Transforming Engineering Learning via Technogogy

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Abstract: - Technogogy is defined as the convergence of technology, pedagogy and content in the transformative use of technology to foster learning. The power of multimedia computing makes it possible for technology to cater for the needs of pedagogical elements that can be viewed from the standpoint of technology. The application of technogogy will now witness the presentation of content in a continuum rather than a segmented approach for a specific cohort, each level taking into account the learner characteristics, learning styles and preferences and the production of a variety of appropriate media components to support, complement or for the purpose of teaching and knowledge retention in engineering education.

Key-Words: - Technogogy, Technology, Pedagogy, Content, Learner characteristics, Learning styles

1 Introduction
Thus far, the power of multimedia computing has not been exploited to its fullest potential, with usage that merely skimmed the mundane issues such as patterns of interaction in videoconferencing [1] and multimedia design for learning [2] and repeated works such as in problem-based learning [3, 4], constructivism principles into online classes [5], why students are not learning in online courses [6] and reflective learning practices [7].

Then on, many aspects of the computer mediated environment were ventured, whether in a stand alone fashion, online, offline, synchronous, asynchronous, virtual reality or any blended model. Educational technology has overtaken us in terms of the provision of a transformative learning environment. Learning management systems (LMS) as well as learning activity management systems are now made available to us for immediate use, leaving us to further interject with more transformation in the educational environment to foster learning. It is time that we apply fully the immense versatility, diversity and depth that technology can muster and honour the very rich interplay from, and intersection of technology, content (the subject-matter) and the pedagogy (the means of teaching it). Too, e-learning which is a vehicle that covers a wide range of technology-delivered instruction to enhance traditional approaches to learning can be elevated to a new level of excellence in the learning environment.

2 A Matter of Learning Styles
“Instruction begins when you, the teacher, learn from the learner. Put yourself in his place so that you may understand what he learns and the way he understands it” (Kierkegaard)

This bring us to the ever crucial area of how do we educate on students. Put succinctly, teaching and learning do not improve because of improved technology [8]. Specifically, content is meaningless without context. And context is not created by sitting in front of a computer reading content [9]. Learning is improved when it is grounded in practical learning theory. By itself, more technology will not make education more efficient. For these reasons, it is imperative that the learning environment of the digital era is developed or the present environment be redesigned so that it is relevant to the power, potential and versatility of the gamut of educational technology available today.

Different students have different learning styles and this occur in a wide variety of ways, including the types of instruction to which they respond best, the ways they approach their individual studies (strategies to studying and learning approaches), and their perception and attitudes about the nature of knowledge and their role in constructing it (cognitive levels). For example, Broberg et al. [10] found that the learning styles of electrical and engineering technology students are as active, highly visual, sequential learners.
An objective of education should thus be to help students build their skills in both their preferred and less preferred modes of learning. The learning theories provide good frameworks for designing instruction with the desired breadth. The goal is to make sure that the learning needs of students in each model category are met at least part of the time. When mismatches exist between learning styles of most students in a class and the teaching style of the teacher, the students will ‘disengage’ from the educational environment.

Until today, we are still trying to determine the exact nature of the learning styles of the learners when their style can change and Felder and Soloman [11] even identified that “everybody is active sometimes and reflective sometimes.” Despite the lip service paid to individual differences different learning styles of the learners, the instructors are still ignoring this fact [12].

Perhaps we should cease to endure these matching processes as one could never know the learning modalities, preferences and styles of a student, as much as one could never know the preferences, inclination and approaches of the teacher. Any one research on the learning characteristics of one particular cohort would be rendered useless against the next cohort. We need a different approach where the direction, preferences and development evolves through the facilitation of educational transaction, with technology playing a pivotal function in the integration of the pedagogy, content, teacher and the learner. We need to work on the preferences and strength of the students through a variety of learning models. In this way, the students have the choice to pursue a learning preference while subtly being redirected to a higher level on a natural progression; a maneuver that require an astute pedagogical approach by the teacher and utilising many forms of information and communication technologies and learning strategies.

2.1 Transforming Learning
The transformation of the learning environment is a crucial element in the definition of technogogy as it signifies the power and function of information and communication technologies and its use in the teaching and learning process. Coming back to the use of educational technology, we always view the functionality of technology from the standpoint of the student on the pretext of it being learner centred. Together with this notion, we adopt the concept of facilitation and transmission of learning that we contend are not an effective approach as we subsume a lot of the initiative and creative use of technology on the student’s characteristics (supposedly). There is no concrete direction of encouraging an individual to engage in practices that will result in meaningful learning, due to the incapability of the students to venture beyond what is presented by faculty.

The primary benefit of educational technologies is not the focus on the content but the focus on the learning practices and engagement that technology enables. In spite of the blended approaches that are integrating technology in the teaching and learning processes, it could be an ignorant way of viewing the possibilities and potentialities of technology. In truth, we should not be using technology to duplicate what we can already do (such as lectures, textbooks and courseware’s), but we should design uses of technology that enables us to participate and engage in teaching and learning practices that we cannot do given our current constraints. For example, we can create virtual case studies, support communication and collaborations among geographically distanced individuals and groups and create texts or artifacts from the interaction that take place thus fostering more learning. In essence, we are moving from mere infusion or integration (as a natural buy-in) but are approaching the transformation of the learning environment in its entirety. The students (from childhood to adolescence and into adulthood) should benefit from all known learning theories and models as well as learning styles and strategies. We should not be the determinant in fixing the recipe for the students as we do not absolutely know how, when and where students learn.

3 Technogogy
The power of technology, as portrayed in a convergent mechanism via multimedia computing and the Internet must go beyond presenting facts with more razzmatazz, colour, audio, visual, simulation and animation, but must have the capability to converge in the educational environment transaction, the function of the teacher, the needs of the students, the learning styles, the learning theories and the various pedagogies and the different functioning technologies.

Idrus [13] initially presented technogogy as the transformative use of technology to foster learning to describe the focus on technology-driven pedagogy in the learning environment. Nonetheless, it seeks to address the pivotal role of technology in presenting a learning object that has taken into account the relevant pedagogies and learning modalities.
Shulman [14] and Koehler and Mishra [15] presented the pedagogical content knowledge (PCK) and the technological pedagogical content knowledge (TPCK), respectively in a Venn Diagram, as in Fig. 1, that showed the logical relationships between the three components of technology, pedagogy and content. Koehler and Mishra [16] went on to argue that true technology integration, is understanding and negotiating the relationships between these three components of knowledge.

![Venn Diagram](image)

**Fig.1** The components of technological pedagogical content knowledge by M.J. Koehler & P. Mishra [16]

Technogogy is the three-dimensional intersection of pedagogy, technology and content (learner focused), the meeting point would result in a technogogically articulated learning object or a technology pivoted learning object. This learning object is in fact akin to the pedagogical content knowledge, where Shulman [14] proposed that a conceptual analysis of teacher knowledge would incorporate both the categories of teacher knowledge, and the forms for representing that knowledge. Further, Mishra and Koehler [17] incorporated technology into the pedagogical content knowledge, calling it the technological pedagogical content knowledge (TPCK), proposing the interplay of the three main components of learning environments: content, pedagogy, and technology.

Since we are pivoting from the viewpoint of technology, we are able to peruse the learners in a continuum, from childhood to adolescence and into adulthood. Appropriate technologies can be empowered to facilitate for the design of a learning object based on learner characteristics. Then, technogogy as the convergence of technology, pedagogy and content [18] will give rise to a technocentric learner continuum environment. The relationship between technology, pedagogy and content in a converging role must be deliberated from a three-dimensional perspective to give rise to its depth and volume in the creation of learning objects. Hence, the relationship framework is visualised in the form of a cube known as the technogogy cube as shown in Fig. 2.

![Technogogy Cube](image)

**Fig.2** The technogogy cube

Each dot in the technogogy cube will represent its own triple-point parameter of (x,y,z) of pedagogy, technology and content resulting in the design of a specific learning object taking into account the learner-focused content, relevant pedagogy and appropriate technologies. The y-technology axis is labeled with the very basic technology to the emerging e-learning technologies and learning tools; the x-pedagogy axis is labeled with all known pedagogies, traditional end electronic and the z-content axis is labeled with content focusing on the learner cohort-inherent learning theories and strategies.

### 4 Implications of Technogogy

The application of technogogy will now witness the presentation of content in a continuum rather than a segmented approach for a specific cohort., each level taking into account the learner characteristics, learning styles and preferences and the production of a variety of appropriate media components to support, complement or for the purpose of teaching and knowledge retention. We can now witness the design of content (learning object) for the learning environment that is based on many learning theories such as situated learning, multiple intelligences, experiential learning, constructivist theory, cognitive load theory as well as connectionism, to name a few.

The technogogy cube can also be viewed from many different parameters, by keeping one of the axis as a constant. Let us consider a scenario on the cube with constant content, as shown in Fig. 3. We
can then formulate how this content can be presented in various pedagogies utilizing the appropriate technologies available. This will enrich the learning environment and conform to the needs of the students.

Conversely, we can also keep the technology constant which will give rise to the teaching of a course employing various pedagogies by using the same technology. A constant pedagogy scene is shown in Fig. 4 with positions of points in space as learning objects and the plane of learning environment to describe the relationship at a given pedagogy.

5 Technology Learning Environment

Imagine a scenario where a student logs on to the computer and is assessed for his learning style before being directed to the most appropriate learning environment design based on the learners’ preferences. There the student is served with a buffet of learning that has been laid out to choose or try in his educational transaction; the logistical difficulties in creating learning experiences to suit every situation and learning style, notwithstanding. This will give rise to new paradigm in the design of the learning environment and experiences in technogy that pivots on technology for the presentation of a pedagogy-rich learning environment. Among the paradigms and focus that will be in play are (to name a few):

- The use of intelligent and pedagogical agents
- More robust pre-and post test/assessment softwares
- Preparation of learning objects
- Design of artificial intelligence
- Multiple/cross disciplines
- New learning theories
- Interoperability of systems
-Sharable/Reusable learning objects
- Resource repositories
- Intelligent tutoring system
- Innovative portal development
- Collaboration softwares and webwares
- Data management and data mining

Stephenson [19] pinpointed the technical innovations that are likely to push the next generation of online teaching and learning more towards learner managed learning where technogy fits the bill as the learning support environments will now provide easy access to online support from tutors, mentors or external specialists, open chat facilities, special interest groups, one-to-one exchanges with a personal supervisor, tracking and personal log services and links with other frameworks and activities; altogether a transformation to foster learning. Ally [20] identified among the use of strategies to allow students to process the information at a higher level, include activities for students to transfer the knowledge and skills to new situations, provide opportunities for real life applications and specify activities for constant upgrading.

There are already many endeavours that conform to the concepts of technology; a concept that seek to converge content, pedagogy, learning styles and preferences as well as interactive technologies. This idea has been captured to some extent by Harmelan [21] in his presentation of the personal learning environment. Assis, et al [22] investigated optimising instruction via adaptive hypermedia and Bourguet [23] is testing the prowess of technology with bilingual education in mainstream classroom. However, technogy is not limited to the computer mediated communications; whether synchronous or asynchronous, but seek to redress the application of educational technologies by reinventing, upgrading or blending multiple traditional technologies such as...
audio-graphics, audio books and browser-based stand alone CD content design.

6 Concluding Remarks
Technogogy is defined as the convergence of technology, pedagogy and content in the transformative use of technology to foster learning. The power of multimedia computing makes it possible for technology to cater for the needs of pedagogical elements that can be viewed from the standpoint of technology. Technogogy will allow for a continuum from childhood to adolescence and into adulthood in a way that addresses both learning needs and activities. The concept of technogogy also conforms to the framework of Web 2.0 and e-Learning 2.0 [24] towards a ubiquitous learning environment platform for engineering learning.

References:


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