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Design Web-based Personalized Environment for Industrial Robots Learning

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Abstract: Despite attempts to improve the vocational students' performance in industrial robotics, student achievements are constantly decreasing. Because the student may not be known what their learning problem is and how they need to learn. This paper is an attempt to propose the students' guidance with web-based personalized learning. The beginning of our work concerns the construction of a test concept item that is used to diagnose learning problems based on industrial robot concepts for vocational education students. Then, we develop learning material to support students learning after receiving a suggestion. The ambition of the present work is to enhance student performance by providing them with web-based learning using personalized tools. Therefore, we hope that this study will guide engineering educators in developing an individualized learning system and combining a student's hands-on opportunity in the future.

Keywords: Recommended system, web-based learning, educational robot, vocational education

1. Introduction

Presently, engineering education is an essential issue in the economic growth and development of the country. The construction of the workforce is vital for the manufacturing industry. Thus, workers should acquire the essential skills needed to create new technology for use in the career part. Engineering education is a teaching and learning activity to apply the knowledge and principle to the professional practice of engineering.

In Thailand, engineering education is a part of the STEM education in vocational colleges that focuses on student learning that acquires professional knowledge and skills to be used in their careers in enterprise and industry (Dymock & Tyler, 2018). Mechatronics and robotics engineering is gaining popularity major in Technical and Vocational Education and Training (TVET). Due to the development of breakthrough technologies helps the deployment of robots in the industry. Implementing and integrating such technologies will improve productivity, flexibility, and competitiveness in diverse industrial settings.

During the learning process, the students have learned an industrial robot topic, both conceptual and practical. However, many factors are associated with why student failures during classes impact the learning outcome. Many students who cannot grasp the fundamental concepts of the industrial robot so cannot learn and understand more complicated concepts in the future. Therefore, it might be better to find an appropriate way to improve their conceptual learning ability in the topic. Significantly, the education system should promote students' learning by developing innovative technology to solve students' learning problems and use technological tools to implement the learning process effectively.

Many studies have developed web personalize to diagnose individual student learning, such as individual information, learning problems (Rhode, Richter, & Miller, 2017; Fatahi, 2019; Wanichsan, Panjaburee, & Chookaew, 2021) to enhance students had better learning achievement than those who learned with the conventional system.

The study's primary objective in this paper was to develop a web-based personalized environment to optimize each student's needs based on their learning problem through a technological recommended system.

2. Related work

2.1 Web-based Personalized Learning

A personalized learning system became a widespread issue and trend in educational technology research in the past decades. It is a management system that considers the student differences and tailors the information for enhancing learning appropriately.

Many studies have supported that the mechanisms to develop web-based learning based on personalized individual students' resources such as background knowledge, abilities, preferences, and interests to provide learning materials appropriately (Benhamdi, Babouri, & Chiky, 2017; Schmid & Petko, 2019; Wongwatkit, Panjaburee, & Srisawasdi, 2017). Educational research finds that a personalized learning system promotes students' engagement in the learning process with a strong sense of motivation and interest (Balakrishnan, 2018). Some research studies presented several personalized information sources used to determine the personalized students' learning materials (Chookaew, Wanichsan, Hwang & Panjaburee, 2015; Thanyaphongphat & Panjaburee, 2019). In addition, Romero et al. (2019) proposed a conceptual model of an intelligent system to support students' self-regulated learning with employ semantic technologies for using learning paths and student e-portfolios. It is an essential tool for learning and acquiring skills, solving interactions, and managing content and learning resources; it also helps identify obstacles and barriers and possible solutions (Kompen et al., 2019).

2.2 Industrial Robotics Course Overview

The industrial robotics course is an essential subject for vocational and higher education student engineering programs in Thailand. Many factories widely used Industrial robots, particularly in manufacturing systems. Using articulated arms or robots with rotary joints in the industry has increased (Adinandra & Marsiano, 2016) because it is programmed to quickly, efficiently, and accurately execute a specific task. The use of a robotic arm is spreading in the last years for manufacturing processes such as pick and place, welding, subtractive and additive manufacturing. A robot arm includes a series of joints, articulations, and manipulators that closely resemble the motion and functionality of a human arm. Progress in developments on industrial applications leads to the appearance of a curriculum on an industrial robot.

Thailand context, vocational education curriculums have the industrial robot course that focuses on using the robot in manufactory consist of 9 topics: Fundamental of Industrial Robot, Structures of Robot Arms, Component and Function of Robot Arms, Basic of Robot Arms Movement, Basic of Robot Programming, Robot Arms Movement Simulation, Gripper of Robot Arm, Application of Industrial Robot Arm, and Industrial Robot Arm Maintenance.

3. A Design of Personalized Learning System

3.1 Industrial Robot Concept-Effect Relationship

This study uses a concept-effect relationship (CER) model (Chu et al., 2010; Panjaburee et al., 2013) to building a testing and diagnostic system for personalized recommendations to students with a learning problem. The proposed approach begins with the analysis of the content of the course. Then, we set the relationship between each concept and each test item when applying the concept-effect relationship model. The CER model represents the prerequisite relationships among concepts that should be learned in a specific order.

Figure 1 shows the nine concepts of an industrial robot of vocational education. It shows the example of industrial robot CER model is essential in diagnosing students' learning problems.

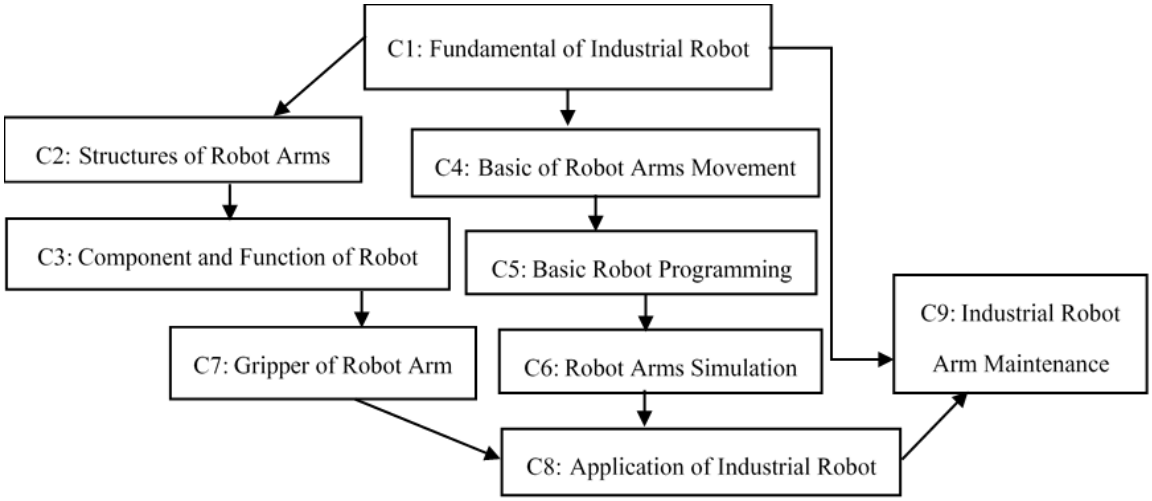


Figure 1. The concept-effect relationship of industrial robot course.

For instance, if a student fails to answer most of the test items concerning ‘‘Basic robot programming’’. In that case, the problem is likely that the student has not thoroughly learned ‘‘Basic robot arm movement’’ or its prerequisite concepts. Therefore, the recommendations given to individual students are pathway learning appropriate to the student context based on their learning problem.

3.2 Personalized Learning Problems

Recently, recommender systems have been efficiently applied in education due to recommender strategies for learning. The diagnostic test of the learning problem consisted of thirty multiple-choice questions concerning nine concepts taught in the industrial robot course. The test items have evaluated the students’ learning problems to present the learning material.

Figure 2 show the steps of the student participating in the system as follow:

Steps1: The student logs in to the system.

Steps2: The student takes a test within 30 min.

Steps3: After the students completed the 30 test items, the recommendation followed the learning problem and received learning material for each learning concept.

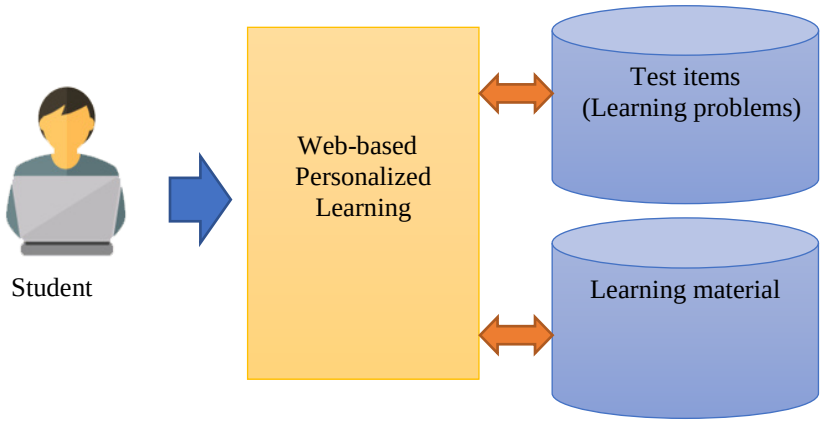


Figure 2. Web-based Personalized Learning framework.

3.3 User Interface of The Web-Based Personalized Environment

Based on our prosed system, we developed a web recommendation system and supporting learning material for improving individual student learning. This system was developed by google form and google studio for creating the interactive and responsive approach.

Figure 3 presents example screenshots of the result of the recommended system—the personalized learning suggestion based on each student's learning problems. The colors of the button represent the learning problem; the red buttons represent students who have failed that is concept learning problem very high level in concept. The yellow button means students have the concept should be revised to understand the fail concept, and the green buttons represent students have pass concept that is no learning problem in concept.

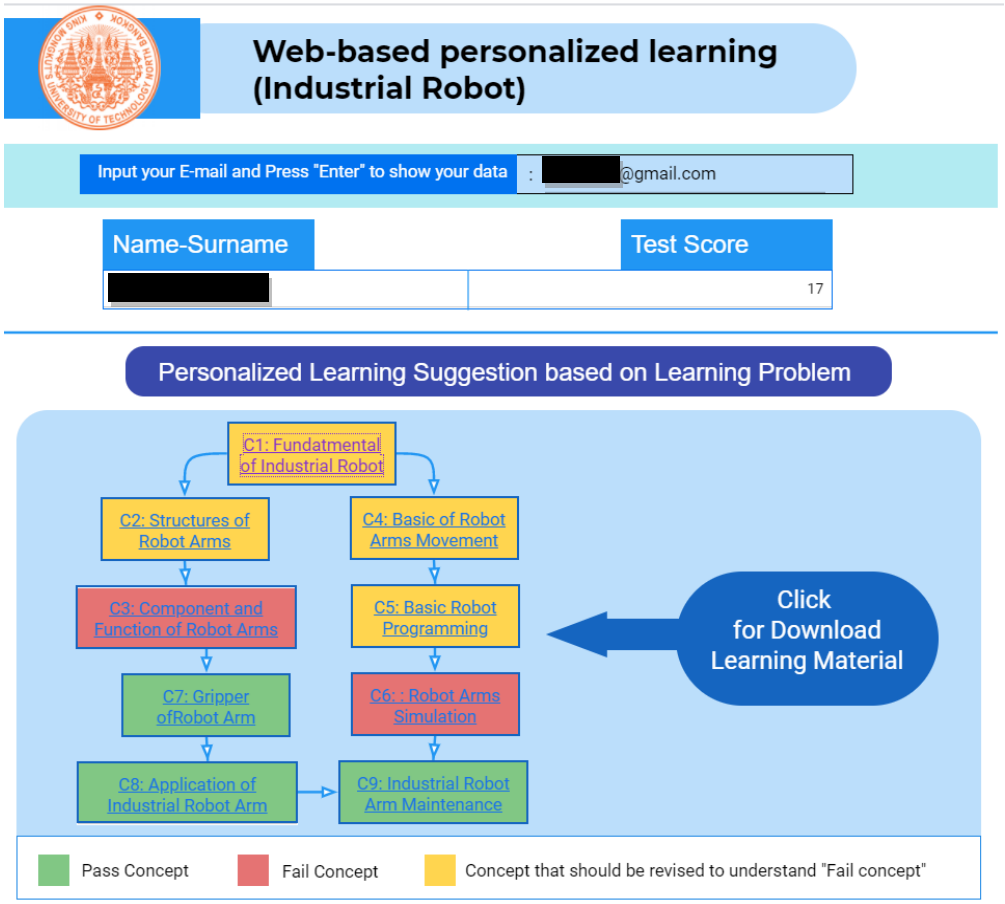
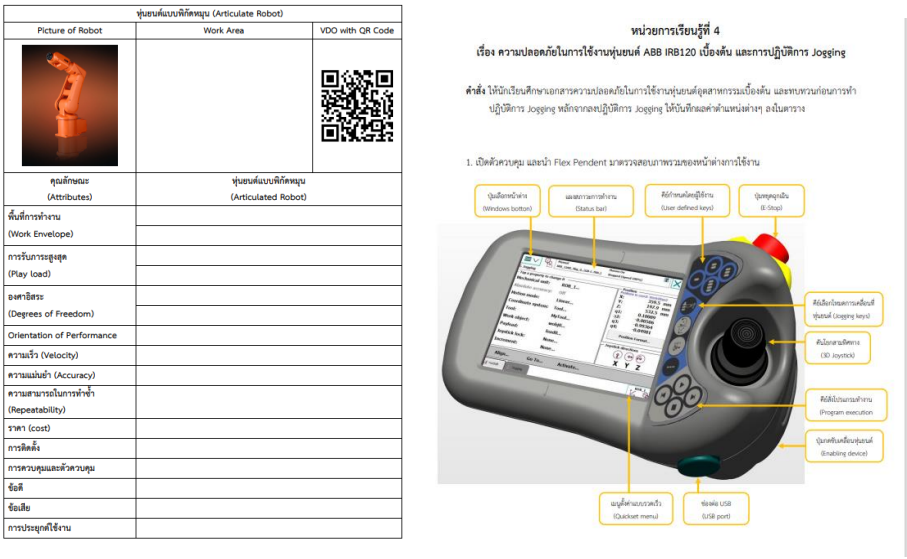


Figure 3. Example screenshots of WPL from recommended system.

In addition, when the student receives the recommendation related to the learning problem of each concept from the diagnosis system. The student will get the learning material with a download to learn and understand the concept again. The learning material includes instructional content related to industrial robot concepts, a learning activity sheet, and a QR code link to an internet resource for each student, as shown in Figure 4.



หุ่นยนต์แบบพิกัดหมุน (Articulate Robot)

Picture of Robot	Work Area	VDO with QR Code

คุณลักษณะ (Attributes)	หุ่นยนต์แบบพิกัดหมุน (Articulated Robot)
พื้นที่การทำงาน (Work Envelope)	
การรับภาระสูงสุด (Play load)	
องศาอิสระ (Degrees of Freedom)	
Orientation of Performance	
ความเร็ว (Velocity)	
ความแม่นยำ (Accuracy)	
ความสามารถในการทำซ้ำ (Repeatability)	
ราคา (cost)	
การติดตั้ง	
การควบคุมและตัวควบคุม	
ข้อดี	
ข้อเสีย	
การประยุกต์ใช้งาน	

Figure 4. Example of learning material

4. Conclusion

In this study, we proposed the students' pathway with a web-based personalized environment. Our work concerns constructing a test concept item used to diagnose learning problems based on industrial robot concepts for vocational education students. Then, we develop learning material to support students learning after receiving a suggestion.

The limitation of this study is that the student should be pass studied in industrial robot topic owing to use the information in diagnosis and personalized of the web learning system. However, web personalized learning has not been fully implemented. In the future, we plan to employ vocational students in many colleges. In the experimental research design, we will choose the students as target students to test our web recommender system for a personalized environment. In addition, we design two groups: the experimental and the control group, to compare the impact of the dependent variable. To ensure an effective web learning environment, we will present this in the future study.

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