorough review of the research literature was done. It allowed the researcher to know the amount of work done in the concerned area. The clarity of the problem was possible with thorough understanding of the knowledge generation in the area of research. It provided the source for hypothesis. It suggested the method, procedure, sources of data and statistical technique appropriate to the solution of the problem. The review of the related literature provided some insight regarding strong points and limitation of the previous studies. It enabled the researcher to improve investigation and to arrive at the proper perspective of the study. The studies have been analyzed by keeping objectives, methodology and findings of the present study in mind and to draw the conclusion and to strengthen the rationale of the present research.