International Journal of Scientific Research and Management (IJSRM)
||Volume||5||Issue||10||Pages||7276-7279||2017||
Website: www.ijsrm.in ISSN (e): 2321-3418
Index Copernicus value (2015): 57.47 DOI: 10.18535/ijsrm/v5i10.13

A study of the learning experience from an emerging technology integrated curriculum

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Abstract:
This study aims to explore the learning effect of emerging technology integration in a senior high school curriculum as implemented by the High Scope Project of the Ministry of Science and Technology, R.O.C. Through senior high school teachers' inquiry instruction and interaction with students, it explores students' learning experience in an emerging technology integrated curriculum and further probes into subjects' perception and effect of the experience. The research questions are: (1) What are the subjects' past experience with emerging technology? (2) What is the subjects' feedback from participating in an emerging technology integrated curriculum practiced by teachers? (3) What is students' personal reflection after participating in an emerging technology integrated curriculum? This study adopts qualitative research of in-depth interviews, and the subjects are 6 students in one senior high school in southern Taiwan. Since the subjects are senior high school students who participate in an emerging technology integrated curriculum and the recorded interviews and observations are based on their agreement, this study practices purposive sampling. The research tool is the researcher's self-designed interview outline. The study is based on multiple sources such as in-depth interviews, observations, and feedback. The main findings of this study are as follows: 1) senior high school students' past behavior with emerging technology is rare; 2) teachers proposed practice courses that include immediate feedback and interaction, and these courses are the most popular with students. Teachers' questions and encouragement and students' problem-solving process result in students having a positive learning effect; 3) with experience from participating in competitions, students develop personal reflection and confidence. External praises lead to the construction of personal positive self-concept; 4) important self-reflection includes acquisition of new knowledge, passion in attempts, demand for a great amount of originality and ideas, etc.

Keywords: senior high school students, emerging technology, learning experience

1. Introduction

With the quick change and rapid development of science and technology, it is necessary for schools' curriculum to change with the trend of emerging technologies. There are various emerging technologies, among which "natural environment sensing", including temperature sensing, humidity sensing, and PM2.5 measuring, is the most related to people's daily life and to change in the natural environment. Since the subject of this study is a senior high school located near a mountainous area, the "natural environment sensing technology course" in emerging technologies is selected as the content to be integrated into the original curriculum so as to demonstrate the importance of this school's basic courses and featured courses.

Studies on the integration of emerging technologies into curriculum and teaching have gradually increased in recent years due to the active promotion of the High Scope Program by the Ministry of Science and Technology. Yang et al. (2015) explored the learning effect in scientific ability of senior high school students who participated in an emerging technology integrated curriculum and discovered that the overall performance of students who participated in the High Scope Program was much better than that of students who did not participate in the High Scope Program in terms of "interpreting scientific phenomena", "evaluating and designing scientific inquiry", and "interpreting scientific data and evidence", and the total scores of these three scientific abilities were measured in the PISA 2015 pilot test. Tsai et al. (2009) took "modeling" and "cognitive mentoring" as the main axis of curriculum development and developed an emerging technology integrated innovative curriculum in senior high schools. The study discovered that through the implementation of this curriculum, students' learning interest, learning effect, and understanding of emerging technologies improved; the measurement results

before and after participation in the program also showed that teachers who participated in the program also changed their concepts of modeling significantly. The purpose of the study of Huang and Chen (2011) was to provide a successful example that one senior high school successfully designed and implemented the Emerging Technology Inquiry-based Curriculum (ETIC). The discoveries of the study mainly include: the teaching purpose of ETIC was to cultivate students' concern for environmental issues, the knowledge of developing alternative energy sources, and to teach students to learn by inquiry; the ETIC curriculum provided students with the process of empirical scientific inquiry and cultivated students' high-level thinking abilities. Foreign scholars such as Czerkawski (2013), Spector (2013), and Yu (2013) also explored the integration of emerging technologies into curriculum and teaching.

The above domestic and overseas scholars have attached great importance to the emerging technology integrated curriculum. Therefore, this study aims to further explore students' learning experience of such an integrated curriculum. The purposes of this study include: (1) understand senior high school students' past experience with emerging technology; (2) explore students' process of participating in the emerging technology integrated curriculum practiced by teachers; (3) understand senor high school students' self-reflection after they participate in the emerging technology integrated curriculum; (4) use the discoveries of this study as a reference for the promotion of the emerging technology integrated curriculum.

2. Research Design and Implementation

2.1 Research participants

This study focuses on the experience of participants and hopes to help senior high school students in remote areas to understand more about emerging technologies, cultivate strong scientific learning habits, improve their learning efficiency through the experience of interviewers who participated in the emerging technology integrated curriculum, and further construct a positive self-concept.

Since the subjects are senior high school students who participated in the emerging technology integrated curriculum and the recorded interviews and observations are based on their agreement, this study practices purposive sampling. The researcher asked the teachers in the school about qualified students who were willing to accept the interview and established a good interview relationship with interviewees after explaining the purpose and procedure of this study in detail. Six students in one senior high school in Taiwan participated in the interview of this study. Please refer to Table 1 for their detailed information.

Table 1 Interviewees' Information of Formal Study

Number	Gender	Educational system	Whether the subject participated in the emerging technology integrated curriculum	Whether the subject participated in extracurricular competitions of the emerging technology integrated curriculum
S1	Male	Senior high school	Yes	Yes
S2	Male		Yes	Yes
S3	Female		Yes	Yes
S4	Male		Yes	Yes
S5	Female		Yes	Yes
S6	Female		Yes	Yes

2.2 Research tools

The research tools include the researcher, the interview outline, and other tools, which will be explained as follows.

1.Researcher

The researcher is an important tool in information collection and analysis of qualitative research. The researcher of this study examined relevant experiences and self-training, converted the conversations with interviewees into verbatim transcriptions according to the interview guide before and during formal interviews, and further conducted information analysis so as to avoid personal subjective suggestion and guidance and obtain objective and detailed information.

2.Interview outline

The researcher adopted an unstructured interview outline, including:

(1)What are the subject's past experiences with emerging technology?

(2)What is the subject's feedback from participating in an emerging technology integrated curriculum practiced by teachers?

(3)What is the student's personal reflection after participating in an emerging technology integrated curriculum? What are the possible reasons that influence these opinions and attitudes?

3.Other tools

Other research tools include interview notes, interview consent, and reflection logs.

2.3 Research procedures

The research procedures include: (1) research preparation stage; (2) information collection stage; (3) information analysis stage; and (4) research completion stage. Each stage shall be discussed and checked by the research group so as to ensure the rigor of this study.

2.4 Information processing and analysis

In this study, participants' interview tapes were converted to verbatim transcriptions before the analysis. When converting the interview tapes to transcriptions, any special emotional responses of the two parties such as pause and silence were also marked in addition to the oral conversation. The researcher also coded the information, using B to represent student and T to represent the interviewer. The dialog was coded after one party stopped taking and the other started talking. Therefore, B1-12 means the 12th dialog of the first student. The researcher further organized, classified, compared, and summarized all kinds of information and classified the codes according to their attributes and developed core categories; after that, the researcher organized the core categories and formed the primary code tale, then, the information of other interviewees was gradually added into it, was deleted, or new categories were added so as to complete the code architecture of all interviewees and answer research questions.

2.5 Triangulation

The reliability and validity of qualitative research can be

improved through the examination of various information, the researcher, and multiple methods.

2.6 Research ethics

This study adheres to research ethics, keeps the identity of the subject confidential and respected during the process of the study, implements the ethics principle of informed consent, and cares about the interviewees' gains during the experience process.

3. Research Results

Through in-depth interviews and document analysis, the discoveries of this study are as follows.

3.1 What are senior high school students' past experiences with emerging technology?

1. The subjects often surf the Internet in daily life, but seldom browse contents related to emerging technologies.

I like programming and have exposure to emerging technologies, and I have taken a computer class in the first grade of junior high school. (S206)

I don't read such contents in daily life. (S412)

2. The subjects did not have classes related to sensing before, but they are willing to learn emerging technologies.

I only heard about temperature sensing, humidity sensor, and PM2.5 measuring just now; these courses are not available in junior high school. (S363)

I don't know the course, but I am willing to participate in this course and try new things! (S150)

3.2 What are the subjects' feedbacks from participating in an emerging technology integrated curriculum practiced by teachers?

1. Before the class, some students chose this course after consideration, while others did not think so much about it and they just wanted to have a try. After the class, all students thought they had gained valuable experience.

I want to learn something different, such as improving the speed of rewriting programs, making it turn faster, or making the mobile robot move more smoothly. (S130)

After the class, I think this experience is very helpful for us. (S325)

I am very surprised that I like this course. (S642)

You will feel curious that you have access to ARDUINO. You may see something similar on the Internet and know what it looks like, but in this course, you will learn how it works. (S385)

2. The subjects liked the practical courses and the immediate feedback and interactions with teachers.

I really like the practical courses, because I can learn new technologies. (S602) (S650)

I like teachers teaching the knowledge I don't know in class. (S160)

I like operating machines to measure temperature and humidity. It will strengthen my impression and I really like it. (S163) (S230)

I participated in the test in school and the test is conducted according to groups. (S235)

3. Most students were surprised at their performance and felt satisfied.

I think the group homework of drawing the rainfall statistical chart is quite easy. (S3118)

My group uses my chart to set the detection button to start all the programs and uses Arduino software to make the sensing and detection system. (S612)

4. Subjects' favorite homework assigned by teachers is to design the rainfall measurement chart by groups.

First, the teacher let you collect relevant information on the Internet and then draw the chart by your own imagination. (S2120)

Not all students can draw the chart. (S3116)

I only drew one chart..., and they told me to add emerging technology in it..., finally, my classmates decided to use my chart. (S3120)

In addition, the teacher has designed a quick response question related to KAHOOT. If we have different answers, we will discuss first then answer it. (S3159)

Students can answer the question designed by the teacher online. I think it is really challenging and I like it. (S3161)

5. If there are difficulties during the group work, subjects will work together to solve them.

The teacher will ask more questions than usual to guide students, but won't give the answer directly.

During the process, we may not succeed at once. If we have difficulties, we will ask our friends for help. (S122)

Although we may fail sometimes, we will ask teachers for help, and they require us to think first. (S140)

I like it. I will discuss with my classmates. If I have any questions, I will ask them immediately. (S226)

Some students will ask the presenter questions. All the members in the group will answer. They are pretty awesome. (S3136)

6. Feedbacks and suggestions for the course.

Don't go too far in the beginning, or the contents will be vague and general. The teacher only taught us what Arduino was, but did not tell us why. (S393)

Yes, the contents can't be taught in one class, and the class hours are not enough. (S236) (S395)

The teacher didn't tell us the origin of Arduino. (S3100)
My suggestion for this course is that we can start from the basic knowledge and then go deeper. (S577) (S3112)

3.3 What are the subjects' past experiences of participating in extracurricular competitions using the knowledge learned in the emerging technology integrated curriculum?

1. The subjects felt nervous when participating in competitions and felt happy and surprised when winning prizes; the subjects would like to thank the group members.

I felt nervous before competitions and always worried that the instruments would break down temporarily. (S270) (S630)

Winning the competition is the result of teamwork. (S283)

I think I'm awesome! Some schools may have more resources and their students also practice more than us. (S536)

2. Although there were difficulties during the competition, all the team members worked hard together to solve the problems.

If there are problems, we will keep correcting them. If the data are in a mess during the competition, then it is hard to control. (S2105)

When the competition started, it was knocked down at first, and we tried to improve it and solve the problem. (S2108)

We cooperate with each other and share the work according to each person's specialty; each procedure is linked to another. (S327)

3. Students' innovative ideas and learning interest are inspired by observing the achievements of other students (groups) and participants.

Everyone has his/her own work and can express his/her own opinion. (S654)

The presenter of Group One explained it clearly. (S672)

4. The results of the competition come from the support of various parties and the positive feedback of inquiry teaching.

The principal supports this competition, because he also majored in science and engineering. (S411)

The teachers were moved to see students who won the competition. (S1134)

It doesn't matter whether to win the competition or not. The most important thing is the experience we gained. (S572) (S637)

I feel that other students have practiced longer than us, and they are more specialized. (S320)

We only achieved good results, because we didn't have too much practice. We have to practice more. (S103)

3.4 What is the student's personal reflection after participating in an emerging technology integrated curriculum? Any influence on future career and suggestions?

I can learn some new knowledge, such as the experience of rewriting programs. (S106) (S244)

I can disassemble and reassemble the robot by myself. (S183) (S339)

The robot is easier to control after you adjust the parameters; so all parts are linked together. (S342) (S606)

4. Conclusions and Suggestions

According to the results of the study, the following four conclusions are drawn:

1. Senior high school students' past behavior with emerging technology is rare, but they all regard it as a valuable experience after they take the course.

2. Teachers proposed the practice courses that include immediate feedback and interaction, and these courses are the most popular with students. Teacher's questions and encouragement and students' problem-solving process result in students having a positive learning effect.

3. With experience from participating in competitions, students develop personal reflection and confidence. External praises lead to the construction of a positive personal self-concept.

4. Important self-reflection includes acquisition of new knowledge, passion in attempts, demand for a great amount of originality and ideas, etc.

According to the conclusion of the study, the following suggestions are proposed:

1. Improve students' learning motives and the willingness to participate in the emerging technology integrated curriculum, including:

(1) Select students who are willing to participate in the curriculum; (2) conduct adequate communication with students before they choose the curriculum; (3) organize more observations and on-site measurement activities outside the school so as to enhance students' understanding of the curriculum; and (4) provide incentives for participating in the curriculum, such as awarded points, grade points, and presentations.

2. Enhance teachers' ability in inquiry teaching and natural sensing technology, including:

(1) Inquiry teaching: hold a seminar on writing teaching plans so as to enhance teachers' ability of writing teaching plans; and (2) Imitate study: provide other schools' featured teaching plans of integrating emerging technology into teaching.

5. Acknowledgment

The authors thank the Ministry of Science and Technology of the Republic of China (Taiwan) for funding this research (MOST 105-2514-S-230-002). We also give our sincere thanks to the article's reviewers for their constructive suggestions.

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