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Examining teaching orientation challenging subject in the 21st century regarding cell biology

Nunnapat Thilaworrakan[1], Ladapa Ladachart[2]

[1]Doctor's degree student of Science Education, Faculty of Education, Chiangmai University, [2]Department of Curriculum, Instruction & Learning, Faculty of Education, Chiangmai University

nunnapat_ph@cmu.ac.th

Abstract. Advances in science and technology the educational paradigm has been transformed into constructivism, a changing context, so the nation's people's resources must be prepared as soon as possible. Therefore, education must focus on people thinking about being and solving problems, the teaching needs to be adapted from passive learning to active learning, focusing on students being able to analyze and seek their knowledge. Teachers as an educational profession need to be aware of their teaching methods. This research report aims to study the teaching beliefs of biology teachers on specific topics as part of pedagogical content knowledge (PCK) is considered necessary for teaching science teachers. The researchers collected data from a sample of 10 biology teachers using a measure of faith in biology, improved from Cobern *et al*. (2014). According to the research, teachers believe in teaching between active direct and guided inquiry, but when conducting an interview, the majority of teachers use didactic teaching models. This research reflects the reality of teacher teaching and the challenges that go through the country's educational crisis into the 21st century.

Keywords. Pedagogical Content Knowledge, Teaching Orientation, Biology Teachers

Introduction

Educational management could be considered as an important factor in the production and development of quality human resources; therefore, it has the potential to compete in driving sustainable development sustainably in every field of the country, which in line with the entry to the 21st century that is changing according to the global trends caused by advances in science, technology, and information. The educational management must focus on the students in learning, practicing, and inspiring at the same time. Students must practice learning from practice and pursuing knowledge by themselves (Active Learning) with the teacher helping the students to achieve those results, one of the importance is that teachers in the 21st century must seek knowledge along the way together with students. If there is a need for the student to have a high learning potential, teachers in the education system must also have a high quality. As Organization for Economic Co-operation and Development (2012) established teachers' characteristics in the 21st century, to sum up, it could be concluded that teachers must be more knowledgeable, be professional, have high capability and potentiality, have innovative teaching for students to get the desired learning result, and prepare students for entering the

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reality of working in the 21st century. Consistent with the Thai Education Reform (2014) which has proposed strategies for teacher development by promoting professional standards for teachers and educational personnel for teachers to change their teaching that leads to learning in the 21st century.

At the same time, the 21st century could be considered as an era where the world is highly competitive, so science education is one of the top factors that should be developed. If the science education management's quality could help improving skills in the 21st century such as helping a high level of thinking skills development, problem-solving, including, communication and cooperation; especially, if learning to gain an understanding of the nature of science and encourage the practice of scientific processes (Nuangchalerm P., 2015; Pitiporntapin S., 2015). Thus, it could be said that the quality of science education is very important in enhancing skills in the 21st century.

Scientific Literacy is considered as the primary goal of educational management, and it is acknowledged that science education is of paramount importance; therefore, educational reform is to be in line with scientific literacy. Scientists are interested in the development of science curriculums so that educational arrangements for students come to be concrete by the concept of scientific knowledge. And they have summarized the definition as "the ability to perform scientific processes and contribute meaningful scientific information in daily life" (Five, Huebner, Birnbaum. and Nicolich, 2014). Same as in Thailand, Science Literacy is a part of education management for the 21st century, which requires all students to be developed to comprehend science relied on the search for knowledge (Bureau of Academic Affairs and Educational standards, 2010). From the policy mentioned educational personnel needs to change the teaching to be consistent which would lead students to become aware of science. An important issue that teachers must be aware of is teaching methods and knowledge content that must be integrated to transfer to students or what is called Pedagogical Content Knowledge to made students be able to think, be able to do, and solve problems.

Science education researchers turned to realize that the science teachers' knowledge from the current situation, it is found that science teachers still do not have access to a truly scientific methodology. Does this research require finding the biology teachers' teaching orientations in how is its quality? How do those orientations affect knowledge, content, and teaching methods? Is it consistent with changing to the 21st century? To find ways to develop science literacy in Thailand.

Theoretical framework

1. Pedagogical content knowledge: PCK

Shulman (1986) presents the concept of Pedagogical Content Knowledge as an element of a knowledge base for teaching and learning. The main element of the Shulman concept of Pedagogical Content Knowledge: (i) knowledge about the representation of specific content and teaching strategies, and (ii) understanding of learning problems and students' concepts in specific content and proposed ideas of "The paradigm that is missing in the teaching and learning researches". Shulman calls that missing paradigm as the unique content and the lack of interest in teaching which emphasizes two important points which are knowledge and understanding in professional practice, especially, under conditions of uncertainty as a teaching profession, and specificity as a specialist. Shulman examined the evaluation questions for teacher selection. Grossman (1990) presents the components of Pedagogical content knowledge which could be summarized as follows: (i) the knowledge of students' understanding and misconceptions in the subject being taught (ii) the knowledge regarding teaching strategies and presentation of the content of the teaching (iii) the knowledge about the purpose of teaching in

specific content that focuses on (iv) the knowledge in courses and equipment or learning resources in the curriculum. Grossman's concepts focus on the value of content knowledge in curriculum development and organized the composition of the teachers' knowledge base with three important components that combine to be the Pedagogical content knowledge; consisting of specific knowledge in subjects, general knowledge about teaching, and contexts such as teachers and school. Magnusson, Krajcik, and Borko (1999) presents elements of the Pedagogical content knowledge in science including (i) orientation of teaching science (ii) the knowledge of student's understanding of science (iii) the knowledge of science curricula (iv) the knowledge of assessment, and (v) the knowledge of instructional strategies. From the above elements, beliefs in science teaching may affect the teaching and learning of teachers. Gess - Newsome (2002) describes the elements of Pedagogical content knowledge could be summarized into 3 parts which are content element (Subject matter), teaching strategies content (Pedagogy), and context content (Context). Teachers could develop Pedagogical content knowledge by promoting development in every three fields; however, there are many levels of explanations of Pedagogical content knowledge methods. Veal & MaKinster (1999) has divided into three levels which are (i) subject level (Subject-specific PCK) (ii) program level (Domain-specific PCK) and (iii) Topic level (Topic-specific PCK), which in each level would be specific, descending order; however, knowledgeable teachers need to adapt Pedagogical content knowledge methods to be suitable for their students and their context.

2. Science Teaching Orientation

Magnusson, Krajcik, and Borko (1999) classified orientations in scientific teaching into nine categories: 1) process 2) academic Rigor 3) didactic 4) conceptual change 5) activity–driven 6) discovery 7) project-based science 8) inquiry 9) guided inquiry and explain different orientations such as the process for helping students develop science process skills, academic rigor for presenting scientific knowledge, didactic for transferring scientific facts, conceptual change for changing incorrect concepts, activity-driven for students to participate in activities by taking action and inquiry for students to explore science. Cobern *et al*. (2014) developed a test to study the teaching orientations in four types, namely, 1) didactic 2) active direct 3) guided inquiry 4) open inquiry. Friedrichsen *et al*. (2011) conduct a study of the orientations of science teachers which found that teaching beliefs of some teachers' types are evenly matched. Kind (2016) studied science teacher students and found orientations in teaching science into five types: 1) didactic 2) academic rigor 3) activity-driven 4) conceptual change 5) inquiry. In Thailand, most science belief studies are found in the production of pre-service science teachers such as Faikhamta C. (2013) found 5 types of orientations which are science project, guided inquiry, activities, and discovery. Ladachart L. (2019) studied 50 first-year biology teacher students found that most students have orientations between active direct and guided inquiry. Ladachart L. (2019) conducts a study of 10 third-year biology teacher students; the majority of students' orientations were guided inquiry. The answers of student teachers vary according to the context or situation of each question, but there are still a few studies of teaching orientations of in-service teachers in Thailand.

3. Scientific inquiry

Scientific inquiry is a diverse activity that involves observation, questioning, and verification from sources in books and other sources; to be aware of various things in terms of experimental evidence, the use of data collection tools, data analysis, interpretation, suggestion, description, prediction, including and communication which needs to use assumptions, critical and logical thinking, and consider other explanations (NRC, 1996). Scientific inquiry is both a

teaching method and a way for students to explore the world (Carin and Bass, 2001). It may be a simple question, but be careful with the world and attract students to answer questions. The seek for knowledge consists of using activities to learn the actual practice and processed activities for the benefit of knowledge creation. Searching for knowledge encourages students to connect their knowledge with observations and use these observations as evidence for further scientific knowledge of each individual. In this teaching environment, teachers act as facilitators of learning. Scientific inquiries are guidelines for understanding scientific content (NSTA, 2004). Students learn by using questions and use the evidence to find the answer, in the learning process, knowledge acquisition strategies are used by the students learn from the examination and gather evidence from various sources and the explanation has been developed from that information, including communication and dispute to conclude. Flick and Lederman (2006) extends scientific inquiry into the fundamental principles of modern science that they are diverse processes and thinking methods that support the development of new scientific knowledge, aside from scientific practice. Scientific inquiry includes the process that scientists use to develop knowledge which is a characteristic of science itself. Therefore, the scientific inquiry could be considered as the results of different students such as abilities related to scientific processes and knowledge about various processes. Bell et al. (2005) divide the level of scientific inquiry into four types 1) confirmation 2) structured inquiry 3) guided inquiry 4) open inquiry. Lederman (2009) has divided the levels of scientific inquiry as follows 1) exploration; is a form of surveying problems, steps and correct interpretations, confirmation of principles through activities that are known of future operations. 2) direct inquiry; is a form of direct investigation for knowledge with problems and steps that students would receive directly, in this type of activity, students would examine the problems presented by the teachers using the steps established by the teachers. Students have the opportunity to develop their conclusions by analyzing the data and using the pieces of evidence for conclusions. 3) guided inquiry; is a form of inquiring for knowledge, suggesting questions, or research problems for students, in which, and students would develop their methods and processes. 4) open-ended inquiry; is an open form of inquiring for knowledge, in which, there are open methods and solutions. The goal is for the students to have full responsibility for all aspects of the inquiring. These activities involve creating one self's research questions; it is the process of developing skills in answering questions, researching, collecting and analyzing data, including using evidence to make one self's conclusions.

Scientific inquiry is the main goal of science teaching (NRC, 2012) and it is used in science education (ABD-El-Khalick et al., 2004) which is recognized in the teaching of science. The Institute for the Promotion of Teaching Science and Technology (IPST) and OECD (2012) have recommended science teachers to teach using the concept of self-knowledge (constructivist) such as inquiry-based learning, project-based learning, and problem-based learning, which require the inquiry to be a guideline for students to allow doing as specified in the Basic Education Core Course (2008) "aims for students to learn science that focuses on linking knowledge to the process, having important skills in researching and creating knowledge using the process of searching for knowledge and various solutions". In the Thailand context, scientific inquiries are not prevalent in teaching and learning (Dahsah & Faikhamta, 2008). Many teachers have an understanding of teaching and learning by searching for incorrect knowledge. The inquiry is to follow various predefined procedures without a real understanding of that practice (Ketsing J. and Roadrangka V., 2010).

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Research method

The method of this research is a mixed research method (Creswell and Plano Clark, 2011) found quantitative data and qualitative data by measuring from the orientation in teaching and answering questions from the knowledge of Pedagogical content knowledge methods, as well as interviewing for information. In this research, the researcher used interviews and teaching observations as the main facts to obtain clear information, which would truly help explain the teachers' orientations.

Participants, 10 active teachers teaching biology, one male and nine female, in a secondary school in the north; aged between 25-40 years, of these, there are four case studies. The interviews, these teachers have received training in teaching such as animal specimen collection, the study of animal physiology and anatomy, the development of biology teaching media, the use of technology in learning management, biology teaching, biological STEM, and using a microscope, and there are lesson plans based on the guidelines of the Institute for the Promotion of Teaching Science and Technology (IPST).

Research instrument, instruments used in this research are orientation tests in biology teaching about cell biology with improvements from Cobern *et al*. (2014). The test was to create a situation for the participants to choose four multiple-choice options and explain 12 reasons, which involves content and concepts that consist of a cell structure, a cell division, cell transportation. In the questions, there are situations related to the step into the lesson, the lesson, and the conclusion of the lesson; in which the situation is specified. How would teachers choose the method of teaching?. This research is conducted with active teachers who have teaching experience; the researcher did not have the objective to use the results from the test to interpret the teacher's orientations, but only required to see the beliefs in teaching that teachers want to happen in their classrooms. In this teaching orientation test, each answer represents four types of teaching orientations, which are 1) didactic 2) active direct 3) guided inquiry 4) open inquiry, which is a tendency that science teachers would use in organizing teaching and learning activities. This test is used by many researchers to study pre-service teacher students (such as Ladachart L., 2019; Ladachart L., 2019). The use in in-service teachers (such as Ramnarain et al., 2016), in each question, the researcher designed the situation in the classroom to resemble a real school event that the student had to experience such as experimental research, in which the researcher requires the participants to choose the answer as well as providing reasons and confirming the results of teaching orientations from another interview. The characteristics of this improved tool by the researcher, the researcher used this experiment with five biology teachers who were not samples. In addition, the researcher also used the Pedagogical content knowledge methods on students' understanding, curriculum, instructional strategies, and the assessment, to assess the orientations by using the framework of Pedagogical content knowledge methods of Magnusson, Krajcik, and Borko (1999).

Data analysis, researchers use voluntary research from the participants because this research is a collaborative work of researchers and researchers must be ready to exchange knowledge, moreover, be open to accepting changes in one are teaching orientations. The participants may have their ideas due to their teaching experience and may not accept the changes; therefore, the researcher, has to ask for voluntary consent from the biology teacher in this study and ready to work with them to develop their orientations in science teaching.

In which the researcher has brought the test of pedagogical content knowledge methods five tests: 1) the test of teaching orientation on cell biology 2) the test of knowledge and beliefs about the understanding of students 3) the test of knowledge and beliefs about teaching strategies 4) the test of knowledge and beliefs about curriculum and evaluation. Participants answer the question in the test using one month to receive the most information, then, the

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researcher used the interview form to interview the teachers who studied the subjects to check the pedagogical content knowledge methods in each teacher. Therefore, this research is a combined research and there is reflective coaching. The researcher searched for teaching orientations based on the answers of the participants in the truth, not looking for the static value of faith; but, if it is just a way to consider the tendency of that orientation, the sample consisted of 10 biology teachers and four case studies.

Data analysis, the researcher analyzed by translating the answer of the data into numbers according to the level of orientation in teaching science from low to high, by rating, didactic (1 point), active direct (2 points), guided inquiry (3 points), and open inquiry (4 points); brought each score to the percentage and the average of those orientations, then, analyzed the reason for the answers given by the participants in the method of analysis in individual orientations in terms of teaching.

Results and Discussion

The purpose of this research is to answer 2 research questions which are 1) how do biology teachers orientation in teaching regarding cell biology? 2) how do orientations and pedagogical content knowledge affect each other?.

The first question: How do biology teachers orientation in teaching about cell biology?

From the use of orientations in biology teachers' teaching by using simulation to introduce the lessons, teaching steps, and the summary lessons regarding cell biology found that; biology teachers have the orientation in teaching at introducing the lesson step, most of the samples are guided inquiry; while, there are still open inquiry, and active direct. Two participants have orientation in didactic. The orientations in the teaching steps, most of the samples were a guided inquiry and open Inquiry, but five participants have active direct; therefore, two participants have orientation in didactic. In summary, step, when the orientations of a biology teacher were analyzed, the sample found that most of them are active direct; moreover, there is a guided inquiry and open inquiry, only one participant has an orientation in didactic.

From the analysis of the answers of the samples in the test of teaching orientation on cell biology, the results show that the average score of each person is in the range of 2.40 - 3.50; and the mean score of all samples is 3.01. An example analysis of teaching orientations about microscope (figure 1) could indicate trends in orientations that the participants believe in teaching during the active direct and guided inquiry. However, the didactic and open inquiry was still evident in the results of the analysis of the statistical values obtained. The researcher did not focus on using it to interpret the orientations in the teaching of the samples but must have an interview to get visual information. The interview found that most of the sample teachers had didactic orientations.

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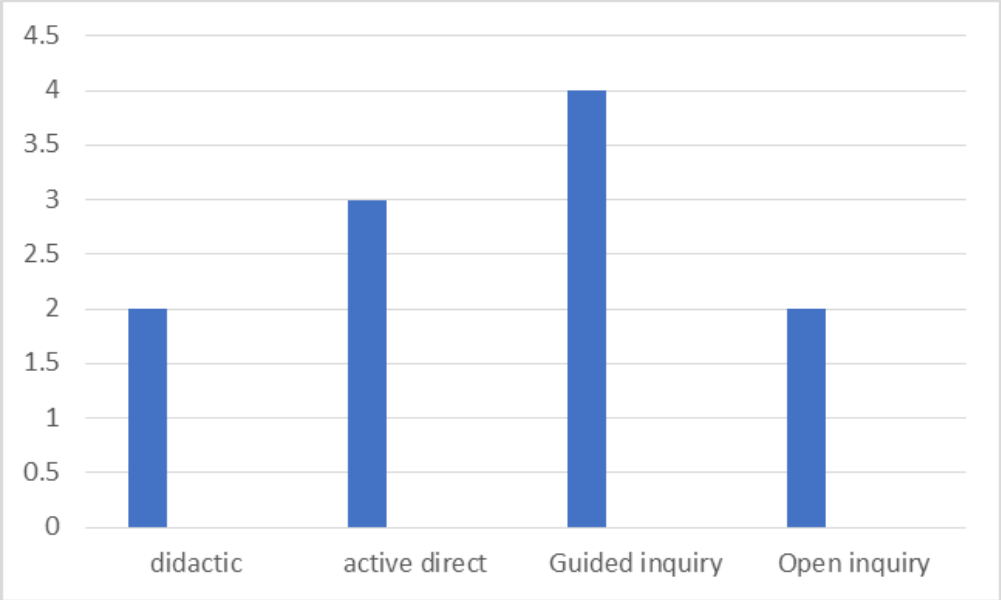

Figure 1: Teaching orientation - microscope

The second question: How do orientations and pedagogical content knowledge affect each other?

From using the pedagogical content knowledge methodology that the researcher created, it able to analyze each side from the text that the teachers gave in the pedagogical content knowledge methods as follows;

1. Knowledge and belief in students' understanding

Mostly, nine teachers have knowledge checking by using questions, using tests, stimulating students' opinion expressing. There is one teacher who provided examples daily and students are given examples, while teaching, the teacher found the students had incorrect concepts. The students understand that cells are the smallest unit of life that could convey the characteristics of life. Students do not understand the meaning and role of the cell, but they understand that cells are living things. There are corrections to the wrong concepts that occur, the teacher shown the video clip about the living unit to the students to watch, along with class discussions. The teacher reviewed the composition of cells from subunits to large units for students, which created new knowledge for students and ask for true knowledge with students, using to practice about cells for students to understand; or using real media to compare children such as ostrich eggs. In case of cognitive conflict, teachers have guidelines for creating new knowledge (construct). Most of the teachers asked the students to watch picture videos about the content and asked questions, then, explained to add in the content to understand the correct things.

The teacher painted the picture with explanations; there is one teacher who allows students to search for images that are correct concepts by themselves. From the concept of construct the knowledge (constructivism) which could not yet occur. It could be seen if the students have an incorrect concept, teachers often re-teach with lectures and repeatedly asking questions.

2. Knowledge and belief about the curriculum

Teachers have an understanding of the curriculum as follows: the teacher must have a goal for the students to be able to remember and understand more about biology. It should be a long-term memory for students and could be used in daily life, given that learning management is important to students that they can create knowledge. Students are knowledgeable,

understanding could explain and practice. Teachers reference the use of curriculum or textbook of the Institute for Science and Technology.

From the science curriculum of the Institute for the Promotion of Teaching Science and Technology that teachers use as references; the researcher found that teachers use the curriculum guide as a guide to writing lesson plans, but was not used. The curriculum still focuses on knowledge of content, as could be seen from the indicators specified for the students to understand, explain, state methods and search for information about the content. Therefore, it makes teachers understand that they must describe to the students to remember, understand and explain, and to be correct according to the content.

3. Knowledge and belief about Instructional strategies

Most teachers have lectures, including demos and the experiment uses the ATLAS 5E teaching strategy sometimes. There is one teacher using activity management by guiding and keep summarizing the knowledge at the end. Three teachers are using scientific inquiry. The teachers still useless scientific inquiry and they understand the meaning of the discrepancy that the scientific inquiry is searching.

4. Knowledge and belief about assessment

From the analysis of the responses of the sample, it was found that teachers evaluated according to the objectives of the cognitive domain (K), psychomotor domain (P), and affective domain (A), all three dimensions are tested before learning and after learning. There is a ranking or grade based on criteria, using technology to check the answers of students. Teachers have specified the competency of the students in the lesson plan which is an important skill, but it could not be measured.

When interviewing and analyzing the results of the case subjects, the results appear as follows;

Suda, a female aged 34 years having a bachelor of education with 10 years of teaching biology experience. She graduated from the Faculty of Education (biology teaching). Understanding students, she thinks that teaching about cells is difficult to convey to students because sometimes when teaching until the end of the lesson, students asked the question: "Where is the cell?". Therefore, allowing students to watch the media or animation, but when the students found the actual test; they could hardly imagine. Students often remember alternating stories about organelle, and the students often remember the patterns of specific cells, plant cells, and animal cells. Suda supports students to do experiments, practice observing, setting problems, hypotheses, experiment, and summarize by themselves. There is a good learning atmosphere such as giving a friendly opinion to students and asking and answering creatively. She found that the students have discrepancies, such as the use of specific terminology of cells, the characteristics of cells. In teaching strategies, there is a teaching goal set in the lesson plan. She has to teach, starting with things near the students, then, connect to the content. Students would get the main concepts, remember content, and apply it in daily life. Most of them are in a narrative style, but there are times when activities that involve students, such as asking students to come out to write a board or use media applications. The teacher has some teaching problems, such as teaching about the breakdown of nutrients at the cell level; in which the teacher spends five rounds of teaching, but the students still do not understand. Regarding the curriculum, she has an understanding about the curriculum that the curriculum involves studying biology, and scientific methods: using various experimental activities. The important subjects are microscopy, cell division, chemical reactions in cells, cell structure, conveying cellular respiration, and the use of the searching process for knowledge by using the curriculum set by the Institute for the Promotion of Teaching Science and Technology (IPST). Suda focuses on the students to have knowledge, understanding, and love in biology, apply

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knowledge in daily life, and be able to use it for the examination. In terms of evaluation, teachers have 15 minutes time limit for students to use mobile devices, in which the students analyze and discuss together within the group; then, take the test on the phone in the lesson at the end of the class, the teacher would use questions to bring to the conclusion. After that, the knowledge would be checked from the exercises at the end of the chapter.

Wipa, a female aged 36 years old with a master's degree from the faculty of Education biology teaching experienced for 12 years. In understanding students, Wipa found the students understand that the cells were only plant cells and animal cells, and all organelles in plants and animals are all the same. The concepts that Wipa thinks that students barely understand are hormonal because there is a lot of content, unable to visualize and there are not many memory techniques. As for the matter about cells, at first, it is difficult because the students have a wrong concept; Wipa has encouraged the students to memorize and learn techniques to understand. Wipa has to understand their understanding before studying, and she found that the students have incorrect ideas about the composition of cells. For teaching strategies, in the beginning, teaching was considered difficult, but once the experience starts; there is a technique to remember, and focusing is easy. Mostly, it would use the format of the lecture slide. Some inquiries of knowledge are used to stimulate students' thinking by distributing worksheets, then, the students summarize by themselves. There is a learning management process that is student-centered, allowing students to design their studies and doing group process by oneself. Wipa has students designing and creating the cell model by themselves by using equipment in daily life or as waste products; some groups made it into 2D, and some made it 3D and using activity sets, worksheets, and textbooks as well. In terms of curriculum, teachers have an understanding about the curriculum that activities must be organized with content that should be consistent with the content of the core curriculum, but the organization of activities should be different according to content and students. Wipa has to create lesson plans, identifying goals, and objectives divided into a cognitive domain (K), psychomotor domain (P), and affective domain (A). Focus on students to understand the guidelines of the cognitive domain (K), psychomotor domain (P), and affective domain (A); and to focus on scientific process skills psychological science. For an evaluation, it was found that the evaluation according to the objectives in the learning management plan. There is a post-test, but no pre-test because the knowledge would be checked before studying in the textbook.

Pimjai, a female aged 34 years with a master's degree in Faculty of Science and Education Biology teaching, experienced for 6 years. In understanding students, the concepts that Pimjai thinks might be hard for students are to understand chromosome concepts. As for the transporting cells, the students understand; but when analyzing the exam that linked to maintaining balance or excretion of the kidneys, most students could not do it. Teachers have to support, giving guidance, and creative activities for students to study. Media technology is used in organizing activities to enable students to participate in activities. She found that students had errors in mitosis and meiosis, and they often remember the opposite of the two. For teaching strategies, the teacher provides lecture teaching, using explanations, demonstrations, experiments, and arranges a variety of activities for students to practice (active learning). There is a learning management process that focuses on the students by allowing the students to participate in Activity, also, there is a course for learning and searching for knowledge as well. Pimjai has expectations in teaching, so students can take exams such as the national exam (O-NET) because they are responsible for this matter by trying to bring the exam to the learner to practice, but teaching at grade 10 level once they reached up to grade 12; the students might forget the exam Pimjai brought for them in grade 10. Pimjai teaches according to the teaching plan by specifying cognitive domain (K), psychomotor domain (P), and affective

domain (A); but not specifying, expect in the curriculum lesson plan. Pimjai has an understanding of the curriculum that the teacher must set the objectives according to the learning subject. For example, organize activities to suit the learning content, such as searching for knowledge, demonstrating teaching by considering the suitability of the subject to be learned, organizing teaching and learning activities to achieve the set objectives, and create a positive attitude for students in biology studying. The important content matters based on the core curriculum. The teacher has a focus on the students that they would be able to explain, understand, analyze the cells and can applied use in their everyday life. From the interviews, it is found that the students in this school tend to focus on science which is the foundation, especially, the students who study in the medical preparation plan. Students wishing to continue their studies in medical sciences, so require a strong biological foundation. The creation of a lesson plan in the form of scientific research, but not every lesson plan has it. In evaluation, there is an evaluation based on the objectives in the learning management plan, which have a test measured by answering questions, and the score of answers received from students complete the objective evaluation: cognitive domain (K), psychomotor domain (P) and affective domain (A).

Nucha, a female aged 27 years with a bachelor's degree in Faculty of Education Science (biology) experienced in teaching biology for 2 years. Understanding's students, the concepts from Nucha thinking that students hardly understand in the concept of cellular respiration and photosynthesis. As for the cell's transport Nucha think that it is not difficult because it would focus on the students to watch the video clips to make the students understand more. She has encouraged students to search for new knowledge by using questions and storytelling which is linked to studying content or allowing the students to view images that are different from the general cell characteristics encountered them. The teacher understands that in teaching about cells, students should learn about living things, the structure, and function of cells, different types of cells; in which the students should have previous knowledge about living units. At the same time, the teacher found that the students had an incorrect conception about the writing of specific terminology, and organelle's differences between plant and animal cells. Teaching Strategies, Nucha has lecture management, experiment, searching for knowledge. There is a learning management process that is student-centered, with students being able to think, search, experiment, and solve problems by themselves. There are many activities and using group processes for students to participate in each other. The nature of the research for knowledge is the teacher asks the students to search for an answer and then discuss it together in a group, to find an assumption between friends and teacher. The curriculum, Nucha understands of the course, involving, the study of biology and scientific methods, the use of various experimental activities, and use the process of searching for knowledge. Nucha has a goal for students to easily understand and applied to use in daily life. It also, wants students to like biology which is specified in the lesson plan according to the curriculum. The content and skills that Nucha understands are the studies involving living organisms that bring knowledge to be compiled into one's understanding. For evaluation, teachers have various assessments, such as giving exercises, testing before and after learning, using questions to observe behaviors, report the experiment which could measure all aspects involved cognitive domain (K), psychomotor domain (P), and affective domain (A).

The research found that the use of the orientation tests in teaching with in-service teachers may not be true because teachers may choose the best answer, but not what they do in the classroom. The pedagogical content knowledge methods of biology teachers that appear to affect the orientations of biology teachers, reflects that the teachers are still teaching with teacher-centered learning and they still have a general teaching style with general measurement

and evaluation, checking students is still just using questions, which is not able to make students truly create knowledge by themselves. Teachers continue to describe the content for students to memorize, focusing on student achievement, aiming for students to be able to achieve high scores. Able to study at university level in the health sciences, or science and technology but does not promote analytical thinking or argument like science should happen in the classroom and the important reasons that have been overlooked are that teachers tend to follow the "pattern" that their teachers have taught in the past, which is a form of lecture and writing on the board. Therefore, the teacher's orientations are still didactic.

Conclusions and Implication

The purpose of this research is to study, first, how doing biology teachers orientation in teaching about cell biology? second, how do orientations and pedagogical content knowledge affect each other?. By studying from a sample of 10 participants and analyzing from the case study of four participants. The research revealed that by using the orientation test in teaching biology the researcher created, it appears that the biology teacher's orientation in teaching between active direct and guided inquiry; and still having a didactic and open inquiry. From the observation of the teaching and the interview of pedagogical content knowledge from the teacher would reflect the didactic mainly in this regard?. The researcher found that the teachers still maintain the teaching style by describing and transferring scientific facts to the students. The specific knowledge of science is obscured, and it becomes general teaching. This may because the teachers still lack the understanding of science teaching methods that are real science. Teachers could not understand the nature of science, or even not understanding the true meaning of scientific inquiries which could be analyzed as follows:

The first topic, the main goals, and guidelines for an accepted science teaching are "scientific literacy", but when analyzed from the science teaching curriculum in Thailand, it found that specify learning results that cover content scientific process skills and 21st-century skills, including mental science. The curriculum appeared in biology as an additional science subject consisting of five subjects, which if considered did not correspond to scientific knowledge, that is used by many countries with the interpretation of science as "The ability to understand scientific processes and contribute meaningfully to scientific information in daily life" (Five, Huebner, Birnbaum. & Nicolich, 2014). Knowing science must be able to 1) explain the phenomena 2) evaluate and design scientific investigation 3) interpret scientific data and evidence (OECD, 2013), but courses in Thailand focus scientific literacy on scientific knowledge than on obtaining knowledge scientific, the knowledge lacks philosophical and natural characteristics of knowledge acquisition which focus on scientific processes and mental science; more than philosophy and nature, knowledge acquisition. The course does not reflect the scientific work. Hodson (1988) sees that what is missing from the science course is the philosophical nature of acquiring scientific knowledge which is difficult to say "nature of science" (Ladachart et. al, 2013) makes science knowledge in the Thai context changes from reality, which causing the teaching and learning management to not develop scientific knowledge. In addition, for teaching and learning management, the teachers lack understanding of the nature of science, therefore, teaching is not a true science; despite the nature of science as part of the learning standard. According to the core curriculum (2008), learning subjects eight: the nature of science and technology which have the essence of the scientific process searching for knowledge, problem-solving, and psychological science. Therefore, teachers continue to interpret the curriculum as having to focus on the process and the content that is stated to be included in other subjects, but each science subject for learning at the upper secondary education level is separated into branches, which are responsible for the teaching of

each subject, learning biology, chemistry, physics; but the content relating to the nature of science and technology has been neglected because teachers only teach content that they are responsible for, therefore, science may be reduced.

Second Topic, teachers' teaching strategies in Instruction should be aware that scientific inquiry, but the interpretation of the inquiry in the Thai context is different from the scientific inquiry. The teachers use scientific inquiry in the meaning of searching for knowledge. This may be because the curriculum specifies just a search for knowledge, but does not show the unique nature of the scientific search. Teachers do not yet have access to scientific inquiry teaching methods. Teachers often understand that the quest is for students to act on their own, so students learn from research sources with presentations in front of the class. Learning subjects in general without being scientific consistent with research related to scientific inquiry, in which the teachers have the interpretation of "inquiring for knowledge" is "searching for knowledge" (Bongkotphat, T. & Roadrangka, V., 2010). Some teachers understand that the scientific inquiry was "having students search for information, then. the teacher teaches more than the students searched" (Liangkrilas, J. & Yutakom, N., 2010). The study found that teaching and learning by scientific inquiry are still widespread (Dahsah and Faikhamta, 2008). Many teachers still lack an understanding of science teaching by scientific inquiry (Musikul K., 2007). Teachers also understand that the search is for students to act accordingly. Scheduled procedures without real understanding about that practice (Pongsophon P., 2009) and misunderstandings from their experience of science teaching (Ladachart L., 2011; Ladachart L. and Ladachart L., 2016; Lortie, 1975) when teachers interpret the meaning of the scientific inquiry wrongly. Even if the teacher asks students to use science process skills, but still following the pattern; students still do not know the reason why they need to do it. In this regard, teachers should be aware of science teaching which should encourage students to study facts, arguments, apply other situations, allowing students to assess and compare stories; to judge the most reliable by one.

Since this research is mixed-method research, obtaining quantitative data and qualitative data does not aim for the true teaching orientations from quantitative data. At the same time, this research was done with the participants, 10 subjects and four case studies which may not fully explain the orientations of biology teachers due to the orientation in teaching may change according to the context. At the same time, the orientation in the teachings of each teacher is complex which each having different backgrounds, such as previous knowledge as a student and basic learning in the Faculty of Science or Faculty of Education.

Challenging issues of Thai science teachers regardless of teaching biology, physics, or chemistry, how teachers can make changes to teaching from the traditional learning style, with teachers as the center of learning (teacher center) to the teaching that focuses on students as the center of learning (student center) by allowing students to practice (active learning). Teachers must think about learning to change or transformative learning to participate with others and reflect strongly on the assumptions that support their values and beliefs. Mezirow (1991) is used in professional development, enhancing decision-making capacity and develop science programs for teaching expertise which able to practice and develop skills, including advanced knowledge for students (Taylor, 2015); in order to achieve an appropriate learning process, and there is a reflection of what he has taught from the past to the present to improve himself. The teacher has reflected ponder oneself which may result in future actions and able to develop potential students for being a science expert in the 21st century.

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