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Instructional Design for the New Age: A Review of ID Principles and Models for Teaching the 21st Century Skills through ICT

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Abstract

Instructional design, as a science, is relatively young with its roots being traced to military training during World War II. Instructional design saw a vibrant phase of development between the 1950's and 70's with a lot of brilliant fundamental research in the field, happening during the period. Starting with Programmed Instruction (Skinner, 1954), the most important theories and models that established ID as an applied science like Bloom's Taxonomy (1956), Gagne's Events of Instruction (1965) and ADDIE (1974) were founded during this period. With many new ID models being developed in the 1970s, the instructional design process grew very influential in military and industrial training. However, its application in the field of education gained significance only with the advent of computers in the 1980s.

Theories of Cognitive Psychology and Constructivism were applied to ID in 1980s and 1990s. However, it was the integration of Information and Communications Technology (ICT) that gave ID, a firm foothold in the sphere of education. The internet in 2000 laid the foundation for the digital revolution in teaching and learning that we see today.

The need for integration of ICT in Instructional Design saw development of various new ID models, modification of and alternative approaches to existing models. Besides content and pedagogy, technology became an important conduit of delivery in the new models like TPACK and its spinoffs. However, the research shows that the established models like ADDIE still enjoy the widest application with suitable integration of ICT. The need to customize training and education for the 21st century skills, a collective vision of the global business, educational and governing communities, is likely to see radical changes in the way instruction is designed and delivered in the days to come.

Keywords: Instructional Design, ID Principles, Skills through ICT, TPACK, ADDIE

Introduction

Instructional design originated during World War II, where training had to be standardized and materials needed to be created in large scale along with tests for assessment of abilities. Hundreds of training films and film strips were produced by the United States Army between 1943 and 1945 to train the United States personnel for the war, with more than four million showings during the period.

B. F. Skinner developed Programmed Instructional material based on Operant Conditioning theory (1954). Programmed Instruction (PI) model relied on individualized instruction and self-pacing. Instruction material consisted of frames, small steps sequenced carefully, seeking response, and providing immediate feedback or results. (A handbook of programmed learning, G O M Leith, 1966**)**.

Keller Plan, 1960, advocated a Personal System Of Instruction (PSI) which was grounded on Skinner's theory where self-pacing but with only written material, was used. Written material broken into small units with respective specific learning objectives was used with flexible sequencing. It was also called Individualized Instruction Model (Callahan, C., & Smith, R. M.,1990).

Benjamin Bloom in 1956, classified learning based on learning objectives and proposed Knowledge as precursor, and Comprehension, Application, Analysis, Synthesis, and Evaluation as skills for learning. While Bloom's Taxonomy is still considered to be one of the most widely used lesson planning tool at primary level, it was found wanting as a design model for higher levels because of its highly structured and mechanized design which did not allow teachers to be creative. Revised Bloom's taxonomy **(**2001, Lorin Anderson and David Krathwohl) minimally modified the elements except for replacing synthesis with creation and placing it at the highest level of the taxonomy.

Robert M. Gagne (1965) identified nine events as part of instructional development of a course. It has been highly influential and still finds usage in Instructional design as well as ID research.

ADDIE (1975) is basically a generic approach to designing instruction consisting of five phases of Analysis, Design, Development, Implementation and Evaluation. Over time, different learning situations led to development of different models by adapting ADDIE and spinning it off to different learning settings.

Even though these five phases illustrate the core components of ID, instructional design models are required to describe how to conduct and practice the process of ID. (Gustafson & Branch, 2002).

ADDIE, over time, evolved as the common underlying structure, around which various models were developed so much so that it was called just an "umbrella term" referring to these models. (Molenda 2003). ADDIE retains its place as the most widely used one (Goksu, et al. 2017).

The Dick and Carey Model (1978) has 10 components that are connected with context, content, learning and instruction. In an interesting comparison, Purnima valiathan, 2022, mapped the 10 components of Dick and Carey with 5 phases of ADDIE stating that all tasks performed under Dick and Carey are performed under ADDIE also. (*Introduction to Instructional design*, Purnima Valiathan, 2022). There has been numerous such comparisons and the critical difference between the two models is possibly found to be the separation of assessment into one formative assessment included as part of implementation, and summative assessment for the final Evaluation. (Rupa Basu, 2018). The Formative assessment also makes the model flexible and iterative, a big advantage over ADDIE.

Numerous other models were developed in 1970s, as many as 40 up to this period (Andrews and Goodson, 1980). Even though the influence of ID in industrial and military training was significant, its impact on public education was almost negligible with limited usage in curriculum development and some textbook references (Shakuntla Nagpal, Dinesh Kumar, 2020).

The application of constructivist theory and processes in 1990s brought in the much-needed impetus to ID process and had greater impact than the cognitive practices prevalent then. The constructivist approach presented instructional principles as a solution to complex and realistic problems. (Driscoll, 2000).

While one view was that the Instructional design grew out of behaviourist psychology (Strain, 1994; Kember, 1991), another insisted that it was a product of cognitive learning theories (Hannafin and Reiber, 1989) crediting Gagne, Merrill, Reigeluth and Scandura for developing ID. Even though Constructivist theories have largely influenced recent developments, modern instructional design borrows from scientific principles from various learning theories.

Computer Based Teaching and ICT

Technology, in the form of various video and audio resources, have been around since the early days of Instructional design, and so has computer science with the first-generation computers being invented around 1945. But it was not until the invention of microprocessors and its resultant development of personal computers in 1980's, that the computers or digital technology had much to do with education or Instructional design.

Computers became commercial and more popular in the 1980s, but they were not yet adapted to the general educational context except for learning to program. (Cennamo et al., 2019). After the portability and affordability of computing power, another significant milestone was High speed Internet, and with the advent of internet, ICT became increasingly influential and finally an integral part of education.

Internet opened up a world of possibilities to access information through Web browsers. (Moreno-guerrero et al., 2022). New telecommunication technologies like fiber optics, 4G and 5G networks enabled portability of web access through smart phones and similar devices. Educational institutions became more interconnected and established platforms for collaborative work and innovative training methods (Alencar & netto, 2020; foster & Shah, 2021).

The emergence of high-speed data enhanced the impact of ICT on education, bringing in revolutionary educational practices like e-learning, mobile learning, Massive Open Online Courses (MOOCs), Open Educational Resources (OERs), etc. Today, smart phones and other hand-held devices have become preferred tools of instructional delivery (Shakuntla Nagpal, Dinesh Kumar, 2020).

On the other hand, for the traditional teaching and learning environment to keep pace with the transformation was a significant challenge, particularly in the early days of Computer Based Teaching (CBT). But today governments are investing big time in ICT integrated educational systems making ICT an integral part of teaching instead of a mere supplement. However, successful ICT integration is a highly challenging task.

In simple terms, ICT Integration in education refers to use of technology resources in daily classroom and as well as in the management of educational institutions. These resources can vary from Computers, Internet, e-mail, Software Applications, Electronic Publications etc. (Anupama Singh, 2012).

Instructional Design in the Digital Era

In spite of the speed with which technology transformed the learning sphere in the last two decades, instructional design has not only kept pace but has thrived, indeed. One of the reasons could be the fact that ID itself is too young a science. While some new ID models emerged, a few other early models reinvented themselves.

Bloom's taxonomy (1956) already revised once (2001) got another digital facelift in the form of Bloom's digital Taxonomy (Andrew Churches, 2008).

Cognitive Approximation Model (CAM) (1989) which enjoys wide application in the e-learning atmosphere has its roots in the Zone of proximal development (Vygotski, 1934) and Brunner's concept of scaffolding (1976).

Successive Approximation Model (SAM, 2012) was developed by Allen as an alternative to ADDIE which he believed was obsolete even though it is used in e-learning designs**.** Savvy start, an aspect of SAM, encourages collaboration of all the stakeholders and hence is very useful in technology enhanced designs.

The non-iterative and linear design is a huge limitation of ADDIE, but it was still the most widely used ID model between 1999-2014 **(**Idris Göksu, et al.). Modern ADDIE is more iterative than its original version.

New models developed in and after 80's had technology at its heart or at least had adequate scope for accommodating it. ASSURE is one such model where the U stands for **"**Utilize technology, media & materials". Future U ID is another popular model used in online learning. Developed by Whitmyer (1999), the model consists of 4 phases namely Discovery, Design, Development and Delivery.

Hybrid models like ADAPT (Tuckman, 2002), an acronym for Active Discovery And Participation through Technology, blended computer mediated instructional activities with traditional class room features of constructivist theory like scaffolding, self-pacing and written material.

Marques and Woodbury et.al used internet-based tools for assignments, communications, and information search in their Hybrid Instructional Model (1998). For generating spontaneous and immediate feedback, the model used traditional classroom methods and tools like textbooks, live lectures, and offline assignments. Another hybrid model that used blended approach was Situational Instructional Design Model **(**Zemke 2002) where theories and models of Bloom, Gagne and others were used depending on the situation.

TPACK - A New Age Model For 21st Century

Content vs Pedagogy conundrum in Education is age old and it is widely acknowledged truth that both are equally crucial for effective teaching. In recognition of the relationship between content and curricular knowledge, Shulman initially developed Pedagogical Content Knowledge (PCK) (1986).

Adding Technology to the mix, Shulman, Mishra and Koehler developed TPACK (2006) with 7 components in all possible combinations of the three elements of technology, pedagogy and content knowledge.

ICT-TPACK is a variant developed by Angelie and Valanides where technology refers to ICT. Developed using a methodology called Technology Mapping (TM), ICT-TPCK applies ICT to make the process of teaching-learning more effective. Various other offshoots like TPACK-COPR (2010), TPACK-IDDIR (2014), Synthesis of Qualitative Evidence (SQD, 2019) are a few offshoots of TPACK, which endorsed not only its wide usage but also its tendency to attract research.

21st century skills is an identified list of skills and abilities believed to be vital to succeed in 21st century society. Originating in USA in 1980's, it has developed into a global movement by a variety of governmental, academic, non-profit, and corporate entities.

Using TPACK for teaching 21st Century Skills is a subject attracting contemporary research (Hidayu Shafie, et al.).

Conclusion

Instructional design, a science less than 100 years old, has gone through a lot of transformation after the advent of computer-based teaching in 1980's, and Information and Communications Technology Integration in last two decades. Many fundamental theories have reinvented themselves or lent to development of new models which have ICT integrated into them. ADDIE, despite its limitations, continues to be popular. TPACK is an important conceptual framework for a new era of education including ICT integrated education as well as 21st century Skills.

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