Personalized Learning in Chemical Engineering Process Control

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Abstract—This study aims to evaluate the effectiveness of student learning experience by introducing a personalized learning approach. Multiple Intelligence Theory (MIT) is used as the basic of this approach. A total of 35 Chemical Engineering students were surveyed to identify their learning preferences. The relationship between the survey result and teaching technique was analysed before a method was proposed to personalize the learning of a specific topic of this subject to the students as an initial experiment.

Keywords—Personalized Learning, Multiple Intelligence, Process Control

1. Introduction

Process Control is important in the industry to ensure the product quality, safety and process efficiency and consumption. Every process requires specific design to accommodate its parameters[1][2][3][4]. It is important to have the ability to identify the nature of the process in order to design the control system.

Every individual was brought up in a different environment, teaching methods and thus having a wide diversity of learning profiles[5]. By acknowledging the diversity of learning styles, approaches in learning and intellectual development, we can conclude that no two minds are alike[6]. Thus, a wide range of innovative teaching methods was introduced over the years in order to improve the quality of education and one of them is Personalized Learning.

In a nutshell, the science of human brain is one of the important key areas of study. In the context of education, individual cognitive development is often associated with teaching methods. In one of the findings by [6], they identified the categories of diversity which are Learning Styles, Approaches to Learning and Orientation to Studying and Intellectual Development. These categories explain the effect of personal growth and unique needs in the process of learning.

1.1 Objective

The main objective of this research is to study the effectiveness of Personalized Learning in Chemical Engineering curriculum. By introducing Personalized Learning in Engineering Curriculum will not only allow the students to trigger their cognitive skills in learning, at the same time this will act as a self-discovery of their own ability and inner talent that can be utilized in many ways.

2. Theoretical Framework

2.1. Multiple Intelligence

From the founding of neuroscience[7], there are substantial relationship of that with learning process. The ability of understanding a theory or fact is closely related to the type of perception and analyzing skills that present naturally within oneself. One could have more than one type of approach in solving problem and it is known as multiple intelligence [1]. During the 1980s a range of intelligence that was proposed and it was then regarded as a base for research. Musical Intelligence, Bodily-Kinesthetic Intelligence, Logical Mathematical Intelligence, Linguistic Intelligence, Spatial Intelligence, Interpersonal Intelligence, and Intrapersonal Intelligence are the basic intelligence proposed during the early years and across the centuries, more new intelligence was discovered uniquely in their own way. These intelligence describes how one person interprets and deliver their own view through their individualize approach[8][9]. In a conclusion of this founding is that no two individual would have the same intelligence profile.

2.2. Learning Styles

Understanding personal psychology type is important as the first step in order to make improvement in the effectiveness of their work. The Myers-Briggs Type Indicator described 4 facets of type which are personal integration with the surrounding, “perceiving processes”, “judgment processes” and “preferences among the mental processes”[10]. Identification of student’s learning patterns would help the educators to enhance their unique dominant by designing effective teaching instrument. For an example, two individual can be an Extrovert but they are different in Judging and Perceiving. At some point, they might show a mixture of two distinguished pattern of a facet, but there will dominance on of the pattern. Research [6] finds that engineering modules are biased towards introverts, intuitors, thinkers and judges. Through Personalized Learning it is aimed to bring this gap between the current teacher-centered teaching methods close to the unique learning styles of the students.

3.0 Research Methodology

The experiment for this study is to be conducted in “Process Control System Design” topic. It is a form of assignment and this topic requires students to relate process integration and equipment specification in the design.

Based on the learning preference of the students, an instrument was proposed to assist in the student’s learning process. This instrument is a 3D Rapid Prototype Model, resembled the main equipment of the process in a given case study. It allows the students to relate technical knowledge to the problem statement before generating the solution.

3.2. Participants

This study group consists of a total of 35 Year 3 Chemical Engineering students who enrolled in the Process Control course module. They are then divided into two groups- Controlled Group (CG) and Uncontrolled Group (UG).

2.4 Data Inputs

2.4.1 Pre-test Survey

This pre-test survey involves students and also the industry. It aims to collect the feedbacks of the students’ past experience towards the teaching method of the subject, learning styles, intelligence profile, and also determine the expectation between the industry and the learning institution. Students were given survey forms while interview session was carried out with industrial personnel.
Personalized Learning in Chemical Engineering Process Control

2.4.2 Post-test Survey

It is important to run a survey on the Controlled Group in allowing them to comment on their experience with the model they have been using as a tool in their learning process. The areas will be covered in the survey includes the effectiveness of the tool in generating clearer definition of their challenge given, area of improvement of the tool, the importance of the hardware in every module and also the individual motivation to learn.

2.5 Data Analysis

Results from the survey are analyzed to see the population of the learning profiles in the class. This result has to be further validated through student informal interview and also the lecturers because the questionnaire given out to the students are from the source of different culture and background.

Results from the post-test survey are very useful in improving the design of instrument to further enhance the effectiveness in student’s learning in class.

3. Result

![Graph showing student's response towards the module](image)

**Fig. 1** Student’s response towards the module

Engineering subjects requires understanding theoretically and also imaginative applications of the knowledge into real life operations. From Figure 1, about 15 student facing difficulty in relating complicated examples. According to the students, they need additional material in order to visualize the challenge and by saying so, students’ need the class to be conducted in an interactive environment too. Out of the 24 students responded to the other 3 reasons of why the module is difficult to understand, 10 of them confessed that they lose interest and motivation in attending classes because they couldn’t get the gist of every lecture they attended due to weak presentation by lecturer and also minimum involvement of the students in the class. Thus, for technical topics which need visual and concrete material for understanding, a downsized model would be an effective tool to be used.

![Graph showing student's response towards different teaching methods](image)

**Fig. 2** Student’s response towards different teaching methods

The response of students towards different learning methods is illustrated in Figure 2. 54% of them realized the benefits of personalized Learning after being briefed about what exactly it is all about, while 8% prefers the current method and some of them thought that neither of them will affect their current learning method. The survey extended to discover learning preference of the students in the group. Students who choose to stay with the current method found to be Linguistic dominant as the class material are of more words, while the others are having different Intelligence dominant and learning styles. These responses seem to that personalized learning aimed at each individual’s learning style is effective for learning technical subjects in engineering.

4. Conclusion

From the study, the results show that personalized learning is suitable for engineering students who are learning technical subjects. They are seen to be more motivated and benefitted form this experiment to personalize their learning. However, this initial experiment model needs to improved and as for the future work, personalized learning are to be designed for other engineering modules.

5. References


