Metacognitive Awareness Based on Gender in Conceptual Change Learning Assisted Android Mobile-learning on the Topic of the Human Reproductive System

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Abstract: This study aims to describe the level of metacognitive awareness of male and female students in conceptual change learning on the topic of the human reproductive system, the relationship between knowledge about cognition and cognitive regulation. The research subjects were students of class XI at a high school in Bandar Lampung. The instrument used to collect data is a metacognitive awareness questionnaire developed by Schraw & Dennison (1996). The results of the study show that male and female students are dominantly at the level of "developing" metacognitive awareness in the sense that they can be helped towards awareness of thinking for themselves if they are inspired or supported. This study also revealed that girls are more dominant in their minds-on, while male students tend to be more hands-on. Each knowledge about cognition and regulation of cognition has a strong relationship, both in male and female students. Through this research, it appears that conceptual change learning facilitates male and female students to identify and revise concepts that develop in society related to the human reproductive system to become scientifically correct.

Keywords: Metacognitive Awareness, Conceptual Learning, Gender

INTRODUCTION

One type of knowledge that must be mastered by students in Indonesia is the metacognitive dimension. The application of the independent learning curriculum provides real support for the development of metacognitive abilities. This can be seen from the spirit of instilling life-long learning capacity which indirectly strengthens students' metacognitive abilities (Suri et al., 2020). Previously in the 2013 Curriculum, metacognitive knowledge also received

attention by being designated as Core Competency 3 (KI3) which reads "Understanding, applying, and explaining factual, conceptual, procedural, and metacognitive knowledge in science, technology, arts, culture, and humanities" (Kemdikbud RI, 2018). Metacognitive is an adjective form of metacognition which is interpreted by thinking about thinking processes (Flavel, 1979; Livingston, 1997). Meanwhile, metacognitive awareness is defined as the behavior of knowing and being aware of how one learns and knowing which work strategy is best (Veenman et al., 2014). Several studies have concluded that a person with good metacognitive awareness is positively correlated with mastery of strategies and academic learning outcomes (G., Schraw & R.S., 1994; Ulfah et al., 2013). In addition, metacognitive awareness also significantly influences a person's ability to solve problems (Adhitama & Supriatno, 2018). The results of the research above are consistent with the statement that the more students who are aware and know the level of metacognitive awareness, the better the learning process and achievement.

Gender is an issue that has received much attention from researchers in the field of education and learning (Mahdiannur et al., 2020). Hasnunidah & Wiono's research found that there were no significant differences in argumentation skills in male and female students in Bandar Lampung after participating in learning with the Argument Driven Inquiry model. (Hasnunidah & Wiono, 2019). Meanwhile, a survey conducted by Miswari et al., revealed that the critical thinking skills of female students were higher than male students in one of Medan's high schools (Miswari et al., 2020). Furthermore, Ambarawati et al., concluded that there were significant differences in critical thinking skills between male and female students at SMAN 5 Surakarta (Ambarawati et al., 2014).

Conceptual change is a learning model that is believed to be able to assist students in bridging the gap between knowledge about everyday phenomena and scientifically correct concepts (Azevedo, 2019). This learning model departs from Burner's theory which holds that students start learning with their own ideas about a topic of discussion. The ideas possessed by these students are not entirely scientifically correct. A process called disequilibrium in the form of providing scientifically correct facts is believed to be able to lead students to a higher intellectual level than before. (Posner et al., 1982). Dahar in (Sudewa et al., 2014) identify that the syntax for learning conceptual change includes 1) conceptual and contextual presentation of problems, 2) conflicts that are in misconceptions about related problems, 3) contradictions in denial and strategies in demonstrations, analogies, or counterexamples, 4) contradictions in proving concepts and scientific principles, 5) conflicting material and contextual examples, 6) conflicting questions to broaden understanding and meaningful application of knowledge. Indirectly, the syntax above supports the training of metacognitive abilities.

The material of the human reproductive system consists of concrete and abstract facts. Subjects that must be mastered by students include the structure, function, mechanism of the organs and glands that make up the reproductive

system. Given the ethical-cultural basis, the character of high school students and body processes that cannot be observed directly (Barroh et al., 2012). Based on this, it is important to mix reproductive system material with the development of representative technology and communication media. Some concepts that arise and confuse students will be clearly illustrated by applying the media (Yasin & Ducha, 2017). The importance of visualizing the structure, function, mechanism of the organs and glands that make up the human reproductive system so as not to form misconceptions in students is proven by research results (Hikmawati, 2017; Wati et al., 2019; Hamid & Haka, 2021).

A study concluded that the conceptual change model was able to reduce misconceptions by 71% (Hamid & Haka, 2021). Furthermore, the use of a concept change learning model combined with e-learning has also been shown to be able to reduce misconceptions about the reproductive system material and increase self-regulation, self-efficacy and self-confidence among students in several high schools in Lampung (Haka et al., 2021). Given the importance of metacognitive abilities in students, it is necessary to do research on the development of metacognitive awareness in male and female students in learning conceptual changes in the material of the human reproductive system. It is hoped that the results of this study will add to the reference of learning strategies carried out by teachers to develop students' metacognition abilities.

METHODE

Research Design

This research is a type of descriptive research with a survey method. This is adjusted to the objectives to be achieved, namely describing students' metacognitive awareness based on gender after participating in conceptual change learning assisted by android mobile learning on the topic of the human reproductive system. In line with expert opinion, that descriptive research is describing social phenomena without aiming to draw general conclusions (Sugiyono, 2017). Hence, this research does not manipulate or give treatment to the variables.

Population and Sample

This research was conducted in one of the senior high schools in Bandar Lampung City. The research subjects were all students of class XI MIA.1, MIA.2 and MIA.3, totaling 103 people. So the sampling technique used is saturated or census sampling, where the entire individual population is used as research subjects (Sugiyono, 2017). Furthermore, field data collection took place in 3 learning meetings.

Research Instrument

The instrument used to collect data is a modified metacognitive awareness questionnaire (Schraw & Dennison, 1994). The questionnaire is in the form of a statement of 52 items which must be answered using the goutman scale (yes/no). All of them are in the form of positive statements and are selected by students according to the learning conditions experienced. Among the data that will be collected through the questionnaire is knowledge about cognition and regulation of cognition. Aspects of knowledge about cognition consist of declarative, procedural, and conditional knowledge. Aspects of regulation of cognition consist of planning indicators, strategies for managing information, monitoring of understanding, improvement and evaluation strategies. The validity of the questionnaire was tested using the product moment correlation equation, while the level of reliability was measured using the Cronbach's alpha equation because the form of the data was in the form of a scale (Arikunto, 2013).

Questionnaire data that has been collected is converted on a scale of 100 and then categorized based on Green (2002) as presented in Table 1 (Tibrani, 2017). Correlation tests were carried out to determine the relationship between knowledge about cognition and cognition regulation and the relationship between indicators of metacognitive awareness in male and female students. The prerequisite tests applied were the One Sample Kolmogorov-Smirnov Test to measure normality, and the Levene Test of Equality of Error Variances to measure homogeneity, each at a significant level of 5%. Data were analyzed with the help of SPSS version 21 for Windows.

Table 1. Estimates of Metacognitive Awareness Levels

Level	Interval	Name	Description
0 – 18	0	Not yet	Not yet leads to cognition.
19 – 36	1	At risk	Seems to have no awareness of thinking as a process.
37 – 54	2	Can not really	Not being able to separate what he thinks from how he thinks.
55 – 72	3	Developing	Can be helped toward self-awareness if inspired or supported.
73 – 90	4	OK	Aware of own thinking and able to distinguish between input, elaboration and output stages of one's own thinking, sometimes using this model to organize one's own thinking and learning.
91 – 108	5	Super	Able to use metacognition skills regularly to regulate their own thinking and learning processes. Aware of the many possibilities of thinking, able to use them fluently and reflect on their thought processes.

RESULT AND DISCUSSION

The research process took place by applying a conceptual change learning model assisted by android mobile learning to all class XI students on the topic of the human reproductive system. During learning, student behavior is observed with the help of a video camera. The learning was carried out in three meetings, where at the third meeting a metacognitive awareness questionnaire was given to be completed. Furthermore, the results of the questionnaire were analyzed to describe the state of metacognitive awareness of class XI students in conceptual change learning assisted by android mobile-learning on the topic of the human reproductive system.

The results of the study in Figure 1. show that the average level of metacognitive awareness of male and female students is in the "developing" stage, meaning that they can be helped towards awareness of thinking for themselves if inspired or supported. Three indicators were found for male students who were at the "can not really" stage, namely planning, information management strategy, and evaluation. Meanwhile for female students, only one indicator was at stage 2 (can't really), namely the planning aspect. The "can't really" level refers to students who don't have the ability to separate what they think from how they think.

One level of development of metacognitive awareness that is dominantly owned by male and female students is planning. Doyle (2013) states that planning indicators are the ability to apply knowledge about cognition related to tasks and selecting strategies to achieve targets (Adhitama & Supriatno, 2018). Operationally, planning relates to students' ability to develop plans to achieve learning objectives such as selecting references and managing effective learning time (Veenman et al., 2014). This low ability is suspected because the use of e-learning applications directs students to focus on the task features that have been provided. Besides that, the preparation of learning stages in e-learning applications has been arranged according to the conceptual change learning syntax so that they do not feel the need to design reference management and learning time.

Based on the distribution of levels of metacognitive awareness in Figure 2, it can be seen that half of the male students (50%) are still at levels 0 (not yet) and 1 (at risk). Meanwhile, for female students, 26% are at stage 0 (not yet) and a quarter are at the super stage. These findings indicate that both male and female students were found to be at the not yet level of metacognitive awareness. In accordance with Green's categorization (2010), it means that a quarter of male students and female students have not yet led to cognition (Tibrani, 2017). Meanwhile, it was also found that more female students achieved metacognition awareness at the "super" level compared to male students. That is, there are more female students than male students in terms of the ability to use metacognitive skills regularly to manage their own thinking and learning processes and are aware of the many possibilities of thinking and are able to use them fluently and reflect on their thinking processes.
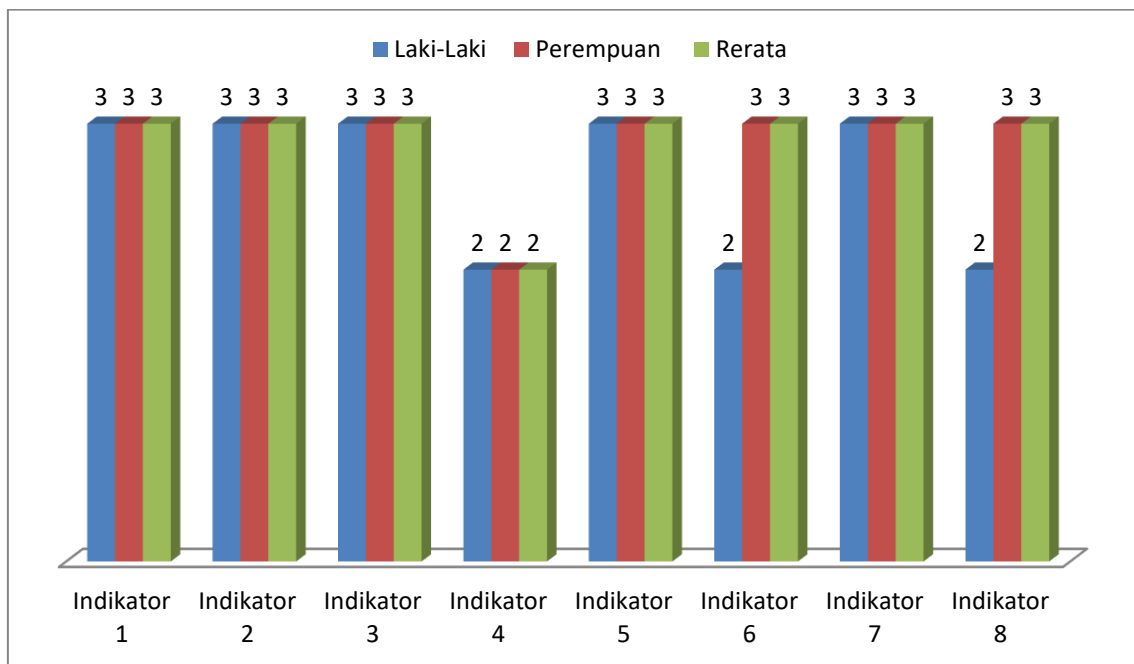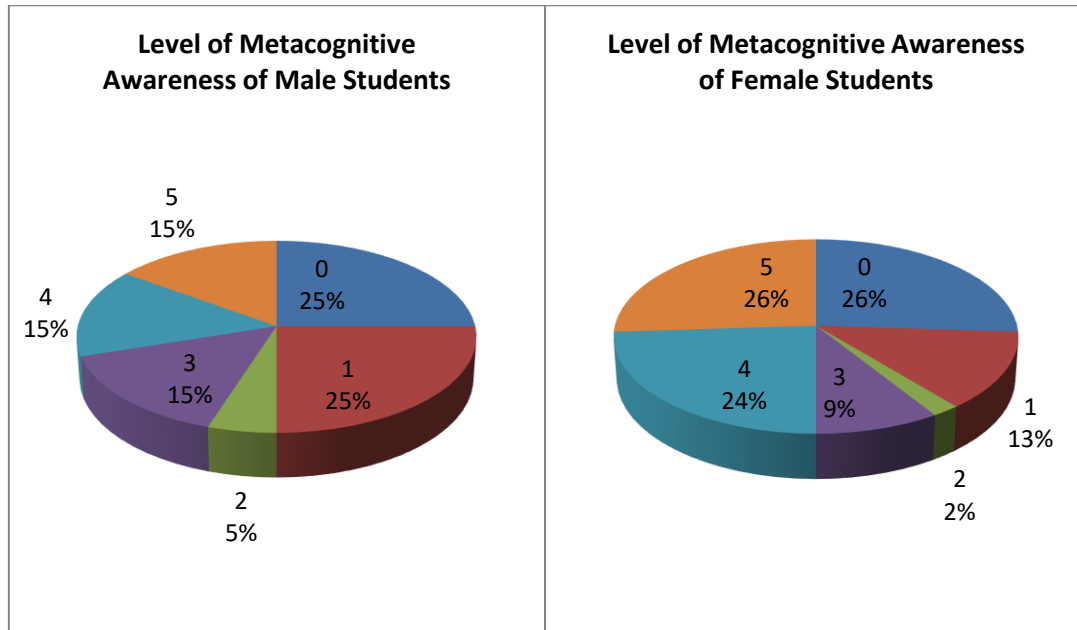
Figure 1. The average level of metacognitive awareness of male and female students in each indicator

The findings in this study strengthen the results of research which concluded that more female students at the age of 15 have higher metacognitive awareness than male students at the same age (Anumudu et al., 2019). The conclusion of a study also strengthens this, where the characteristics of men prioritize hands-on activities compared to women who are more dominant in using communication techniques (Li & Nietfeld, 2007). This is closely related to the characteristics of metacognitive awareness which demands the use of coherent thoughts (minds-on) not just a physical activity.

Knowledge about cognition includes declarative, procedural and conditional knowledge while the regulation of cognition includes planning, monitoring understanding, strategies for managing information, strategies for improvement and evaluation (G., Schraw & RS, 1994). Based on the data in Figure 1, it can be seen that the cognition knowledge and cognitive regulation possessed by both male and female students are in the developing stage, which means that the two levels of metacognitive awareness can be helped towards awareness of thinking for themselves if it is stimulated or supported. Cognitive knowledge is important in learning concept change because it will direct students in recognizing and building correct concepts based on science. Meanwhile, the slices of cognition regulation in concept change learning are more directed to students in choosing the right strategy to prove a concept is scientifically right or wrong.

Based on the results of observations during the learning process, each emergence of cognitive knowledge can be seen in student activities. Declarative knowledge appears from the activity of mentioning concepts related to the topic

of the human reproductive system in electronic learning applications. While student activities that appear and are aligned with procedural knowledge, namely student proficiency in carrying out learning syntax in accordance with the directions contained in electronic learning applications. Furthermore, student activities related to conditional knowledge are in the form of the ability to adapt when encountering learning difficulties by reviewing discourse independently.

Keterangan: 0 = *Not yet*; 1 = *At risk*; 2 = *Can not really*; 3 = *Developing*; 4 = *Ok*; 5 = *Super*

Figure 2. Distribution of male students' metacognitive awareness levels

The next level of metacognitive awareness is the regulation of cognition that is responsible for direct student activities (Baker & Czarnocha, 2002). The research data show that cognitive regulation has a greater diversity of levels than cognitive knowledge. It can be seen from the indicators of strategies for managing information and evaluating male students that it is lower than that of female students. Information management strategy indicators refer to the ability to process information efficiently in the form of organizing, parsing, summarizing, and focusing on important information (Anderson & Krathwohl, 2001). Meanwhile, evaluation indicators refer to the ability to review and analyze effective strategies and actions during learning (Danial, 2018). The higher level of women is thought to be due to the similarity of characters between indicators and women, namely prioritizing sequential thoughts.

Table 2. Knowledge and Setting Correlation Analysis

No.	Gender	Sig. (2-tailed)	Pearson Correlation	Correlation Degrees

No.	Group			
1.	Unisex	.000	.841**	Perfect
2.	Male	.000	.748**	Strong
3.	Female	.000	.777**	Strong

**. Correlation is significant at the 0.01 level (2-tailed).

It was previously known that metacognitive awareness is divided into two levels, namely knowledge about cognition and regulation of cognition (Aşıkcan & Saban, 2018). Based on the results of the analysis in Table 2. it can be seen that there is a significant correlation (0.000) between knowledge and students' cognitive arrangements in learning conceptual changes in the material of the human reproductive system. These findings indicate that students' knowledge of the best strategies in learning is closely related to their ability to implement and monitor the effectiveness of these strategies to achieve learning goals. Table 2 also shows the Pearson correlation number of 0.841 which means that the level of relationship between knowledge and students' cognitive regulation in conceptual change learning is in the perfect category (Arikunto, 2010). Further analysis on gender also shows the same conclusion but with a strong category.

The results of the correlation analysis between knowledge about cognition and cognition regulation which have a positive value indicate that the two variables have parallels and are very close. This finding indicates that an increase in the score of knowledge about cognition tends to increase the score of students' cognitive regulation. A study conducted on middle-level students in the city of Bandung also showed similar results even though it used project learning models and environmental pollution materials (Adhitama & Supriatno, 2018). This also applies to indicators of knowledge about cognition and cognition regulation.

Based on the results of metacognitive awareness analysis in conceptual change learning shows the importance of metacognitive knowledge to support the meaningfulness of the learning process. Both male and female students both displayed significant performance when analyzing concepts on the topic of the human reproductive system. As it is known that meaningful learning is cognitive activity related to the assimilation of new information into one's thinking structure (Tarmidzi, 2019). A study found that the application of meaningful learning concepts was able to increase conceptual understanding in teacher training students who attended lectures on basic science concepts (Juniartini et al., 2017). Based on the results of the research, it is evident that metacognitive knowledge influences the passage of a meaningful learning.

The use of electronic learning media further strengthens the spirit of independent learning in students because each has the same opportunities, time and learning materials (Yasin & Ducha, 2017). Such a learning atmosphere is in line with the spirit of implementing an independent learning curriculum, especially in a differentiated learning strategy which refers to students' freedom in determining learning strategies based on needs (Wahyuningsari et al., 2022). The common thread that can be drawn from these facts is that one's

metacognitive knowledge can be honed by applying conceptual change learning and does not rule out the application of differentiation or other learning.

CONCLUSION

In general, male and female students who were used as research subjects showed a level of metacognitive awareness at the developing stage, which means that the two levels of metacognitive awareness can be helped towards awareness of thinking for themselves if they are stimulated or supported. The results of the study also found that there was a significant relationship between knowledge about cognition and regulation of cognition at the perfect degree. These conditions still show the same correlation when analyzed by gender. Based on the research findings, teachers should be able to design learning and assess the development of students' metacognitive awareness. This is important, given the need for students to analyze concepts scientifically so they don't go astray.

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