

How to build a 5Why scaffolding guided questioning teaching case film? Campus insects unit as an example

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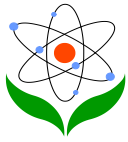
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Received 04 Jul., 2012

Revised 25 Mar., 2013

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Abstract

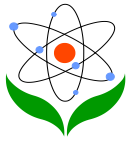
The purpose of this research is to set up a 5Why scaffolding guided questioning teaching case film for student teachers. The case can provide complete 5Why scaffolding guided questioning science teaching unit (campus insect unit) for the student teachers to observe and learn the curriculum design, teaching didactics and problem solving method. In this research, we use focus grouping interview, experimental didactics, 5Why scaffolding guided questioning teaching feedbacks, instructional evaluation as research method, and ask science mentor teacher integrate into the research.

As the results, the teaching has three characteristic. First, 5Why scaffolding guided questioning teaching case curriculum design has an appropriate teaching situation. The teacher will ask different layers of questions, so that the student can probe into the core issues quickly. The second characteristic is when students don't have penchant for analytical thoughts; the teacher provides them a direction to think or gives them some examples to erect the scaffold to the answer. The third characteristic is that teachers can use fishbone diagram and falsification teaching to help students solve their problems. The teacher guides the students to discuss the main reason of the problem and ask them to put forward a suitable solution.

The 5Why scaffolding guided questioning teaching case film had added headline to prompt each teaching stage to the student teachers. As the evaluation, the teaching case film scored 4.3 to 4.5 point in 5, which means that the teaching case can present the curriculum design and teaching didactics of 5Why scaffolding guided questioning teaching and are appropriate for teacher training institutions when teaching student teachers. The 5Why scaffolding guided questioning teaching case film has placed on the internet platform, so that the student teachers can post their questions on the platform and communicate with the tutor or the professor directly to enhance their 5why scaffolding guided questioning teaching ability.

Keywords: 5Why Scaffolding Guided Questioning, Campus Insects Unit, Teaching Case Film, Teaching Evaluation

Introduction

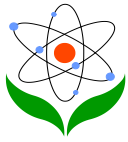


Rationale and Importance of this study

In recent years in Taiwan, there has arisen a vogue for experiential learning, requiring that curricula was designed in accordance with the needs, interests and experiences of students, and the curricula was changed and reorganized periodically in order to promote the development of further experience (Ou, 2002). Researchers discover that "5Why scaffolding guided questioning" can apply to the questions which students want to discover, and lead them to do series thinking. When using "5Why scaffolding guided questioning", researchers let students to draw fishbone diagram, then sum up and classify the cause about the questions they wish to discover; third, discuss the cause and effect of it and make students to put forward the falsification causes and settle down the main reason; forth, students can learn new inquiry teaching tactics, investigate independently, consult with classmates and solve the problem in this kind of teaching, and act like a scientist (Hong, Lu, & Tseng, 2007; Hong, Lu, & Tsai, 2008; Hong, Ke, & Lu, 2009). Se and Lai (2010) use "5Why scaffolding guided questioning" teaching method when teaching biological diversity. In their research, it shows that 5Why hierarchical questioning steps can foster student's ability to investigate and overcome problems; using fishbone diagram which draw by each students group can make students learn how to cooperate with each other and cause them to rethink profoundly and to fix their fishbone diagram. Lu, Liang, and Hong (2008) use 5Why scaffolding guided questioning teaching case method and combine it in science teaching method classes, which found 81.9% in-service teachers (about 50 teaches) affirm the achievements of 5Why scaffolding guided questioning teaching. They think case method teaching can enhance their comprehension of the real teaching field, understand students levels much more specifically, know more about 5Why scaffolding guided questioning teaching and know how to ask 5Why hierarchical questions after watching mentor teacher teaching process.

National Science Council grants a number of science teachers professional development training program which support to build the student science teacher training system. Lu (2012) investigate 210 elementary science teachers in the Taipei area and found 40% teachers think the "Campus insects unit" is difficult to teach, but using "5Why scaffolding guided questioning" in the lesson can guide students to observe and probe when learning the lesson.

In this case, this research combines "teaching case film" which film Campus insect's lesson that teach by senior mentor teachers in the student teacher's science



method teaching classes, and lead these student teachers to learn about the theory and practice in 5Why scaffolding guided questioning teaching method to attain senior mentor teacher's alternative experience and applied to their actual teaching.

Research Objective

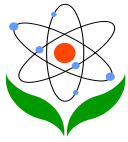
The study combine senior mentor teachers and build 5Why scaffolding guided questioning teaching case film which wishes to pull in the teaching pattern of "how does senior mentor teacher teach"? Building this professional development support system, student teachers can inspect and learn from a complete teaching unit that can help them understand curriculum design; problems might have to face in teaching process and how to solve the problems they meet. The research objectives are: (1) How to develop the curriculum by using the 5Why scaffolding guided questioning teaching method? (2) How to use the method in experimental-teaching? (3) How to build the teaching case film?

Literature Review

Theory and practice of 5Why Scaffolding Guided Questioning

The objective of Root Cause Analysis (RCA) is to identify "root cause(s)" so that these latent failures may be eliminated or modified and future occurrences of similar problems or mishaps may be prevented (National Aeronautics and Space Administration, NASA, 2003). Some fire-fighting is carried out in order to handle and recover immediately. Since this expeditious approach deals with the patching up symptoms quickly, the problem seems temporarily solved. Over time, the problem is likely to recur, thereby eliminating or reducing the anomalous impact. Critical the importance is a way to prevent the recurrent failures (Envision Software, 2007).

Hong (2006) stated when we "confirm the reason" during problem solving process, we try to analyze the consequence, which we use 5Why method to confirm. 5Why is proposed earliest by Teach honor in Toyota Motor Company. In the company, they had used 5Why to deal with problems by asking "why" consistently (Yang, 2006). Lu, Hong and Tsai (2008) had designed inquiry-based learning curriculums through 5Why scaffolding guided questioning. They think that teachers should provide challenges and encourage students to learn through questions. For example, students have difficulty understanding the pupa stage of butterflies. In this situation, the teacher can give them some directions to think about what's the different



between the caterpillar and butterfly, and give them some examples like do the caterpillar needs a safe shelter to grow into butterfly? These directions can let students try to figure out why the butterfly needs the pupa stage when growing. The Quality Assurance Project (2006) proposed that cause-and-effect diagrams, which named fishbone diagram, can also reflect the causes that were hard to reach. The fishbone diagram can help the team to brainstorm about possibility of the causes.

Theory and Practice of Teaching Case

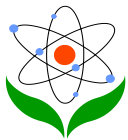
Case teaching methodology or teaching case method is a teaching method that use a vivacious case in life, that are enable to study, as the teaching material to achieve its educational aid. The teaching material sometimes combined with the learner's daily experience, which makes them jump into the situation more easily and can provide more ideas when learning the case (Shulman, 1992). Case teaching method has founded by president of the law school of Harvard University C. C. Langdell. The educational organ of U.S.A., American Educational Research Association (AERE) and American Association for Higher Education (AARE) popularizes and applies the teaching case method (Merseeth, 1996).

Case teaching is using real cases as instructional materials. The real situation will be shown in classes. Through interactive discussion between professors and students, students can learn the main concepts in teaching cases and enhance student's thinking-level and problem solving abilities, etc. (Doong, 2008). While the problems in the case are reality problems, students can discuss the case and deliberate, clarify, and reflect on education issues, which cut down the gap between theory and practice. Student teachers also can improve professional abilities while learning the cases (Tseng, 2006).

Methodology

Research Design

This teaching case film shown a mentor teacher incorporates 5Why scaffolding guided questioning in the campus insects unit that provided in the textbook. The mentor teacher guide students to understand the insects in campus and a draw fishbone diagrams to identify the causes of "Why are there so many grain white butterflies on campus?" The research design is shown in Table 1.

**Table 1 Building "5Why scaffolding guided questioning" teaching case film**

Research Questions	Research Methods	Data collection and analysis
3.1.1. Design Campus insects unit curriculum	<ol style="list-style-type: none">1. Confirm 5Why scaffolding guided questioning curriculum's teaching key point.2. Use focus grouping interviews and teaching evaluation sheet before taping the teaching film.	<ol style="list-style-type: none">1. Curriculum design, teaching plans, worksheet and focus grouping interview records.2. Do the interpretation analysis.
3.1.2. Experimental-teaching of Campus insects unit	<ol style="list-style-type: none">1. Film mentor teacher's first teaching case film (the experimental-teaching film) and give mentor teacher feedback, before the second film shoot.2. Use focus grouping teaching evaluation sheet to evaluate the teaching films.	<ol style="list-style-type: none">1. Classroom observation, feedback from 5Why Scaffolding Guided Questioning teaching, learning evaluation sheet and focus grouping interview records.2. Doing the interpretation analysis.
3.1.3. Building 5Why scaffolding guided questioning teaching case film	<ol style="list-style-type: none">1. Shoot, edit and produce the teaching case film.2. Use focus grouping evaluation sheet when building teaching case film.	<ol style="list-style-type: none">1. Edit teaching case film, then statistics and analysis the evaluation sheet of the teaching film, and the focus grouping records.2. Do the interpretation analysis.

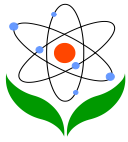
The experimental-teaching we had mention in table 1 is a teaching method when training pre-service teachers. When the pre-service teachers design their only curriculum, they will have a few problems. So when they discuss and micro-teaches the curriculum in class, find out the problems and fix the design again and again is an experimental-teaching.

Research Tools

Focus Grouping Discussion Outline

In this research, we set up three focus grouping outlines before us building the elementary school science 5Why scaffolding guided questioning teaching case film.

The first focus grouping interview focus on how to use 5Why scaffolding guided questioning method to design campus insects unit curriculum and do the teaching evaluation; the second interview emphasize on how to use 5Why scaffolding guided questioning method to do the experimental-teaching of campus insects unit



and then fill out the evaluation sheet; the third focus grouping interview focus on building the 5Why scaffolding guided questioning teaching case film and complete all teaching evaluation sheet.

Observation records of 5Why Scaffolding Guided Questioning teaching

This research use observation records of 5Why Scaffolding Guided Questioning teaching formatted by Lu, et al. (2009). The content includes two assessment dimensions: 5Why scaffolding questioning (depthless of 5Why questioning, effectiveness of scaffolding erection and effectiveness of drawing fishbone diagram) and subject knowledge content (establish scientific concept and the effectiveness of guiding the students).

Teaching evaluation sheet (TES)

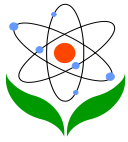
The teaching evaluation sheet was designed by Lu, et al., (2009). It was designed to assess 5Why scaffolding guided questioning teaching film that contained four assessment dimensions: main ideas, useful for teachers teaching, help students learning and willing to enforce. The content validity and reliability of the TES was built by three science educative professors and five experienced primary school teachers, the internal consistency of the TES was 0.83. The evaluation methods uses Likert 5 point scale (very poor=1, poor=2, ordinary=3, good=4, very good=5).

Results and Discussion

Curriculum Design of using "5Why scaffolding guided questioning" in Campus Insects Unit Film

Before filming the teaching case, we synthesize the relevant data from focus grouping interview record and sum up three the main ideas for the teaching lessons.

In the first teaching lesson, The Structure and Function of Insects, scholars believes that butterfly is easy for students to observe on campus and can easily describe the concepts of butterflies, for example, the butterflies can use their proboscis to sip nectar from flowers. Mentor teachers disagree with scholars, they indicate "Proboscis are hard for students to observe and needs teacher to build their thinking scaffold." This confirms the first concept of the teaching film, introducing the insect's mouthparts, the diversity of insect's food and their relationship.



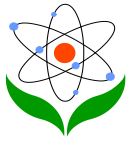
Second, introduce the life cycle of butterfly and cricket in the insect's life cycle lesson. Scholars believe that if students can raise their own butterflies, student can observe butterfly's life cycle easily and make an induction from their observations (figure out the four different life cycle stages of butterfly). But the mentor teachers consider that there are two types of insect's incomplete metamorphosis, paurometaboly and heterometaboly, which student might be confuse and confound form holometabolism (complete metamorphism) which butterflies are.

Third, mentor teachers deem "Students are easily to observe grain white butterfly (*Pieris rapae crucivora*) in spring. If teachers can use 'Why is there so many grain white butterfly on campus' as the topic for the lesson, students will start to notice problems between insects and ecological system in the lesson of Campus's Insects.

In the focus grouping interview one of the scholar consider that "When teachers need students to find and classify the main reason, the mentor teacher can use fishbone diagram in teaching. This not only can guide by teachers and done with all the students, but also the mentor teacher can show the student teachers how to guild students when teaching.

Table 2 Campus insect's unit curriculum design using 5Why scaffolding guided questioning teaching method

Teaching activities and objectives	Presentation of curriculum design
1. Structure and Function of Insect Example: Insect mouthparts is related to their food 1-1 Understand the diversity of insect's food 1-2 Understand insect's mouthparts is related to their food	1. Teachers lead students to observe butterflies mouthparts construction in campus and explore how butterflies sip nectar as food. 2. Teachers guide students to observe how the mantis eat cockroaches, and guide students to observe mantis's mouthpart using 5Why scaffolding guided questioning teaching. 3. Teacher's question: According to the food of this insect, what kind of mouthparts of the insect might look like? If students didn't know how to answer the question, then teacher can used insect like butterflies and mantis as an example to lead them thinking. This improves them to think and answer that the butterflies has straw mouthparts to sip nectar, and mantis has chewing mouthparts to help them eat cockroaches.
2. Insect's life cycle Example: Grain white butterflies (<i>Pieris rapae crucivora</i>) and cricket 2-1 Comprehend the growing	1. Teachers let students to raise their own grain white butterflies and generalize the stages of their butterfly (holometabolism). 2. Students observe crickets' life stage on the video and inductive inference its life stage (incomplete

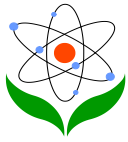


<p>process of butterflies and crickets</p> <p>2-2 Comprehend there are different kinds of life cycle when insects grow from larva to adult</p> <p>2-3 Understand the meaning of pupa</p>	<p>metamorphosis).</p> <p>3. Using 5Why scaffolding guided questioning teaching to comprehend the different life cycle stage of grain white butterflies and cricket.</p> <p>4. Students can conclude that life cycle stage of grain white butterflies has pupa stage and cricket life history hasn't.</p>
<p>3. Campus's Insects</p> <p>Example: Explore learning experience of how to plant cabbage and raise grain white butterfly</p> <p>3-1 Record the place that you saw insect</p> <p>3-2 Recognizing insects living environment, while observing its behavior</p> <p>3-3 Take care of an insect, and realize the importance of maintenance its living environment</p>	<p>1. Teachers use 'Why is there so many grain white butterflies on campuses as the topic for the lesson and guide student group to discuss.</p> <p>2. Students draw the big bone of fishbone diagram and classify the main reasons.</p> <p>3. Each group discusses their idea, put on the bone and small bone of fishbone diagram and reports their ideas to others.</p> <p>4. Teachers guide students to search for the real reason basic to their current situation; and use falsifies discussion to delete the incorrect reason.</p> <p>5. Teachers write down the main reason of the question on blackboard and re-organize the solution of it.</p>

Table 2 shows that how we design the campus insects unit with the 5Why scaffolding guided questioning teaching method, and the teaching steps that we're going to present in the teaching case film. For example, while introducing insect's mouthparts in the structure and function of insect activity, the 5whys are shown in table 3.

Table 3 5Why Examples of the Structure and Function Activity

Why questions		Scaffolding thinking directions
1why	What does the insect's mouthpart do?	Is there something that is related to the mouthparts?
2why	What is the relationship between food and the mouthpart's appearance?	Think again, what do butterflies eat?
3why	If the butterfly has to sip nectar as food, what do you think the butterfly's mouthpart appearance look like?	
4why	If the mantis eat crickets, what do you think mantis mouthpart look like?	If the mosquito bites people, what do you think that mosquito's mouthparts look like?
5why	Do all insects have the same mouthparts? Why?	

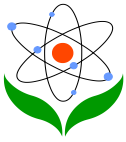


Situations occurs decision making: fishbone diagram, method of falsification and problem-solving strategies

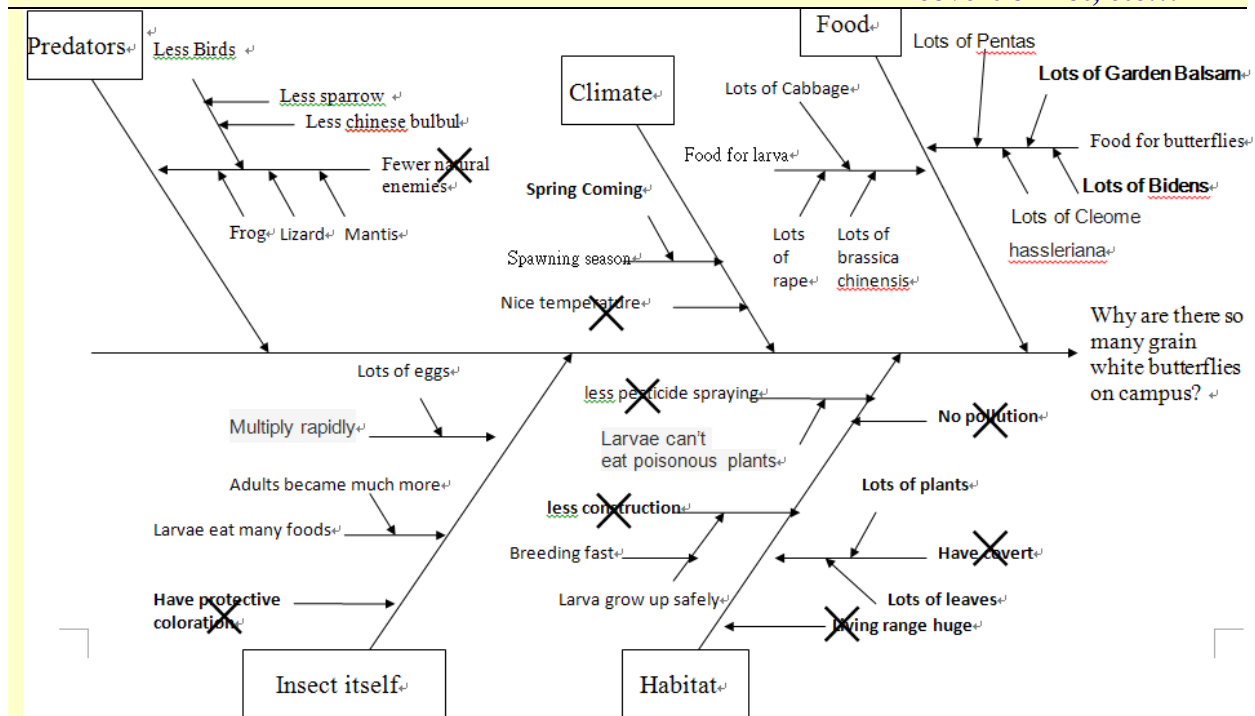
Comprehensive focus grouping interview suggestions from focus grouping 20100423: First, mentor teachers lead pre-service teachers to find the main reason when drawing big bone in fishbone diagram and give some direction for students to discuss. Second, teaches needs to give enough time for students to discuss which need lots of extra times when doing method of falsification, so teacher needs to adequate prepared of the topic content, scaffold erection timeliness and let students to find the basic reason of the problem.

Table 4 Teaching Analysis of "Why are there so many grain white butterflies on campus?" by using fishbone diagram, method of falsification and problem-solving strategies

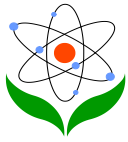
Teaching spindle	Teacher's questions and guidance	Student's answer and response	Final Conclusion
1. How to classify the main reasons in the big bone	Ta: Give some reasons that might affect the numbers of grain white butterflies? Can we divide the reasons into several parts? Ta: What living environment affects might happen to it? Ta: Now we are talking about grain white butterfly, so what kind of thing should we discuss and write?	Sa10: Food Sa21: Environment Sa4: Habitat Sa24: Insect itself Sa2: Grain white butterfly itself...	✳️ The final conclusion of the main reason includes food, preferred habitat, insect itself, climate and natural predators and enemies.
2. Teach how to draw fishbone diagram	Ta: Now we are going to try to put the most important reasons and affects near the fish head bone. Ta: The first one is "food". Is there any objection? Ta: What is the next one?	Sa2 : The food is important. S _{most} : No. Sa23 : Habitat.....	✳️ The most important factors puts from right to left on the fishbone diagram's main body, followed by food (what to eat), preferred habitat, climate, insect itself, natural predators and enemies.



<p>3. Each group discuss about their bone and small bone, and share with others</p>	<p>Ta: This is the fishbone diagram from the second group; can you tell or add something in their fishbone diagram? Ta: Is there anything to add in the "grain white butterfly itself" bone? Ta: What is the main reason in "breeding season"? (Point out the question)...</p>	<p>Sa3: We can add spawning season. Sa7: Because there are many leaves plants and falling leaves. Sa9、Sa22: Habitat has to add with non-pollution Sa23: Adult insect's food includes garden balsam and <i>Pilose Beg Garticks</i>.</p>	<p>✳ Teachers and students discuss if there are any effects which needs to add in the diagram.</p>
<p>4. Delete the wrong factors</p>	<p>Ta: Is there any reasons which are not the main ones? Ta: Does others have other opinion? (Teacher deletes protective coloration.)</p>	<p>Sa7 : Protective coloration. You can also take a closer look to find it. S_{most} : No.</p>	<p>✳ After falsify the fishbone diagram, many reason has deletes, like protective coloration, fewer natural enemies, less construction, no pollution, less pesticide spraying, Nice temperature, have covert or not, etc...</p>



In the end of this lesson, the student not only know that planting Brassica plants in spring can attracted grain white butterfly spawning on campus, also know that we can observe grain white butterfly's life cycle in campus.



In the curriculum, the mentor teacher wishes the students has the ability to solve the problem their facing. The mentor teachers ask a simple question during the curriculum, let students to fine out the answer of the question, and make student able to understand why we're planting Brassica plants in spring. When we show this in the teaching film, we wish that the student teachers can also learn mentor teacher's teaching method.

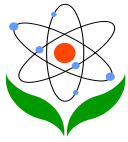
Views from teaching evaluation sheet

We summed up the observation records of 5Why scaffolding guided questioning teaching and the data we had collected containing the views of four senior teachers who teach insect unit in school, four college professors major in Entomology, from teaching evaluation sheet for teaching case film (see Table 5). The table shows that most of the teachers and college professors think that the teaching case film carries out the 5Why scaffolding guided questioning teaching strategy in science teaching and is useful for science student teachers which science teaching ability can be enhanced.

Table 5 Views of teachers and college professors from teaching evaluation sheet for teaching case film

Teaching evaluation item	Mean score	SD (Standard Deviation)
Main ideas The aim of building the teaching case film is to introduce the model of how mentor teacher teach the science lessons, and help other teachers build their professional development support system.	4.5	.63
Useful for teachers teaching Using 5Why scaffolding guided questioning teaching method to teach students, teachers should simulate students' idea in advance.	4.5	.59
Help students learning Guide students to draw fishbone diagrams to identify the main cause to a problem, help students continued exploration and get their respond.	4.3	.61
Willing to enforce This teaching case film can present the steps and techniques of "5Why scaffolding guided questioning" teaching; every teaching stage has shown with special word lines in the film.	4.3	.69

Discussion



In this study, we try to build a teaching case for student teachers to learn how the mentor teachers teach the campus insect unit. Shulman (1992) had mention that teaching case method can teach the student teachers how to face the problem when teaching students, and how mentor teacher guide students to solve the problem and make the final conclusion. Building the teaching case film for student teachers can let them observe the 5why teaching method. But how do we know if the teaching case reaches student teacher's needs? And after the teaching cases were viewed, the student teachers gave feedback and do an experimental-teaching, in which they stated that prior to this research project, they were aware of the benefits that could be obtained through 5Why scaffolding guided questioning teaching. After the experimental-teaching, the student teachers can discuss the problems they have and give feedbacks again to the mentor teacher, which the mentor teacher can teach them, the teaching skills and improve student teachers teaching ability.

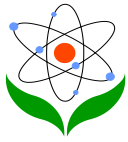
In this study, an achievement test about the topics of "Force" and "Movement", a behaviour control list about the same subjects and interview text documents were used. While the students' academic skills were tested with the achievement test, the behaviour control list was used monitor the students' behaviour in order to check whether the results obtained from the quantitative analysis were accurate or not. The effectiveness of the teaching method was tested by comparing the mean scores of the experimental and control groups. In addition to this, face to face interviews were held with 19 volunteering students from the experimental group to get their views about the method and materials used.

The teaching cases have been evaluated using the evaluation from, and serve as exemplary teaching models for student teachers. When student teachers facing an inquiry-teaching and don't know how to ask the question, this teaching film can present how mentor teachers ask question for students to think, guide students to look into the causes using fishbone diagram, and let students became more engaged and interested to the subject content (Lu, et al., 2008).

Conclusion and Suggestion

Conclusion

Curriculum design of the teaching case film



In this study, we design a curriculum that can present 5Why scaffolding guided questioning teaching in accordance with the pre-service teachers teaching needs. The curriculum design emphasize on questioning students by 5why. The questions of 5why make a deep question during the curriculum. When students can't answer the question, the teacher gives them a direction, and then the students can try to explain and conclude the answer, for example, students can draw out the mouthparts according to the foods insect eats.

Experimental-teaching of the teaching case film

Experimental-teaching focus on the techniques when using 5Why scaffolding guided questioning to teach. The techniques includes: 5Whyquestioning techniques, scaffold erection, fishbone diagram, and method of falsification and problem solutions. When the pre-service teachers do the experimental-teaching, they can find the difficult they have and give feedbacks to the mentor teachers. Then the mentor teachers can give them some advice and help them to fix the problem while teaching.

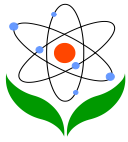
Building the teaching case film

Teaching case film describe its curriculum design philosophy from the beginning, includes: 5Why scaffolding guided questioning, fishbone diagram, method of falsification and problem solving teaching. When building the teaching film, we take notes of the words and the video. We have edited the lines and zoom in the pictures that we're going to show to the pre-service teachers. We also illustrate the contents of 5Why scaffolding guided questioning. To enhance the quality of teaching case film, the film has shown mentor teacher's teaching key point and special word lines in the film, like 5Whyquestioning, scaffold erection, etc... for student teachers to learn and watch.

Suggestion

Using 5Why scaffolding guided questioning case to train pre-service teachers

After using "5Why scaffolding guided questioning" teaching case film when training pre-service teachers, teachers can discuss every aspect of the content and meaning of the teaching, imitate after complete understand, do curriculum design and teaching. In this case, researchers recommended users to assort with



micro-teaching or elementary school practical teaching, so pre-teachers can enhance their teaching skills.

Using Internet platform to conduct "5Why scaffolding guided questioning" practice

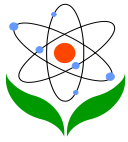
As the Information system progress in this century, people can attain all kinds of information quickly which reduce the distance and shorten hours by using internet. In our research, we place the 5Why scaffolding guided questioning teaching case film on the Internet platform, so that pre-service teachers can directly download information, have dialogue with mentor teachers or class professor any time which can receive discussion and response fast and obtain their solutions to problems quick and directly to improve their inquiry teaching.

Acknowledgments

We appreciated the funding supported from National Science Council, Taiwan, R.O.C. (NSC98-2511-S-152-010-MY3; NSC101-2511-S-152-010-MY2), veteran in-service teachers who participants in study, professors who helped to establish the reliability and validity in this study, and last but not least, the NTUE study group.

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