The Efficacy of Concept Cartoons in Science Education for Eliciting Students' Argumentation

ABSTRACT

This research study aims to examine the efficiency of using concept cartoons in science education for eliciting students' argumentation in primary school. A class of 19 students in grade 6 was chosen to be the population size and three out of 19 were selected as the sampling. The research study employed a qualitative approach by using semi-structured interviews and observation checklists as a tool for data collection. The researcher used thematic analysis to analyze the data.

To see whether concept cartoons are effective for eliciting students' argumentation in science education, the researcher implemented concept cartoons four times in the process of teaching and learning in the classroom.

The findings clearly showed that argumentation was elicited when the concept cartoons were implemented during the process of teaching and learning in science education. Moreover, concept cartoons could elicit students' argumentation by provoking debate, making reasons visible, questioning, and involving in discussion.

The researcher would recommend all the future research to include a larger sample size and extend the scope of research. Moreover, future research should implement concept cartoons in different grade levels to see the effectiveness of concept cartoons for eliciting students' argumentation and use in different subjects. Furthermore, using more than four times of concept cartoons in the class should be considered to see the results of the concept cartoons for eliciting students' argumentation.

Keywords: Concept cartoons; Argumentation

1. INTRODUCTION

1.1. Research Background

The Ministry of Education, Youth and Sport (MOEYS) of Cambodia also set a plan according to the Education Strategic Plan 2019-2023 which focuses on human resources development as the first priority. Human resources development includes

four main themes and one of the four is about strengthening the quality of education, science, and technology (Educational strategic plan 2019-2023, 2019). Thus, to achieve the goals, teachers have to be professional competent, motivated and supported and adequate academic contents, and pedagogical skills are provided to the teachers. Moreover, MOYES transformed Phnom Penh and Battambang Regional Teacher Training College (RTTC) as teacher education colleges (TEC) that moved from basic teacher training from 12+2 to 12+4 to accomplish the goals because teachers play a vital role in developing human resources. Thus, when teachers full of knowledge and pedagogical skills that have been trained for four years to get bachelor in education., they will teach students well and produces a good human resource.

In order to reach the goal, teachers have to be knowledgeable and full of flexible techniques and methods in teaching which help students to achieve the learning objective. However, the new way of teaching and learning with various new methods and techniques are still limited in Cambodia for teachers to use in the classroom to make the class environment become more active, fun, instead of the traditional teaching. To respond to the vision as planned, Phnom Penh Teacher Education College, one of the best teacher education college, has been involved in teaching a lot of student teachers to become potential teachers in the future with the Bachelor of Education (12+4). There are many various methods and techniques that have been taught to the student teachers to use when they graduate and become the teacher. All these methods and techniques include Problems-Based Learning (PBL), Scientific method, Inquiry Based Learning (IBL), Project Based Learning (PjBL), Mind Mapping, and Concept Cartoons. These methods and techniques have their own potential in learning and teaching that can bring change to the traditional teaching or teacher-center to the new way of teaching and learning or student-center. Students will become more actively participated, and the class environment will become more fun, enjoyable, and cooperative. Moreover, all these methods and techniques are used in every subjects in the classrooms, but science is the one noticeable in primary school because students come to science classes with a number of misconceptions and different ideas or point of view according to their experiences or background knowledge in various topics on the lessons (Chin & Teou, 2009). When students come to the

class with misconceptions and different ideas or points of view, argumentation appears when students form into the group or discussion on the specific topic in the classroom.

In science education, argumentation is considered to be the core practice which pushes students to develop their reasoning skills, knowledgeable evaluation criteria, attain scientific literacy, and other skills (Lazarou, Erduran, & Sutherland, 2017). Moreover, argumentation is the skill that can be developed, either by explicitly teaching argumentation, or by allowing students to engage with argumentative discourse. Argumentation is also a social and dynamic process in which individuals have to engage in thinking, constructing, and evaluating knowledge. It covers a statement that is backed by at least one reason (Iordanou, 2012), but participates more than more individuals. Moreover, learning scientific concepts is the gold of teaching science at school, and learning scientific argumentation is also important because it improve students' conceptual understanding, provide them in creating a decision based on facts or information, and help them to work in the scientific way (Faize, Husain, & Nisar, 2017). According to Shirley, Sibel, and Jonathan (2006) state that the use of validity of argument does not come spontaneously, but it requires practice which needs to be explicitly taught, through the provision of appreciative activity, support, and modeling. Furthermore, part of the goals of constructivist science classrooms and social constructivist views of learning are the learning argumentation and other epistemic practices (Jiménez-Aleixandre, 2007). Moreover, argumentation and cooperative debate are central functions of intellectual inquiry in the nature of science which give benefits to science learning that specifically concentrate on the joint exploration of the problems, and concrete evidence by students in the group (Bell, 2004).

Thus, one technique that offers much potential for use by teachers in the classroom in order to elicit the argumentation is concept cartoons which were developed by Keogh and Naylor in the 1990s because concept cartoons are the effective stimulus for a form of argumentation in primary science (Naylor, Downing, & Keogh, 2001). Children respond positively to concept cartoons, engage in focused discussion, and put forward and defend alternative viewpoints. On the other hand, concept cartoons provide students with many different ideas in different cartoon

characters that allow students to express their point of view toward different ideas in each cartoon character.

1.2. Research Problems

In science education, students need to have the opportunity to engage and to interact in scientific argumentation in order to enhance their critical thinking, conceptual understanding and scientific reasoning, debating and provoking argument. These opportunities are rare and little practice in traditional science lessons (Steininger, 2013). Traditionally, science teaching has paid little attention to arguments and controversy which were similar to researcher's practicum. During the practicum, the researcher can see that the teacher in the classroom still used the traditional way in teaching and learning which started the lesson with questions and allowed students to read and find the answer from the textbook. Thus, students had no argumentation if the teacher still depends on the textbook in the process of teaching and learning in the class. Moreover, students in the class seemed to be quiet, had no interest in learning, and the class environment was silent and not fun. Due to the reasons above, that's why the researcher chose to conduct research on the topic of the efficiency of concept cartoons in science education for eliciting students' argumentation.

1.3. Research Objective

This research aims to find out the efficiency of concept cartoons for eliciting students' argumentation in science education in primary school.

1.4. Research Question

To fulfill the research objectives as stated above, this research study seeks to answer below research questions "How do concept cartoons motivate students' argumentation in science education in primary school?".

1.5. Limitation of the study

This study has limitations in various aspects. Due to the time constraints, this study selected only 3 students for the observation and interview. Therefore, the number of respondents cannot represent the whole population of the students in all grades 6 at Beong Salang primary school. As a result, the respondents only represent the class that the researcher did the practicum. On the other hand, the researcher has

a small sample size due to the time constraints. Thus, a sample of 3 students is not well enough to show a whole picture of how all the students perceive the efficiency of concept cartoons in science education for eliciting students' argumentation. Hence, the data collection may not be sufficient.

1.6. Significance of the study

This research on the topic of the efficiency of using concept cartoons in science education for eliciting students' argumentation gives many potential benefits.

1.6.1. The significance for teachers

Using concept cartoons in the classroom as the technique for teaching and learning provides many benefits to the teachers. Teachers can use concept cartoons to help their reluctant students to get involved in the discussion and participation in the process of teaching and learning because concept cartoons may help those students want to expression their ideas against each other and what they disagree with their teammates. Moreover, concept cartoons make students´ misconceptions visible during their discussions, so the teacher can observe students´ misconceptions and find a way to help them to eliminate their misconceptions on time. Besides that, concept cartoons can also make the class environment to be more active and fun because of students´ involvement and participation.

1.6.2. The significance for students

Implementing concept cartoons in the classroom provides many benefits for students in terms of their argumentation in science education which broadens their understanding in science and give students the new experience in learning. Moreover, argumentation is very important for students which helps them to eliminate their misconception which is in their mind through their experience and basic knowledge in their every life and develop their conceptual understanding. Moreover, argumentation in concept cartoons is the way that students can find the reasons to support their claims or view, provide them to question each other, justify, and evaluate claims. Moreover, students will experience debating and going the period of conflict during their learning because they may have some different point of view which lead to a focus group discussion and improve their involvement in the classroom. Thus, concept cartoons bring many benefits to students which play an important role in their learning.

2. LITERATURE REVIEW

2.1. Definition

What are concept cartoons?

Concept cartoons were created by Keogh and Naylor in the 1990s and the use of a single or some cartoon characters engaged in dialogue that start with the misunderstanding. Concept cartoons are interesting and astonishing drawing with cartoons which stand up for different points of view concerning an occurring in everyday life (Keogh & Naylor, 1993). Concept cartoons are visual tools consisting of three or more characters' proposing ideas, discussing on a topic, or a concept in daily life which have different ideas (Gafoor & Shilna, 2013). This concept cartoons are illustrated in Figure 1.

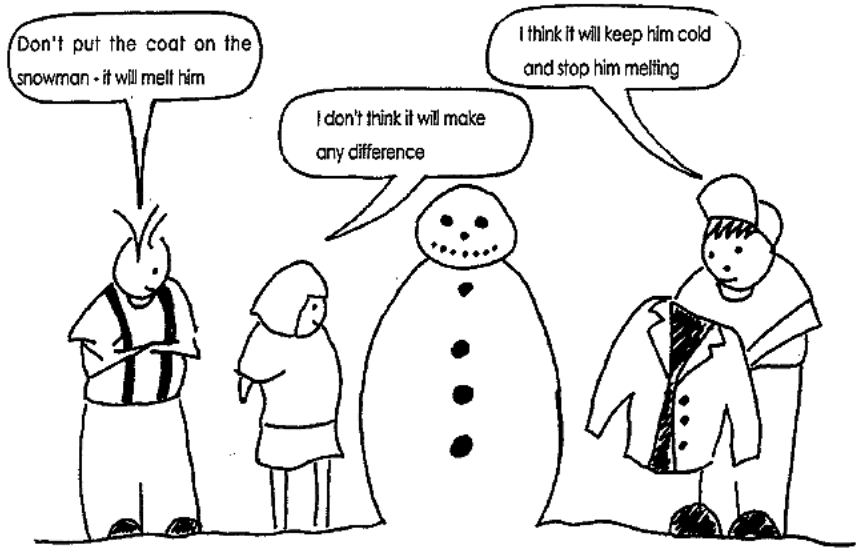


Figure 1: Concept cartoon by Keogh and Naylor (1997)

Concept cartoons are able to encourage students to focus on discussion when they talk about each concept which is shown by the different cartoon characters. This helps students to provoke debate and argumentation among students, especially when they have different ideas or do not agree with their friends' view (Chin & Teou, 2009).

Some of the draft concept cartoons would start with a single character, but it soon became clear that for some students it might be possible for a group of characters to interact, which is an important step in developing and presenting

alternate ideas, including one or more views that are scientifically valid (Keogh & Naylor, 1999). This concept cartoons are illustrated in Figure 2.

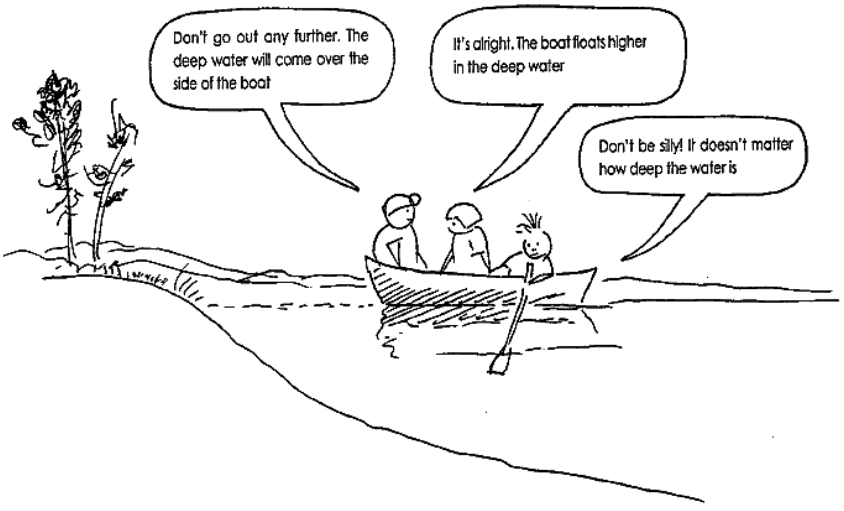


Figure 2: Concept cartoon by Keogh and Naylor (1997)

In science education, students need to have the opportunity to engage and to interact in scientific argumentation in order to enhance their critical thinking, conceptual understanding and scientific reasoning, debating and provoking argument. These opportunities are rare in the traditional classes, which is the better way to use concept cartoons as the teaching tools which are carried out in primary schools or in pre-service teaching training (Steininger, 2013).

On the other hand, the concept cartoons are in a familiar context in order to cause learners to reflect on the science located within their everyday experience, so giving relevance to the ideas being considered (Keogh & Naylor, 1999).

What are the steps of using concept cartoons?

According to the Student-Centered Approaches for Science Education, there are four steps which were recommended such as:

First, teachers show the concept cartoons that are already prepared to the students and explain clearly one by one about the context. Second, teachers give a short period of time for individual reflection, and they read the statement carefully, and answer the two questions such as "with whom do you agree? and is more than one idea correct?" Moreover, this second step should be a small experiment where students think about what is right, wrong, and party true and try to build the definition.

Third, teachers spend time scanning through to see that the group is thinking by raising hands or using voting cards. Finally, teachers play an important role in organizing a discussion with the whole class. Furthermore, teachers have to keep in mind that all answers of each group are discussed, and teachers ask questions to help students to find the correct reasoning (Student centred approaches for science education, 2013).

What is argumentation?

Argument is noticed by various researchers as one of the most essential activities in science education (Newton, Driver, & Osborne, 2010). According to Zohar and Nement (2002) stated that science educators not only argue that argumentation is an important aspect of science education in general; but they also assume that argumentation enhances the learning of the science content.

Argument is used when we need to persuade somebody to accept something or do something. In short, to accept our point of view. When we try to persuade someone of a point of view with reasons for accepting it which is called arguing a case or presenting an argument (Fisher, 2011). Moreover, an argument in critical thinking always contains one conclusion and one or more than one reason.

Argumentation is regarded as a fundamental technique in science education that can help students improve their ability for reasoning, knowledge evaluation standards, scientific literacy, and other subsidiary abilities. Argumentation is the skill that can be improved either by clearly teaching argumentation or by encouraging students to involve in the argument discourse (Lazarou, Erduran, & Sutherland, 2017). Kuhn and Udell (2003) suggest that argumentation is "the dialogic process in which two or more people engage in debate of opposite claims" through which an evaluation and justification of claims to scientific knowledge takes place. Moreover, according to Naylor, Keogh and Downing (2007), argumentation is regarded as the process of evaluating and justifying claims.

2.2. Previous research studies

A number of case studies were conducted by using concept cartoons in their teaching and learning process in order to find out the effectiveness of using concept cartoons. After completing the whole class reflection, students were able to find out the

right answers by having concrete evidence and enabling students to debate which discover students′ personal ideas and reason (Kabapınar, 2005).

Concept cartoons serve as efficient motivation for arguments, including empowering pupils to collaborate and build arguments. They enable argument without the need for formal structures, or teacher intervention to direct the argument process. Moreover, concept cartoons draw common student misconceptions which lead to the generating cognitive conflict (Naylor & Keogh, 2013).

In addition, a study that was conducted in 2010 by Keogh and Naylor showed that concept cartoons showed the constant switching of ideas, the introduction of new ideas into the discussion, and the introduction of justifications in support of ideas. Even if learners were comfortable with the topics covered, the alternative ideas presented in the concept cartoons almost always seemed to question thinking and create the need to discuss ideas which led the argumentation during the class.

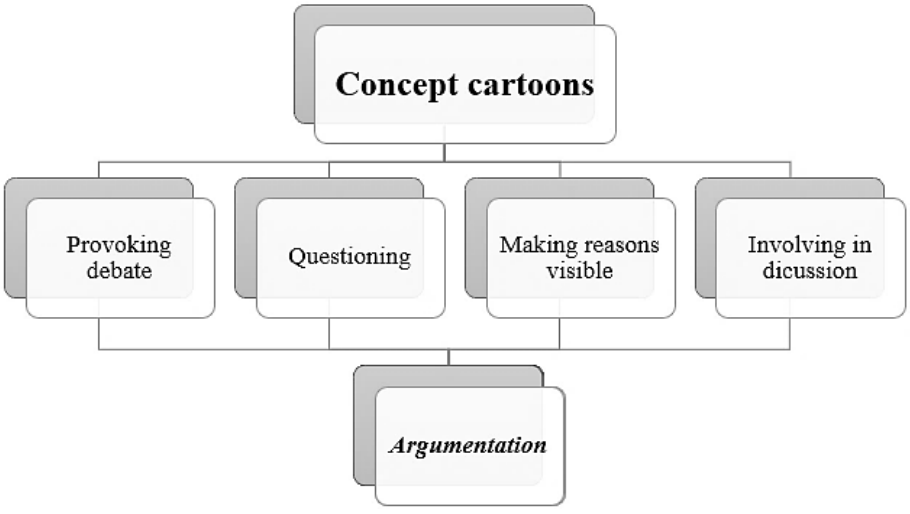
Similarly, regarding Chin & Teou (2009) and Gafoor & Shilna (2013) conducted studied on the use of concept cartoons showed that concept cartoons can be used to express students′ misconceptions, to encourage questions and reflective thinking, stimulate talk and argumentation, make students think and help them understand problems. Moreover, concept cartoons can engage students in focused discussion when they talk about the concepts which can provoke debate and argumentation among students, particularly if opposing ideas happen.

Moreover, the research which was conducted by Kabapinar (2005) to see the effectiveness of teaching via concept cartoons from the point of view of constructivist approach showed that concept cartoons was effective in making focused discussions where reasons could be uncovered, provoked questions, and enabled a debate which uncover students' ideas and reasoning, and allow an investigation's purpose. All the points above are the elements of argumentation that are involved in discussion, debate, reasoning, and questioning. Furthermore, concept cartoons could make students deal with the processes of showing their thoughts by presenting rational reasons, predicting, evidence's evaluation, debate on counter argument. Concept cartoons urge the activities that develop students′ skills of making hypotheses, drawing deduction, and making conclusions be updated (Turkoguz & Cin, 2014).

To sum up, concept cartoons play an important role for eliciting students' argumentation in the classroom which provides students an opportunity to debate, express their reason, try to pose questions to each other and in their mind, and involve in the discussion.

2.3. Conceptual framework

After going through many articles and sources from other authors, the researcher come up with the conceptual framework below:



3. METHODOLOGY

The research study on the topic the efficiency of concept cartoons in science education for eliciting students' argumentation follow the research methodology below:

3.1. Research design

The research study on the above topic is using qualitative approach as the research design to guide how to conduct the study on the topic in order to find out the answers to illustrate the question. In a qualitative approach, the researcher tends to focus on using words and pictures by doing interviews and observations on the students. On the other hand, the researcher focuses on gathering much more information from the students rather than focus on the amount of the numbers because the researcher must interview students to get the information as the researcher wishes. Besides that, the qualitative research design, the researcher would involve gathering data through face-to-face interview with three students who rarely get an opportunity to engage in an argumentation, and during the process of doing

interviews, the interview will be recorded, noted, and reviewed later for my research paper. During the process of the interview, each student must respond to all the questions that the researcher has prepared to ask them, but also the other questions besides what the researcher has prepared.

3.2. Research area

The researcher decided to conduct his research at Boeng Salang primary school where is in Boeng Salang Commune, Tuol Kurk district, Phnom Penh. At Boeng Salang primary school, there are 18 classes, and three out of 18 are grade 6. The researcher conducted the research in one out of three classes at grade 6, that was the class the researcher did the practicum. Moreover, while doing the research practicum, the researcher saw that all the students in grade 6 did not engage in argumentation, that's why the researcher decided to choose that grade as the research site. Furthermore, students in this grade are the class that the researcher taught them during the practicum, so that would be easy for the researcher to get to know about the students well. Besides that, the participants who were involved for the interview and observation are three students at grade 6, and they have different involvement, but mostly they didn't have any argumentation during the teaching and learning process.

3.3. Research sampling and Sample size

Table 4.1: This table illustrate students' demographics, research sampling and sample size

N^o	Description	Sex	Research sampling	Sample
S1	Age: 13 Grade: 6	Male	19	1
S2	Age: 12 Grade: 6	Male	19	1
S3	Age: 12 Grade: 6	Female	19	1

The data in table 4 . 1 shows the sampling which was selected from the population size of the grade 6 at Boeng Salang primary school. In that class, there are 19 students and three out of 19 were chosen by using systematic random sampling.

The researcher chose these three students by looking at their grade, and also their involvement during the class. These three students had different grades from the top one to the medium and to the lower one. Moreover, their involvement is also different from each other during the process of teaching and learning. That's why the researcher chose them to observe and interview.

3.4. Research instrument

According to our research objective and research design, the researcher decided to use non-participant observation and semi-structured interviews to be the research instrument. The researcher prepared an observation checklist to observe the three students' improvement when using concept cartoons. However, during the observation, the researcher decided to use non-participant observation because the researcher just observed the three students while discussing in each group and took note or ticked their activities that they completed. On the other hand, in the semi-structured interviews, the researcher prepared a list of questions for those three students who are studying at grade 6 in my practicum's class. Moreover, the researcher would ask them one by one until reaching the last questions, but the researcher would be flexible to ask more questions if it's needed.

3.5. Data collection

To achieve the research objective of the topic, the researcher divided the data collection into two. First, the researcher chose to observe three students by using observation checklists to investigate students' improvement while implementing concept cartoons from the start until the end. Non-participant observation was selected to observe those students because the researcher just observed those three students by their activities, and the teacher was not involved in the class activities. Second, the researcher chose to interview the three students at grade 6 in order to gather more information and data throughout their answers. Moreover, semi-structure was selected as the data collection for interviewing because it had more flexibility and freedom to ask further questions to collect the data. The participants were interviewed after four times of implementing concept cartoons in the process of teaching and learning. By doing those two types of data collection methods, the researcher would collect the data that is needed.

3.6. Data analysis

To analyze the data that the researcher collected on the topic of the efficiency of using concept cartoons in science education for eliciting students' argumentation, the researcher used Microsoft Excel to analyze students' observation checklists and Microsoft Word to analyze students´ answers from semi-structured interviews.

In order to analyze the observation checklists of each student, the researcher used Microsoft Excel which gathered all students' observation checklists. Furthermore, the observation checklist for each student was put in a different sheet. By doing this, the researcher was able to easily analyze from one student to another, and clearly saw the different improvement of students by using Microsoft Excel.

The interviews were prepared to transcribe from the voice recording into Khmer first. After transcribing the data into Khmer, it had been transcribed into English to facilitate the coding and analyzing process across transcripts. Moreover, in order to analyze the data as the researcher already transcribed, the researcher used the seven steps in qualitative data analysis which were reorganized from Creswell (2014) which are Raw data, Organizing & preparing data for analysis, reading through the data, coding the data, themes or description, interesting themes or description, and interpreting the meanings of the themes/description. By following these seven steps, the researcher came up with fruitful findings.

3.7. Research ethics

Before doing the data collection for this research, the researcher had a clear understanding of research ethics, there was a letter form from the Phnom Penh Teacher Education College, such as letters of introduction for pedagogical internships. This research was approved by the school management from Phnom Penh Teacher Education College to request for doing this research. Moreover, before interviewing and observing the three students, the researcher had the consent form for the head teacher and got his signature to make sure that the researcher was approved to do the data collection from his class. Moreover, all information of the students would be confidential and not discussed with individuals or third-party other than the students´ researcher. Furthermore, the students´ identity would not be revealed without any consent from the three students to anyone other than the researcher conducting the topic.

4. FINDING AND DISCUSSION

4.1. Research findings

The results of this research on the topic of the efficacy of concept cartoons in science education for eliciting students′ argumentation was answer to the research question as follows:

4.1.1. Findings from Observation

According to the observation checklist of S1 during the process of teaching and learning through implementing concept cartoons on lesson 6 which talked about human fertilization, the researcher could see that during the first time of using concept cartoons, he did not have rebuttal for their discussion, challenge or going through the period of conflict. He did not follow up or respond to each other′s different ideas. Moreover, he did not have many reasons to support his conclusion or his ideas in order to make their friends believe their point of view. Besides that, he started with misconceptions because there were many different ideas in each concept cartoon. Furthermore, During the time of using concept cartoons, he did not freely discuss what he chose, or he thought was right because he was shy and did not want to talk, and never persuaded others to accept his view, but he was sometimes involved in the discussion. However, during the second time of using concept cartoons on lesson 7 which focused on the definition of adulthood, the researcher could see that he gradually increased his rebuttal for their discussion, challenge or going through the period of conflict. He sometimes followed up or responded to each other′s different ideas. On the other hand, concept cartoons pushed him to have more reasons to support his conclusion or his ideas. Besides that, he still started with misconceptions. Furthermore, during the time of using concept cartoons, he seemed to freely discuss what he chose, or he thought was right because he really wanted to talk while using concept cartoons and started to adapt with the use of concept cartoons and started to persuade others to accept his view. Moreover, during the third time and fourth time of using concept cartoons on lesson 7 which talked about adulthood of girls and lesson 8 which focused on definition of contraception, all the above pointed dramatically improved which meant that he always debated which going through the period of conflict, followed up or respond on each other′s different ideas, elicited more reasons to

support his conclusion, questioning each other or their friends or his own self, and discussion actively.

Furthermore, observation checklist of S2 showed that during the first time of using concept cartoons in lesson 6 that talked about human fertilization, he did not have rebuttals, challenges or going through the period of conflict and followed up on each other′s different ideas. Moreover, he sometimes had reasons to support their choice but without conclusion during the first time of using concept cartoons, and started with a misconception which was not sure which was the best answer. On the other hand, he did not freely discuss what he chose, and never persuaded others to accept their view, but he was sometimes involved in the discussion and involvement with other members of the group. However, during the second time of using concept cartoons on lesson 7 which talked about the definition of adulthood, the researcher noticed that he slightly improved in involvement through the period of conflict and followed up on each other′s different ideas, but he still had the same number of reasons to support his conclusion or his views which remained the same. However, he markedly participated in the discussion and freely talked and discussed what he was chosen to find out the answer for the whole group during the last two times of using concept cartoons on lesson 7 which talked about adulthood of girls and lesson 8 which focused on the definition of contraception.

Moreover, observation checklist of S3 in the class also showed that during the first time of observing student 3 on lesson 6 which learnt about human fertilization, she had no rebuttal, period of conflict, challenges their friends' view or respond to and followed up on each other′s different ideas. Moreover, she had no reasons to support her conclusion or view. She did not freely discuss what she chose, and never persuaded others to accept her view, but she less participated in the conversation during the first time of using concept cartoons. However, during the second time of using concept cartoons on lesson 7 which focused on the definition of adulthood, she improved to go through the period of conflict and responded to and followed up on each other′s different ideas, but still had no rebuttal and challenges their friends' view. She slightly improved to elicit more reasons to support their ideas, but still had no conclusion and she slightly improved her discussion and freely talked about her ideas

to her teammates. On the other hand, during the last two times of implementation cartoons on lesson 7 which talked about the adulthood of girls and lesson 8 which focused on definition of contraception, she significantly improved her period of conflict and responded to and followed up on each other´s different ideas. She also showed a dramatic improvement by posting her reasons more. She was sometimes trying to persuade her friends to accept her view and discussion.

To conclude the finding from observation checklist that the researcher applied concept cartoons in teaching and learning four times and observed three students, the researcher clearly saw that during the time of using concept cartoons in teaching and learning, students mostly started with misconception or misunderstanding with each cartoon character posting different ideas. Moreover, during the first time of using concept cartoons, students had no rebuttal, challenged their friends´ ideas, or responded to and followed up each other's different ideas which were the point of provoking debate and challenging their friends´ ideas. However, all of these had been improved little by little. On the other hand, among all these three students during the first time of using concept cartoons, they still had limited reasons to support their choice or view and conclusion, but after applying three more times, students seemed to push their ideas and were brave enough to discuss which made their reasons and conclusion visible. Besides that, students also significantly improved their discussion and participation while using concept cartoons as teaching and learning materials. They freely talked about their point of view of what they were chosen and tried to persuade their friends to accept their ideas by giving reasons to support. In summary, students improved and

elicited their debate, made reasons visible, questioning and markedly involved in the discussion.

4.1.2. Findings from Semi-Structured Interview

4.1.2.1. Provoking debates

Data from the interview showed that after implementing concept cartoons in science education to find out its effectiveness for eliciting students' argumentation, students seemed to provoke their debate which allowed them to have rebuttal for their discussion, challenge and going through the period of conflicts. As S1 remarked, "*After*

seeing or hearing other people choose differently from me, I told them and tried to explain about what I thought was right, but they did not totally believe me, and they blamed me." Moreover, students also followed up and responded to each other's different ideas. As S2 mentioned:

> ***S2:*** *After seeing or hearing other people choose differently from me, I tried so hard to explain and told them, but they did not believe or agree with me and sometimes argue with me, and I thought they chose the wrong one. Moreover, when I came to present to the whole class because I had chosen to represent my group, I read their answer, but I did not agree with them, so I also read my answer. However, I still find it hard to choose which one was right and which one was wrong.*

4.1.2.2. Making reasons visible

Furthermore, the data analysis from interviews also revealed that students tended to elicit more reasons while discussing with their teammates in order to support their conclusion or what they chose was right for them and their views because concept cartoons gave students with many different ideas, so they may choose different ideas from other friends. As S3 remarked:

> S3 "*I tried to persuade my friends to accept my view because if I thought this one was right and they chose something different from me, I tried to persuade them to choose my answer because I had a proper reason.*"

Moreover, they started to give more reasons that they thought were right for them and related to their experiences or their background knowledge. As S1 mentioned:

> ***S1:*** *I tried to come up with reasons and explanations to tell them that what they thought was wrong. For example, they all thought that millions of sperm cells could swim from male genitals and all of those could go into the egg of the females, but I think that there was just only one of male sperm cell that could go into the egg. Thus, we have different reasons. And I gave them more reasons because if I want to encourage my friends to agree with me, I have to give the reasons, and they also agreed with my ideas.*

4.1.2.3. Questioning

On the other hand, the data from the interview also showed that students asked their own questions toward their friends. As S3 mentioned, "*Concept cartoon is a tool that made me want to talk and discuss because I asked more questions and was brave to answer.*" Moreover, by implementing concept cartoons, students are able to question in their mind about what was right and what was wrong. As S1 mentioned:

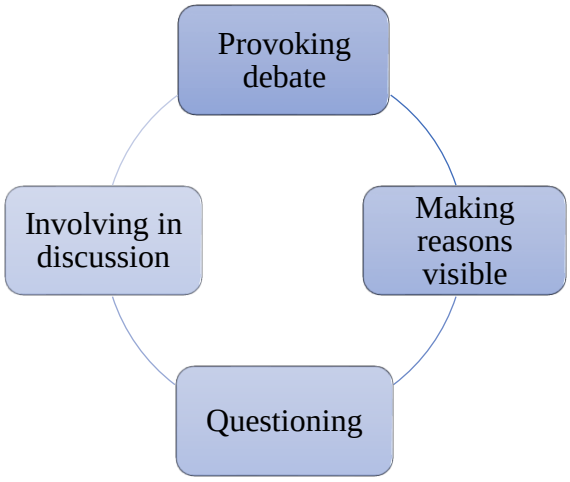
> ***S1:*** *I tried to figure out the answer to what I wanted to know or question in my mind, and when I told my group members about my answers, they did not believe me, and I started to have a misconception.*

4.1.2.4. Involving in discussion

Finally, concept cartoons could provoke reluctant students to get involved in discussion with other members. Concept cartoons could trigger conversation among students, and they freely discussed what they chose without hesitation. As S2 mentioned, "*When I studied without concept cartoons, I wanted to work individually, but when using concept cartoons, I want to discuss in the group more and I sometimes argue with my friend and discuss to find the answer.*" Besides that, concept cartoons could make students try to persuade their friends to accept their view. Three students who got interview said:

> ***S1:*** *Concept cartoons were formed by many different ideas, and reasons, so when this happened, I really want to study with it because concept cartoons provided many different ideas that leading us to discuss or talk about those ideas and encourage me to discuss and tried to elicit my reasons to support what was right and wrong.*

According to the interview, the researcher could draw four main themes such as provoking debate, making reasons visible, questioning, and involving in discussion.



It can be concluded from the semi-structured that concept cartoons appear to encourage reluctant students to engage in debate which provides students to challenge their friends' ideas, propose explanation, and follow up each other's different views, help students to make their reasons visible by providing reasons to support their thoughts, make students ask their own questions in their mind and question each other and create focused discussion which gives an opportunity for students to talk, and freely discuss what they are thinking and their thoughts.

4.2. Discussion

The findings of this study showed that concept cartoons are possible strategies for promoting argumentation in science education which are in line with Nayor & Keogh (2013) and Gafoor & Shilna (2013). One of the most important aims of science is to produce, increase and maintain knowledge. Argumentation is a significant part of science education and both argumentation and science had a tie relationship with each other. Evrekli & Balım (2022) stated that argumentation mainly involves the process of discussion, questioning, and reasoning. Keogh & Naylor (2010); Chin & Teou (2009) and Gafoor & Shilna (2013) showed that concept cartoons encourage learners to engage in debate and challenge their friends' ideas and discussion in the group actively. During the lessons that use concept cartoons in teaching and learning, students who are reluctant seem to improve to become involved in the discussion more frequently than usual, and they have more and more ideas to talk with their teammates. Moreover, they also engage in debate with their friends while they do not

agree with each other about each idea in different cartoon characters. They also involve themselves in challenging their friends′ ideas by asking or giving reasons against their friends′ ideas which leads to the environment in the class to be more active. The use of concept cartoons can create fun, visual, and knowledge-structuring environments that allow students to pay more attention to the lessons and discuss their point of views. Moreover, concept cartoons help students to ask their own questions by asking more to their friends, or teacher about what they never know or don't understand, reveal, and develop the students' thoughts, and apply scientific ideas in daily situations. (Evrekli & Balım, 2022). Chin & Teou (2009) also stated that concept cartoons could make students' reasons visible to support their conclusion through interactive argumentation among pupils by putting forward their ideas. Moreover, concept cartoons encourage students to elicit their views, make and justify their claim, ask more questions, and pose challenges to each other′s different ideas. In order to answer each other's questions and want to convince group members of the assertion they made, the students have to give the explanation to support their conclusion, justify their reasons using the evidence, build on their ideas to expand on their thinking, rebuttal their friends' claims if those ideas are different from them.

5. Conclusion

5.1. Conclusion

Concept cartoons serve as efficient motivation for arguments, including empowering pupils to collaborate and build arguments. Concept cartoons enable arguments without the need for formal structures, or teacher intervention to direct the argument process. Moreover, concept cartoons draw common student misconceptions which lead to the generating cognitive conflict (Naylor & Keogh, 2013). In addition, studies that were conducted in 2010 by Keogh and Naylor showed that concept cartoons showed the constant switching of ideas, the introduction of new ideas into the discussion, and the introduction of justifications in support of ideas. Even if students were comfortable with the topics covered, the alternative ideas presented in the concept cartoons almost always seemed to question thinking and create the need to discuss ideas which led to the argumentation during the class. Similarly, regarding Chin and Teou (2009) and Gafoor and Shilna (2013) conducted studied on the use of

concept cartoons showed that concept cartoons can be used to express students´ misconceptions, to encourage questions and reflective thinking, stimulate talk and argumentation, make students think and help them understand problems. Moreover, concept cartoons can engage students in focused discussion when they talk about the concepts which can provoke debate and argumentation among students, particularly if opposing ideas happen. Besides that, Evrekli & Balım (2022) stated that argumentation mainly involves the process of discussion, questioning, and reasoning which allow students to discuss more and more with their teammates, ask more questions to their friends or question in their mind, and urge them to give reasons to support their view or what they thought that seem to be right for them.

The finding of this study has shown the results which were related to the research above that concept cartoons have brought a significant improvement of the students' argumentation in science education. First, concept cartoons appear to encourage reluctant students to engage in debate which provides students to challenge their friends' ideas, propose explanations, and follow up each other´s different views. Second, concept cartoons help students to make their reasons visible by providing reasons to support their thoughts. Third, concept cartoons make students ask their own questions in their mind and question each other. Finally, it also helps to create focused discussion which gives an opportunity for students to talk, and freely discuss what they are thinking and their thoughts.

5.2. Recommendation

After doing this research on the topic the efficiency of concept cartoons in science education for eliciting students' argumentation, the researcher has found some recommendations like below:

5.2.1. Recommendation for teachers

This study suggests that the teacher should be more cautious with students during the discussion. Teachers should stay close with them in order to provoke more questions while the group has no ideas or students are silent and stay calm. Moreover, teachers should be the facilitator in the process of teaching and learning while applying concept cartoons in the lessons because students might have no experience of the use of concept cartoons in the first time, and they may find it difficult

to discuss. Thus, the teachers have to be with them, and wake around the group to see students' discussion and help students when needed.

5.2.2. Recommendation for future researchers

This study suggests that future researchers should investigate more detail about the topic. First, the future researchers should include a larger sample size and extend the scope of research to make sure that the data is sufficient enough and could be represented for the whole population in grade 6. Moreover, future researchers should implement concept cartoons in different grade levels to compare the results to see how efficient the concept cartoons for eliciting students´ argumentation in different grades are. Secondly, future researchers should implement concept cartoons in different subjects besides science because the researcher has already used concept cartoons for eliciting students' argumentation in the science field already. Finally, future researchers should apply concept cartoons more frequently in their experimental class to find their effectiveness because due to the time constraints, the researcher applied only fourth time in science lessons by using concept cartoons. Thus, future researchers should apply more than four times.

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