The Relationship between Senior High School Students' robotics and 21st century learning

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Abstract: The main purpose of this study investigates the relationship of 21st century learning for senior high school students in robotics learning. There are 28 sophomores in senior high school as the participants to attend the study. The questionnaire is the way to investigate the 21st century learning, which includes 5C (collaborative learning, critical thinking, meaningful use of information and communications technology (ICT), problem solving, self-efficacy), the robotics learning self-efficacy, and the learning beliefs. There are two goals in this study. Goals find the differences between the collaborative learning and cooperate learning, which affects students' self-efficacy and 21st century learning in robotics learning.

Keywords: Robotics learning, 21st century learning, collaborative learning, robotics learning self-efficacy

1. Introduction

1.1 Robotics Learning

Robotics Learning is a complicated integration to many individual courses, such as electronics, electrics, machinery and computing element (Hiroyuki, 1999). Seung Han Kimand & Wook Jeon (2006) indicates the robotics learning is valued practicing tool in mathematics and engineering, since the learning engages in diversity contents.

Comparing to other technologies, many researchers found that the robotics learning can help student connect with the real world when they learn the courses (G. Loewen et al., 2011). Robot is not only a toy, but also a tool for learning (EZF Liu, 2010). Around the decades, robots apply for various curricular, such as language program, mathematics, and cooperative learning (W.I. McWhorter & B.C. O'Connor, 2009). In addition, robots can create a pleasure and meaningfulness for students to experience the learning, so the robotics learning is a crucial trend in the next generation for technology education.

1.2 Self-efficacy

According to the social cognitive theory, psychologist Bandura (1977) defined self-efficacy is one's belief in one's ability who will success in a situation, increases the confidence to achieve the goals, and affects one's thinking and mood (Bandura, 1994). The self-efficacy insists four main elements to develop (Bandura, 1997). Firstly, the mastery experience is from passed succeed or failure experience. Secondly, the vicarious experience: persuading self as others can solve same problem, and improving self-efficacy. Thirdly, the verbal persuasion: persuasive language can make self to believe one's ability and succeed achievement. Lastly, the physiological and effective states: one involves into a specific situation. Physiological and effective states will evaluate self-efficacy.

In engineering education, self-efficacy has been proofed a crucial reason in learning motivation (Ponton. M et al., 2001). Consistently, the study will discuss the robotics learning has different self-efficacy in different groups.

1.3 21st century learning

In 2012, National Research Council of the National Academics of Science aimed the learning essential definition of 21st century learning. The robotics education is the theme of this study. Collaborative learning, critical thinking, creative thinking, problem solving, and meaningful use of ICT are the key factors in this study. The 21st century learning emphasized learning activities as problem-based learning (PBL). The theme of learning and the design of learning environment should integrate into learners' daily life. It will help learner solve problems in real life. Learners can also understand the theme of learning deeply. It will lead learners to solve problems through collecting information, knowledge exploration, interpersonal interaction.

1.3.1 Collaborative Learning

Slavin (1985) indicates that collaborative learning is a structural and systematic teaching strategy. In collaborative learning, teachers assign students who have different skills, gender, and ethnic background into different groups. Through group learning, sharing, peering suggestions and undoubtedly, students can engage in the structural teaching, discuss in the groups, and gain award from teacher. The result of collaborative learning is efficiency than traditional learning (Tsay & Brasy, 2010).

In teaching of collaborative learning, each group includes more than three students to achieve the learning goal. Each student must engage in and work together, and teacher plays a role as a counselor or a promoter (Akinbobola, 2009).

1.3.2 Critical Thinking

Critical thinking is a high level of learning. It advocates the objective collection to find out the evidence, and generalizes the conclusion. Through the conclusion, students should contribute the reasonable reflections for solving problems. From the research of critical thinking, when teachers teach student for evaluating information from internet, teacher should enhance students' critical thinking, and should notice students that they must be cautiously for evaluating information and seeking reasonable explanation. In addition, teacher can quote information from webpages,

and students can criticize and make comments for the assignment (Elder, 2002). The instructional theory of critical thinking should involve with the situated learning and learning factors for approaching the practical thinking model, and establishing the critical teaching and the learning theory correspondingly (Paul & Elder,2002).

1.3.3 Creative Thinking

Teachers must pay attention on students' way of thinking and thinking process to teach. Through the teaching strategy, teacher should provide some ideas or ways for students to brainstorm, and listen to each students' distributed thinking for producing creative learning and performance (Feldhusen, 1980). Furthermore, Bahlke(1980) indicates that teachers not only teach for knowledge and solving problems, but they must go through the teaching to enhance students' creativity, since it will help students in the future.

1.3.4 Problem Solving

When facing to the problem, students will go through the solving problem method to solve problem. From the process of solving problem, students can develop a new concept for realizing the problem. When students understand the answer, it can enhance their previous experience knowledge. Ramelli (2012) represents that the solving problem integrates the learning process. Therefore, teachers should prepare some questions of solving problem for each curriculum. Students will gain some abilities of solving problem when they engage in problems.

1.3.5 Meaningful use of ICT

Information and communications technology (ICT) has the text and the image to assist teaching and learning, and the meaningful use includes diverse learning style and teaching technique (Mayer, 2001). In the globalization and information technology era, the informational and communications technology integrates to teaching universally. An appropriated media for teaching will enhance professional development, and enrich teaching contents. In previous research, using the media for teaching can increase learners' learning efficiency (OECD, 2011).

1.4 Collaborative Learning & Cooperate Learning

The concept of collaboration and cooperation are always confused. Both of the concepts define more than two students as a team to achieve the goal, but these two concepts have different interaction. Tu (2004) had been compared the characteristics of these two concepts. Tu found that the cooperate learning is more flexible than collaborative learning, since the cooperate learning is advanced in a team for developing a high level of thinking skill, and promote one another ability for gaining knowledge and learning. On the other hand, the cooperated learning encourages to think out of the based knowledge box. The cooperated learning uses different level to think about the problems, and the knowledge learning sets on the social constructivist model. Since the cooperated learning is teamwork, so some enterprises consider that the cooperated can be practical apply, and also the collaborative learning becomes the trend of teaching gradually. Srinivas (2004) had been defined that the cooperated

learning is a way for teaching and learning, since it involves in a group of students who solve problem together, and complete a mission, or create a production. In the research of educational practice, the characteristics of the cooperated learning can intensify the group discussion and creativity.

Tu, C. H. (2004) represents the main points distinguishing collaboration and cooperation:

Collaboration

- Applying the small-group activities as strategies to develop higher-order thinking skills and enhance individual abilities to master knowledge.
- Encouraging the laissez-faire approach for higher-level, less-foundational knowledge content.
- Assuming that knowledge is socially constructed.
- Is applied in colleges.

Cooperation

- Encouraging an explorer approach but in a more structures manner for the foundational knowledge typified in gateway instruction.
- Assuming knowledge is constructed socially, but the methodology of choice is for foundational knowledge.
- Is applied in primary school.

Palloff & Pratt(2005) think if the cooperated activities include entity and virtual, it will promote the reflection of development and critical thinking, and work on knowledge and meaningfulness. The cooperated transforms as a learning course.

1.5 Research Question

- Investigating that the groups of cooperated learning and the collaborated learning. Will it causes the performance of self-efficacy in robotics learning? What are the differences?
- In robotics learning, investigates the groups of cooperated learning and the collaborated learning. Will it causes the difference between the cooperated and collaboration in 21st century learning?

2. Method

2.1 Participants

All participants were invited to complete the two main instruments that aims at robotics learning in self-efficacy and 21st century learning. In Taiwan, male students are more than female students in polytechnic background. Thus, this study has 25 males, 3 female.

2.2 Learning Beliefs

The main purpose of the learning beliefs investigated that the beliefs of learning for students. The scale separated into two aspects, which are constructivists and traditional? The explanation and example are shown as below:

- Constructivists: students can learn by himself or herself. Teachers will help, when students need help.
  Example: learning means students have opportunities to investigate, discuss, and express one's thinking.
- Traditional: Only accept teacher to lead the way of learning.
  Example: learning means students remember teachers have been done with teaching.

Each aspect includes six to seven questions. The scale uses Likert 5 points table 1-5. 1 represents as strongly disagree, and the 5 represents as strongly agree.

2.3 Assessing Participants' Robotics Learning Self-efficacy

The main purpose of robotics learning self-efficacy investigated how students confidence in robotics learning. Scale includes six aspects, which are conceptual understanding, practical work, everyday application, higher-order cognitive skills, social communication, and self-efficacy. The explanation and example are shown as below:

- Conceptual understanding：Measuring students' confidence in their ability to understand the definitions of robotics concepts, laws, and theories.

Example: I can be able to use an appropriated way to solve robotics problem.

- Practical work：evaluating students' confidence in their ability to accomplish robotics activities including skills in both cognitive and psychomotor domain.

Example: I know how to use instruments and materials to build up a robotics practice

- Everyday application：addressing students' confidence in their ability to apply robotics concepts and skills to everyday events.

Example: I can learn the knowledge of robot, and connect to the robot report from media.

- Higher-order cognitive skills：assessing students' confidence in their ability to employ a robotics approach such as robotics inquiry skills, problem solving, critical thinking and other higher-order cognitive skills.

Example: When I have problem in robot, I will think directly, and then produce the way to solve.

- Social Communication：evaluating students' confidence in their ability about how well they can communicate or discuss with others.

Example: I feel free to communicate and discuss with classmates about the content of robot.

- Self-efficacy：evaluate high school students' self-efficacy in learning robotics.

Example: I understand what I learn from robotics course definitely.

Each aspect includes five to night questions. The scale uses Likert 5 points table 1-5. 1 represents as extremely no confidence, and the 5 represents as strongly confidence.

2.4 21st century learning

The purpose of 21st century learning is in order to recognize how students use the key learning ability on robotics learning activities. In this study, the scale of 21st century

learning includes five aspects, which are collaborative learning, critical thinking, creative thinking, problem solving, and meaningful use of ICT. The explanation and example are shown as below:

- Collaborative learning: assigning students into groups to discuss, and work together for solving the mission of robotics learning.

Example: When processing the robotics learning, I will work with classmates to complete the mission willingly.

- Critical thinking: students can assess robotics information accurately, and determine what the next step is.

Example: When processing the robotics learning, I will think my learning of robotics is correct or not.

- Creative thinking: students produce different thinking, and brainstorm to build up a robot.

Example: When processing the robotics learning, I can think many new methods to solve the practical problems in robotics.

- Problem solving: When receive problems on robotics course, students will think ways to solve problems.

Example: When processing the robotics learning, I will investigate what the reasons initiate the practical problem in robotics.

- Meaningful use of ICT: Students will use many media materials to record in robotics course.

Example: When processing the robotics learning, I will use computer to record what I learn from robotics course.

Each aspect includes six questions. The scale uses Likert 5 points table 1-5. 1 represents as strongly disagree, and the 5 represents as strongly agree.

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