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Culture – educational paradigm shift learning methodologies derived from axiomatic design principle

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Abstract

Teacher-centered learning pedagogy is a passive approach but most standard practices in many engineering courses than the active approach that is student-centered learning pedagogy. For a country like Papua New Guinea which is rich in culture diversity, the social structure or group identity forms the lines of conflict affecting teacher or student-centered approach. With the advent of technological tools to support teachers in engaging student, the choices are too many to explore. Consequently, the confusion to which learning methods and technical tools are appropriate to the student that have culture affiliation and use such affiliation in engaging them in higher order thinking, knowledge integration and self-efficacy requires support to get the right instructional methodologies based on the Axiomatic design (AD) principle. The results show that the combination of AD law simplifies what learning design for engineers can create a paradigm shift in culture to educational synergy.

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1. Introduction

2. Paradigm shift according to Thomas Kuhn is a change in the underlying assumption of worldview or a profound shift in a fundamental model of events [1]. Centuries ago, the method of teaching had not change a lot. The use of blackboards which later turn into whiteboards and smartboards were the tools used to convey knowledge to the student. However, in this generation, such activity is quite boring to many students.

In most cases, lecturers find student sleeping if not; they do not mind their classes. Incorporating laboratory activities provided a good diversion to classroom boredom and enhancing information delivery as a student are engaged.

In the case of Papua New Guinea University of Technology students, each student represents the diverse cultural groups. About 800 different cultures in the country share the same values, beliefs, attitudes, preferences, customs, learning styles, communication styles, history; historical interpretations, achievements; accomplishments, technology, the arts, literature, etc. [2]. Most of these students are first from the tribes or of the family, and the government sponsors most of their school fees. Tribal war happens in the university whenever cultural issues occur which affects student learning as shown in Fig. 1. A photo of a first year students who were beaten by other students due to a tribal war in campus and had received black eye and arm cuts.

Nomenclature

AD	axiomatic design
CN	customer needs
DP	design parameter
FR	functional requirement
PV	process variable
PNG	Papua New Guinea



Fig. 1. (a) Result of campus fight (posted with permission); (b) Tribal identity.

According to Schram [3], the Vice Chancellor of Papua New Guinea University of Technology, in 2011 before he arrived there had been a huge fight between two groups of students along tribal lines, which one student died. The next year the tension between the rival tribes increased that the campus security officers had to fire their gun into the air to stop an all-out battle that ended with a traditional reconciliation dance resolved thru dialogue. The Papua New Guinea (PNG) culture is rich and with high identity in each tribal group because 97 percent of the country's land are customary. Due to this identity, tribal conflict is frequent because of the rationalization that fighting is a morally acceptable norm.

Creative energy and unproductive conflict may result from cultural diversity within small groups [4]. The migration creates diversity as they carry their languages and customs with them and re-create their existing social structures [5, 6]. Their ways of life as played in the villages takes part into the classroom. They also have a strong family tie, wantok system, which a wealthy family member should share their wealth with other family members who are less privileged. Even those who are artisan should source job for other family members [4, 6]. The social bonds and obligations of the wantok system are often held to be a cause of corruption. However, if the creative energy is harnessed, the unproductive conflict will be minimized if not eliminated.

The study of Betasolo [5] shows that student taking Engineering Materials and Engineering Mechanics (both Engineering subjects) are not interested to be lectured, nor directed by lecturers. Students wanted to prepare for the job, yet they don't want to develop higher order thinking skills, nor foster development and personal growth, and with no interests to develop basic learning skills. Furthermore, the assessments show an interesting revelation that students wanted to understand real life situation yet, the core competencies to do it is not supported. With the advent of technological advancement, engaging student is not a problem in other countries, but to Papua New Guinea's tertiary or university student, the use of these technologies is their first, and the fear of the utilization of these technologies is a hindrance. Betasolo [5] stressed that to get student's participation and the

teaching approach should be student centered. An Inductive Technique Instruction (ITI) is a much more student-centred approach using a strategy known as 'noticing,' where a concept is presented with many examples showing how the concept is used to let the students "notice," how the idea works. The inductive teaching philosophy allows learners to discover and experience phenomenon to achieve learning on their own. When the author started the first semester in 2013 at the Department of Civil Engineering of the Papua New Guinea University of Technology located in Lae of Morobe Province, the laboratory works were conducted in a demonstration only and without engaging the students. So when the author introduced the 'noticing' concepts where students can build their learning they take a time to assimilate. It is where the culture-educational paradigm shift learning concept was conceived.

Among the strategies used in ITI are inquiry learning, problem-based learning, project-based learning, discovery learning, case-based teaching and just-in-time teaching. The approach imposed more responsibility for student learning. The student learns by fitting new information into existing cognitive structures and is unlikely to know if the information has few apparent connections to their understanding and believe. This approach is a constructivist method. The principle of this approach is that student constructs their version of reality rather than simply absorbing lessons presented by lecturers. The method almost always involves student discussing the question and solving problems in class (active learning). The teacher's approach is not to directly supply information. Thus, the students are given more avenues to think about what they have observed and experienced developing independent thinking, and higher order thinking skills to achieve an authentic learning.

The methods presented were first approached in the traditional way (after the 2014 study). In the advent of the technology advancement, the integration of the technology was thought to be challenging. It is because of some constraints like access to the technology freely and the continuous support to use the technology. The most challenging task in the selection is the best teaching and learning a methodology that is appropriate to the skills required by an employer of today's modern society. It is an educational challenge to bring the graduate engineers to the expected level because the learners have a hesitancy to adopt new pedagogical concepts introduced due to evolving economy and that they are not familiar with, that maybe the concept is in conflict with their experience. The challenge is addressed by the Axiomatic Design approach discussed below.

2. The AD Approach in CEP SL Methodology-Technology Integration Selection

Technologies are a tool to aid education and learning. It promotes student-centred learning, allows interaction together, gather information using the internet, enhanced critical thinking, it hone communication skill, allow sharing of ideas without boundaries, and it provides opportunities in designing creativity. The technologies are not the process nor are they the work. But technologies help to achieve the objectives in easier and more efficient manner. The key aspect of axiomatic design (AD) is the separation between what a system has to meet (functional requirements) and the design choices involved in

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