



Contextual teaching learning in human digestive system: The contribution of critical thinking skills

Yakobus Bustami^{1*}, Leliavia¹, Nyeria Elisabeth¹, Adriana Gandasari¹, Desi Ratnasari²

¹ Biology Education, STKIP Persada Khatulistiwa Sintang, Indonesia

² Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Kapuas Sintang, Indonesia

*Corresponding author: ybustami07@gmail.com

ARTICLE INFO

Article history

Received: 28 February 2020

Revised: 30 April 2020

Accepted: 17 May 2020

Keywords:

Correlation

Contextual learning

Critical thinking skills

Human digestive system



ABSTRACT

Critical thinking skills and students' understanding are the supporting factors in students' learning success. This research aimed to determine the contribution of critical thinking skills for the understanding on human digestive system concepts when contextual teaching and learning (CTL) was implemented. The samples were 45 students consisting of public junior high schools 2 and 5 class VIII A at Sungai Tebelian. The instrument of critical thinking skills were essay test totaling of 6 items and to measure the understanding on human digestive system concepts, 20 items of multiple choices test were used. Research data were analyzed using a simple regression correlation analysis. The results showed a significant correlation of critical thinking skills to the understanding of human digestive system concepts. The regression equation of the correlation between the two variables was $Y = 0.736X + 22.861$. The correlation coefficient was 0.640, with the contribution the critical thinking skills to human digestive system concepts of 41.00%. These results showed that there was a significant correlation between critical thinking skills and human digestive system concepts when CTL was implemented in learning. Thus, biology teachers need to develop students' critical thinking skills through the implementation of CTL in learning.

© 2020 Universitas Negeri Jakarta. This is an open-access article under the CC-BY license (<https://creativecommons.org/licenses/by/4.0>)

Bustami, Y., Leliavia, L., Elisabeth, N., Gandasari, A., & Ratnasari, D. (2020). Contextual teaching and learning in human digestive system: the contribution of critical thinking skills. *Biosfer: Jurnal Pendidikan Biologi*, 13(1), 101-113. <https://doi.org/10.21009/biosferjpb.v13n1.101-113>



INTRODUCTION

The education quality can determine the progress of a nation. Education quality can be seen from the quality of students who can develop themselves in facing the industrial revolution era 4.0 (Shahroom & Hussin, 2018). It is a topic of discussions about the internet, digitalization, and intelligent knowledge systems that need skills (Roblek, Meško, & Krapež, 2016; Muhuri, Shukla, & Abraham, 2019). One of the skill is higher-order thinking skills, namely critical thinking skills (Setiawan, Dwi & Budhi, 2017; Bustami, Syafruddin & Afriani, 2018; Ichsan, Sigit & Miarsyah, 2019).

The critical thinking skills are the skills to think through problem-solving with curiosity, has the characteristics of interrogative and skeptical thinking, dare to take risks, dare to decide and carry out and can function effectively in almost all aspects of life and other work (Mahanal, Shila & Zubaidah, 2018; Cansoy, Parlar & Polatcan, 2018). Critical thinking skills are an essential element for students in learning (Mundilarto & Ismoyo, 2017). It can be used as a basis for the analysis of arguments, specific reasons that support the assumptions or conclusions they obtain, and insights on each meaning and interpretation to develop logical reasoning in each student (Bustami & Corebima, 2017; Rosidin Kadaritna & Hasnunidah, 2019).

The critical thinking skills has one of the most important aspects to be empowered because of the understanding domain development and can affect student achievement (Warni, 2018; Amin, 2020) especially the human digestive system concepts (Mardiah, Putra, & Winarti, 2018; Bustami, Riyati, & Julung, 2019). The human digestive system is a material that is contextual and universal in natural science (Biology). It is subject matter at the level of junior high school education consisting of facts, concepts, principles, and procedures that are systematically organized about humans and their surroundings (Mahmudah, Tindangen, & Lumowa, 2018; Bustami et al., 2019). The learning process of natural sciences (Biology) in junior high schools requires critical thinking skills, metacognitive skill, and conceptual understanding (Bustami et al., 2019; Lestari, Ristanto, & Miarsyah, 2019), especially students achievement. The achievement is a person's ability in the learning process to change attitudes, knowledge, and skills that can be produced and measured or observed (Ramadhan, Mahanal & Zubaidah, 2017). The achievement will be able to make students to think more to make improvements in achieving better students' conceptual understanding results (Rosyida, Zubaidah & Mahanal, 2016).

The critical thinking skills correlate with students' understanding (Moslemi, Ghomi & Seyed, 2016; Mahanal et al., 2018). The critical thinking skills can help students to think by bringing up creative ideas to be able to understand the material well, express opinions, and improve students' achievement. This is because there was a correlation between critical thinking skills and students' understanding. Several research results have revealed a correlation between critical thinking skills and concepts understanding. Critical thinking skills have a significant correlation with students' understanding, including the acquisition of concepts and student achievement (Mite & Corebima, 2017; Siburian, Corebima, Ibrohim & Saptasari, 2019). Therefore, it is necessary to improve critical thinking skills and understanding with various learning variations (Mundilarto & Ismoyo, 2017; Wahyuni & Setiawan, 2019).

Critical thinking skills and students' understanding can be improved through an innovative learning variety. It can directly involve students in the learning process or become student-centered, collaborate, and learn independently in the learning process as well as learning that requires a learning approach in the teaching and learning process. One of learning approach is a CTL (Bustami et al., 2018).

CTL is a learning approach that not just act as an object but also as a subject in constructing knowledge so that students can construct knowledge themselves. Students are not just memorizing facts, listening, or taking notes. Students are required to experience it themselves and encouraged to carry out hands-on experiences, so they can master the thinking

skills in the learning process (Rokhma, 2014; Lestari, Amelia, & Marianingsih, 2017). The CTL learning approach allows students to connect their academic thinking with the context of everyday life to find new goals through daily life experiences and learning in the classroom. So the need to apply these approaches can improve students' critical thinking skills and understanding, especially the human digestive system concepts (Susialita, 2016). CTL learning is very suitable for the material of the human digestive system because it is directly related to real concepts in everyday life.

On the other hand, the research results indicate that CTL learning influences students' understanding of materials and critical thinking skills. The implementation of CTL learning improved students' writing skills (Satriani, Emilia, & Gunawan, 2012). Furthermore, the CTL learning affected students' understanding of biology concepts (Abadiyah, Juaningsih, & Fadlilah, 2017; Wuryaningrum, Sartono, & Dewahrani, 2018; Yulinda, & Ilma, 2018), towards students' achievement on natural science (Suryawati & Osman, 2018). Finally, the research results of Bustami et al. (2018) revealed that CTL learning improving students' critical thinking skills in learning environmental pollution.

Based on these problems, it is necessary to conduct research related to the contribution of critical thinking skills to understand human digestive system concepts at the implementation of CTL learning. The implementation of CTL is because previous research only looked at the effect of CTL learning on critical thinking skills and understanding of the human digestive system concepts, not yet showing the correlation of critical thinking skills to the understanding of the human digestive system concepts. Critical thinking skills significantly affect students' understanding of the material being taught, especially the human digestive system concepts. Therefore, this research is needed on the contribution of critical thinking and understanding of the human digestive system concepts. This research was to determine the contribution of critical thinking skills and understanding of the human digestive system concepts students in eight grade of junior high school through CTL learning. This research was expected to give contribution to the school to apply active learning, including the use of CTL in improving critical thinking and understanding on the human digestive system concepts.

METHODS

Research Design

This research was correlational research to uncover the contribution of critical thinking skills as a factor influencing students' understanding on human digestive system concepts by implementing CTL learning. This research used a one-group posttest only design, adopted from the research of Siburian et al., (2019) and Setiawan, Zubaidah & Mahanal, (2020). The one-group posttest only design can be seen in Table 1.

Table 1.

One-Group posttest only design.

Treatment	Posttest
X	O ₁

Note: X: learning with CTL learning, O₁: Posttest score from the experimental class.

Population and Samples

This research was conducted after an experiment (O₁) was the posttest. The research was conducted for a month. The population were all eighth-grade (VIII) students of 2 public junior high schools and 5 public junior high schools in Sungai Tebelian, West Kalimantan, Indonesia totaling of 94 students. Each school consisted of 2 classes. Sampling in this research was carried out with a random sampling technique. 22 students from class VIII-A in 2 public junior high

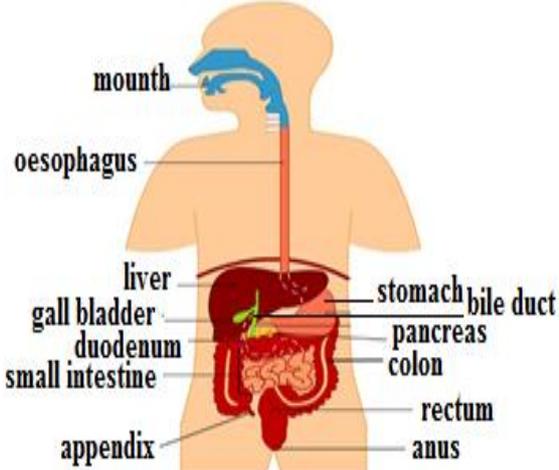
schools, VIII-A in 5 public junior high schools, 23 students at Sungai Tebelian, West Kalimantan, Indonesia, which totaling of 45 students who were taught using the CTL learning.

Instrument

The instrument to measure critical thinking skills was the essay test totaling of 6 items, and to measure understanding on human digestive system concepts multiple-choice test comprising 20 items was used. The essay test was developed based on the indicators of Ennis (2009), namely formulating a problem, making deduction and induction, giving arguments, evaluating, deciding, and implementing. The multiple-choice test was developed based on the indicators of Bloom's taxonomy (Anderson & Khrathwohl, 2001) of remembering (C1), understanding (C2), applying (C3), and analyzing (C4). Indicators' lattices of critical thinking can be seen in Table 2, and understanding the human digestive system concepts can be seen in Table 3.

Tabel 2.

Indicators lattices of critical thinking on human digestive system.

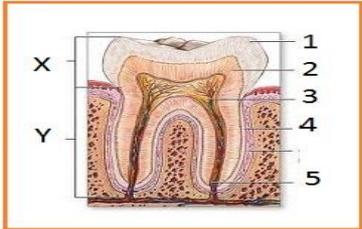
Indicator	Indicators of Critical Thinking	Test Questions
	Evaluating	When we consume fruits that are not washed clean, of course, these fruits will contain dust, dirt, and bacteria that are harmful to our digestive organs. Explain what you think if we consume fruits that contain dust, dirt, and bacteria that continuously enter the digestive organs, then what will you feel?
Describe the digestive organs in humans	Induction	<p>Look at the picture on the bottom!</p> <p>Based on this picture, try to conclude which organs do not undergo digestion and have different functions from other organs?</p> 
	Giving arguments	Why do humans who consume excessive food feel too much pain in the stomach organs? Give your reasons for the event and connect it with digestion!
Describe and observe the digestive mechanism in humans	Formulating a problem	There are two digestive mechanisms, namely mechanical digestion and chemical digestion. Mechanical digestion is digestion carried out by teeth to change the shape of abundant foods into smaller ones. Whereas chemical digestion is the digestion carried out by enzymes to change complex molecules in the food to be more straightforward. Make 3 problem statements

		from the discourse above!
	Deduction	The disorders or diseases of the digestive system are often experienced by humans, one of which is diarrhea. Give 4 ideas to avoid diarrhea!
Describe information about diseases or disorders in the human digestive system and efforts to maintain the human digestive system's health.	Deciding and implementing	Explain how you think the food digestion process from the entry of food into the oral cavity to enter the stomach!

The instrument was previously validated. The validity result shows that valid essay test questions were 6 out of 10 questions, and valid multiple-choice test questions were 20 out of 40 questions. The reliability test results using the ANATES V4 program showed the reliability coefficient of multiple-choice questions was 0.90, and essay questions were 0.86 with very high-reliability categories so that it could be used as a research instrument.

Tabel 3.

Indicators Lattices of Conceptual Understanding on Human Digestive System.

No.	Indicator	Cognitive (C)	Test Questions
1	Students can mention the canines tooth total in healthy children	C1	The digestive organ parts that are directly related to the ventriculus is...
2	Students can mention the stomach part that is directly related to the esophagus	C1	a. Pharynx
3	Students can mention the digestive tract in humans	C1	b. Larynx
4	Students can mention the motion that pushes food on the esophagus	C1	c. Colon
5	Students can mention that gastric pains can lead to other diseases	C1	d. Esophagus
6	Students can explain teeth that are suitable for cutting and biting teeth which help in the food mechanically digestion	C2	Marasmus disease is a form of malnutrition that is often found in toddlers. The following is the characteristic of Marasmus's disease, namely...
7	Students can explain the name of the digestive organs in the mouth that serves as a food location regulator	C2	a. Crooked feet
8	Students can explain the muscles type that function to open and close the anus	C2	b. Distended stomach
9	Students can explain the food digestion process derived from the stomach and acidic atmosphere to be neutralized	C2	c. Old face
10	Students can explain the characteristics of the Marasmus disease	C2	d. Muscle does not develop properly
11	Students can detect the tooth enamel part	C3	The following is the tooth structure picture.
12	Students can detect the tooth pulp part.	C3	
13	Students can sort the results of the mechanical and chemical digestion process	C3	
14	Students can determine the bacteria that help the decay process in the large intestine	C3	
15	Students can sort the food digestion process from protein groups after being bounced	C3	

		The number indicates the tooth enamel part is...	
		a. 1	c. 3
		b. 2	d. 4
16	Students can analyze the digestive organs one function	C4	The process of digestion often experiences disorders of the digestive organs, especially food that is difficult to defecate. This is caused by... a. Food poisoning b. Body cavity infection c. Vitamin C deficiency d. The food lacks fiber
17	Students can analyze the hunger causes	C4	
18	Students can analyze chemical digestion in the mouth	C4	
19	Students can analyze the causes of a disease	C4	
20	Students can analyze food digestive disorders experienced by someone with symptoms of painful bowel movements	C4	

Procedures

The procedures in this research consisted of three steps. The first step was to give the learning process with the implementation of CTL learning. CTL learning has been 7 characteristics, namely constructivism, inquiry, asking questioning, learning community, modeling, reflection, and authentic assessment. Learning was done as much as 4 time meetings on biological material. The second step was to give a post-test to determine the value of students' critical thinking skills and understanding on human digestive system concepts. The third step was conducting correlational analysis to reveal the correlation between critical thinking skills and conceptual understanding of the human digestive system at the implementation of CTL learning. Flowcharts research procedures can be seen in [Figure 1](#).

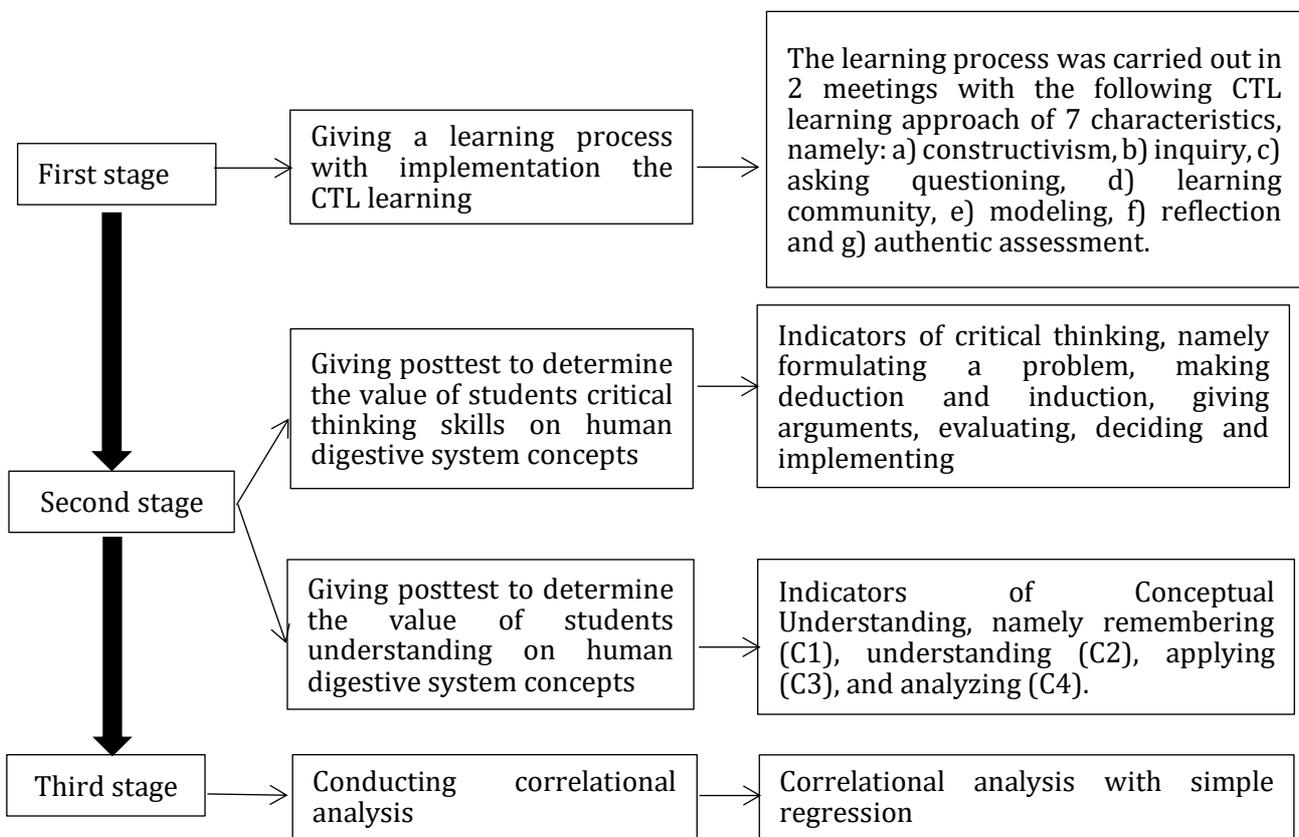


Figure 1. Research procedures.

Data Analysis Techniques

The data analysis was performed by descriptive analysis and inferential analysis. The descriptive analysis aims to determine the average value of critical thinking skills and understanding human digestive system concepts. The inferential analysis aims to answer the research hypothesis. Hypothesis testing begins with a prerequisite test in the form of a normality test and a homogeneity test. The normality test used the Kolmogorov-Smirnov, and the homogeneity test used One Way Anova. Data analysis related to the correlation of students' critical thinking skills to human digestive system concepts using simple regression.

RESULTS AND DISCUSSION

Descriptive analysis was carried out to find the average in the posttest scores. Based on the detailed analysis results in Table 4 showed that the average value of critical thinking skills is 74.80, with the highest value of 85, and the lowest of 60. The average value of students' human digestive system concepts is 76.80, with the highest value of 90, and the lowest of 60.

Table 4.

The value of students critical thinking skills and human digestive system concepts.

Value	Critical Thinking	Human Digestive System Concepts
Highest value	85.00	90.00
Lowest value	60.00	60.00
Average value	74.80	76.80
Category	Good	Good

Descriptive analysis results showed that CTL learning can improve students' critical thinking and conceptual understanding of the human digestive system concepts. The results of this research are in line with previous studies, which revealed that CTL learning could improve critical thinking skills (Komalasari, 2012; Bustami et al., 2018) and conceptual understanding (Abadiyah et al., 2017; Suryawati & Osman, 2018; Supianto, 2019). Increased critical thinking skills and understanding on human digestive system concepts are due to CTL learning characteristics that can increase critical thinking skills and conceptual understanding. CTL stages such as the invitation and exploration stage, explanation and solution stage, and taking action can improve critical thinking (Bustami et al., 2018) and conceptual understanding (Suryawati & Osman, 2018; Supianto, 2019)

The data of normality test results for the critical thinking skills and human digestive system concepts were summarized in Table 5. Based on Table 5, a significant value (sig: 0.216) of students' critical thinking skills and human digestive system concepts is higher than the alpha value (α : 0.05), so the data is normally distributed.

Table 5.

The results of normality in students critical thinking and human digestive system concepts.

Aspect	Sig.	Alpha (α)	Sig. > α	Conclusion
Critical thinking skills	0.216	0.05	0.216>0.05	Normally
Human digestive system concepts	0.106	0.05	0.106>0.05	Normally

The results of the homogeneity test for students' critical thinking skills and human digestive system concepts are presented in Table 6. The results of the homogeneity test in Table 6 obtained was sig. > 0.05. This shows that the data on students' critical thinking skills and human digestive system concepts have homogeneous variants.

Table 6.

The results of homogeneity in students critical thinking and human digestive system concepts.

Aspect	Sig.	Alpha (α)	Sig. > α	Conclusion
Critical thinking skills	0.760	0,05	0.760>0.05	Homogeneity
Human digestive system concepts	0.170	0,05	0.170>0.05	Homogeneity

Based on the correlation analysis results of critical thinking skills in students' understanding of the human digestive system concepts obtained an F value of 29.866 with a significance level of $0.000 < 0.05$, so the null hypothesis can be concluded as rejected, and the research hypothesis is accepted. Thus, there is a correlation between critical thinking skills and students' understanding on the human digestive system concepts. The ANOVA summary of the correlation analysis results of critical thinking skills on students' understanding of the human digestive system concepts is summarized in [Table 7](#).

Table 7.

The summary of anova results correlation of critical thinking skills to student human digestive system concepts on the ctl learning.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1462.105	1	1462.105	29.866	.000 ^a
	Residual	2105.095	43	48.956		
	Total	3567.200	44			

The contribution amount made by the critical thinking skills on students' human digestive system concepts is 41.0%, which is described in [Table 8](#).

Table 8.

The summary of regression of the correlation of critical thinking skills to student human digestive system concepts on the ctl learning.

Model	R	R Square	Adjusted R Square	Std. an error of the Estimate
1	.640 ^a	.410	.396	6.997

Based on the regression test results obtained by the regression line equation, $Y = 0.736X + 22.861$. The correlation coefficient is 0.640, so it can be concluded that the correlation of critical thinking skills on students' human digestive system concepts with the implementation of CTL is strong. The summary of the regression coefficients of critical thinking skills on students' human digestive system concepts with the implementation of CTL learning is outlined in [Table 9](#).

Table 9.

Regression coefficient of correlation critical thinking skills and students human digestive system concepts on the ctl learning.

Model	Unstandardized Coefficients		Standardized Coefficients Beta	T	Sig.
	B	Std. Error			
1 (Constant)	22.861	9.925		2.303	.026
Critical Thinking Skills	.736	.135	.640	5.465	.000

The results of this research are in line with the research of Idayanti (2017), who showed a significant correlation of critical thinking skills with an understanding on human digestive system concepts from class XI science students of state high schools in Pinrang Regency, Indonesia. The correlation coefficient was 0.64. Based on the regression test results obtained by the regression line equation, that was $Y = 0.736X + 22.861$. The contribution made by critical

thinking skills to students' human digestive system concepts was 41.00% and classified in the medium category, while 59.00% were other factors besides critical thinking skills.

This research results showed that the implementation of CTL learning is proven to have the potential to make a significant contribution to critical thinking skills, which eventually can increase understanding on human digestive system concepts. During the CTL learning process, it appears that students were enthusiastic about asking questions, giving arguments, deduction, induction, evaluating, deciding, and implementing so that they can increase the students' understanding of the digestive system material. The activities learning from CTL such as constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment are believed to improve critical thinking skills, which ultimately affect students' achievement. Critical thinking skills could also provide appropriate direction in thinking and working, and help in determining the correlation of something with others more accurately in learning that will affect student understanding (Malahayati, Corebima & Zubaidah, 2015).

The critical thinking skills can emerge students when they are involved in building fundamental knowledge, finding information, and asking questions so that students can solve problems encountered in the learning process. Critical thinking skills are included in CTL learning activities so that CTL learning can help students connect the material with real-life situations. It can also make students actively participate to discover and transform complex information into other situations as well as relate it to everyday life situations (Pradana & Andryansah, 2014; Surya, Putri & Mukhtar, 2017).

Furthermore, contextual learning could provide opportunities for students to improve, expand, and apply their knowledge and skills in various activities both in school and daily life (Bustami et al., 2018). CTL learning requires students to experience rather than memorize, think, and be active. As a result, they can build knowledge based on their own experiences. The same thing was that CTL learning makes experiences more relevant and helps students build their knowledge in their lives (Wakijo & Siti, 2016). So, it can be understood that CTL learning has the potential to empower critical thinking skills so that an increase will follow it in students' human digestive system concepts.

However, some obstacles at the time of the research were: a) there were still some students found when the learning process took place less seriously, and students were still late when the learning process had begun. b) there are still some students who rely on friends who are smarter and more diligent in doing the group assignments given by the teacher. Furthermore, the weaknesses of this research were: a) at the first meeting, students were unfamiliar with the CTL learning. b) there was a commotion at the first meeting due to a lack of control from the teacher.

CONCLUSION

Based on the results and discussion, it can be concluded that there was a significant correlation of critical thinking skills to the understanding of human digestive system concepts at the implementation of the CTL learning, which produces an F value of 29.866. A significance value was 0.000 at the 0.05 level, and the contribution of critical thinking skills to understanding on human digestive system concepts was 41.00%. Critical thinking skills have been able to affect students' conceptual understanding, even though there are several obstacles and weaknesses in learning the material of the human digestive system. Therefore, the teacher can develop students' critical thinking skills so that understanding of human digestive system concepts can be improved, mainly through CTL learning.

ACKNOWLEDGMENT

The authors would like to thank the head of the STKIP Persada Khatulistiwa Sintang, West Kalimantan, Indonesia, the head of 2 public junior high schools, and 5 public junior high schools

in Sungai Tebelian Sintang reGENCY, West Kalimantan, Indonesia who had permitted to carry out the research. Also, the authors would like to thank to Mrs. Hetty Boka as the teachers of Natural Sciences who have helped to conduct this research.

REFERENCES

- Abadiyah, F., Juanengsih, N., & Fadlilah, D.R. (2017). The effect of contextual teaching and learning combined with peer tutoring towards learning achievement on human digestive system concept. *Jurnal Penelitian dan Pembelajaran IPA*, 3(2), 101-111. <http://dx.doi.org/10.30870/jppi.v3i2.1959>
- Amin, A.M., Corebima, A.D., Zubaidah, S., & Mahanal, S. (2020). The correlation between metacognitive skills and critical thinking skills at the implementation of four different learning strategies in animal physiology lectures. *European Journal of Educational Research*, 9(1),143-163. <https://doi.org/10.12973/eu-jer.9.1.143>
- Anderson, & Khrathwohl. (2001). *A Taxonomy for learning, teaching and assessing; a revision of Bloom's taxonomy of educational objectives*. NY: Addison Wesley Longman Inc.
- Bustami, Y., & Corebima, A.D. (2017). The effect of jirqa learning strategy on critical thinking skills of multiethnic students in higher education, indonesia. *International Journal of Humanities Social Sciences and Education*, 4(3), 13-22. <http://dx.doi.org/10.20431/2349-0381.0403003>
- Bustami, Y., Syafruddin, D., & Afriani, R. (2018). The implementation of contextual learning to enhance biology students' critical thinking skills. *Jurnal Pendidikan IPA Indonesia*, 7 (4), 451-457. <https://doi.org/10.15294/jpii.v7i4.11721>
- Bustami, Y., Riyati, Y., & Julung, H. (2019). Think talk write with pictured cards on human digestive system: impact of critical thinking skills. *Biosfer: Jurnal Pendidikan Biologi*, 12(1), 13-23. <http://dx.doi.org/10.21009/biosferjpb.v12n1.13-23>
- Cansoy, R., Parlar, H., & Polatcan, M. (2018). Teacher candidates' critical thinking tendencies research in turkey: a content analysis. *Universal Journal of Educational Research*, 6(9), 1974-1980. <https://doi.org/10.13189/ujer.2018.060916>
- Ennis, R.H. (2009). Critical thinking assessment. *Theory into Practice*, 32(3), 179-186. <https://doi.org/10.1080/00405849309543594>
- Ichsan, I.Z., Sigit, D.V., & Miarsyah, M. (2019). Environmental learning based on higher order thinking skills: a needs assessment. *International Journal for Educational and Vocational Studies*, 1(1), 21-24. <https://doi.org/10.29103/ijevs.v1i1.1389>
- Idayanti. (2017). Hubungan kemampuan berpikir kritis dan kesadaran metakognitif dengan hasil belajar biologi siswa kelas xi ipa sma negeri di kabupaten pinrang. *Thesis*. Makassar: Universitas Negeri Makassar.
- Komalasari, K. (2012). The effect of contextual learning in civic education on students' civic skills. *International Journal for Educational Studies*, 4(2), 179-190. Retrieved from <http://journals.mindamas.com/index.php/educare/article/view/255>
- Lestari, A., Amelia, E., & Marianingsih, P. (2017). Pengembangan lembar kerja siswa berbasis ctl (contextual teaching and learning) sebagai bahan ajar siswa sma/ma kelas xii subkonsep kultur in vitro. *Biosfer: Jurnal Pendidikan Biologi*, 10(1), 32-44. <https://doi.org/10.21009/biosferjpb.10-1.5>
- Lestari, P., Ristanto, R. H., & Miarsyah, M. (2019). Analysis of conceptual understanding of botany and metacognitive skill in pre-service biology teacher in indonesia. *Journal for the*

- Mahanal, S., Shila, A., & Zubaidah, S. (2018). Potensi model pembelajaran biologi berbasis reading-concept mapcooperative script (remap-cs) dan gender terhadap keterampilan berpikir kritis siswa sma kota malang. *Prosiding Seminar Nasional Pendidikan Biologi*, 666-675.
- Mahmudah, M., Tindangen, M., & Lumowa, S. (2018). Analisis permasalahan kemampuan berpikir tingkat tinggi siswa smp terkait pembelajaran biologi materi sistem pencernaan. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 3(2), 200-203. <https://doi.org/10.17977/jptpp.v3i2.10517>
- Malahayati, E.N., Corebima, A.D., & Zubaidah, S. (2015). Hubungan keterampilan metakognitif dan kemampuan berpikir kritis dengan hasil belajar biologi siswa sma dalam pembelajaran problem based learning (pbl). *Jurnal Pendidikan Sains*, 3(4), 178-185. Retrieved from <http://journal.um.ac.id/index.php/jps/article/view/8168/3723>
- Mardiah, S., Putra, A. P., & Winarti, A. (2018). The practicality and effectiveness of lesson plan set on the topic of digestive system in training the critical thinking skills of junior high school students. *European Journal of Education Studies*, 4(7), 20-37. <https://doi.org/10.5281/zenodo.1249996>
- Mite, Y., & Corebima, A.D. (2017). The correlation between critical thinking and the learning results of the senior high school students in biology learning implementing group investigation (gi) learning in malang, indonesia. *Journal of Applied and Advanced Research*, 2(2), 56-62. <https://doi.org/10.21839/jaar.2017.v2i2.57>
- Moslemi, Z., Ghomi, M., & Seyed, D.M. (2016). The relationship between critical thinking skills with mental health and academic achievement of qom university of medical sciences students. *Journal of Medical Education Development*, 9(23), 90-101. Retrieved from <http://zums.ac.ir/edujournal/article-1-695-en.html>
- Muhuri, P.K., Shukla, A.K., & Abraham, A. (2019). Industry 4.0: a bibliometric analysis and detailed overview. *Engineering Applications of Artificial Intelligence* 78, 218-235. <https://doi.org/10.1016/j.engappai.2018.11.007>
- Mundilarto, & Ismoyo, H. (2017). Effect of problem-based learning on improvement physics achievement and critical thinking of senior high school student. *Journal of Baltic Science Education*, 16(5), 761-779. Retrieved from <http://oaji.net/articles/2017/987-1509214187.pdf>
- Pradana, R.W., & Andryansah. (2014). Studi implementasi model pembelajaran contextual teaching and learning (ctl) pada mata pelajaran instalasi motor listrik di smk negeri 1 madiun. *Jurnal Pendidikan Teknik Elektro*, 3(3), 707-711. Retrieved from <https://jurnalmahasiswa.unesa.ac.id/index.php/jurnal-pendidikan-teknik-elektro/article/view/10150/4104>
- Ramadhan, F., Mahanal, S., & Zubaidah, S. (2017). Meningkatkan hasil belajar kognitif siswa melalui model pembelajaran biologi remap stad. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 2(5), 610-615. Retrieved from <http://journal.um.ac.id/index.php/jptpp/article/view/9043/4329>
- Roblek, V., Meško, M., & Krapež, A. (2016). A complex view of industry 4.0. *SAGE Open*, (2), 1-11. <https://doi.org/10.1177%2F2158244016653987>

- Rosidin, U., Kadaritna, N., & Hasnunidah, N. (2019). Can argument-driven inquiry models have impact on critical thinking skills for students with different personality types?. *Cakrawala Pendidikan*, 38(3), 511-526. <https://doi.org/10.21831/cp.v38i3.24725>
- Rokhma, E.M. (2014). Pengaruh penerapan model ctl (contextual teaching and learning) dalam pembelajaran sains terhadap motivasi dan prestasi belajar siswa kelas v m1 ma'arif bego. *Thesis*. Yogyakarta: Universitas Islam Negeri Sunan Kalijaga.
- Rosyida, F., Zubaidah, S., & Mahanal, S. (2016). Keterampilan metakognitif dan hasil belajar kognitif siswa dengan pembelajaran reading concept map-timed pair share (remap-tmps). *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 1(4), 622-627. Retrieved from <http://journal.um.ac.id/index.php/jptpp/article/view/6207/2642>
- Satriani, I., Emilia, E., & Gunawan, M.H. (2012). Contextual teaching and learning approach to teaching writing. *Indonesian Journal of Applied Linguistics*, 2 (1), 10-22. <https://doi.org/10.17509/ijal.v2i1.70>
- Setiawan,, D., Zubaidah, S., & Mahanal, S. (2020). Minat baca dan keterampilan metakognitif pada pembelajaran biologi melalui model pembelajaran remap think pair share. *JPBIO (Jurnal Pendidikan Biologi)*, 5(1), 88-95. <https://doi.org/10.31932/jpbio.v5i1.651>
- Setiawan, M.A., Dwi, A.B., & Budhi, U. (2017). Pengaruh model pembelajaran problem based learning dipadu student facilitator and explaining terhadap kemampuan berpikir kritis siswa kelas x sman 6 kediri pada pokok bahasan fungsi. *Jurnal Florea Volume*, 4(1), 1-4. <http://doi.org/10.25273/florea.v4i1.1167>
- Shahroom, A.A., & Hussin, N. (2018). Industrial revolution 4.0 and education. *International Journal of Academic Research in Business and Social Sciences*, 8(9), 314-319. <http://dx.doi.org/10.6007/IJARBS/v8-i9/4593>
- Siburian, J., Corebima, A.D., Ibrohim, & Saptasari, M. (2019). The correlation between critical and creative thinking skills on cognitive learning results. *Eurasian Journal of Educational Research*, 81(2019), 99-114. <http://doi.org/10.14689/ejer.2019.81.6>
- Supianto. (2019). The effect of contextual teaching and learning (ctl) learning model on the ability of concept understanding class vii students of smp 16, kota bengkulu. *Jurnal Pendidikan Matematika Raflesia*, 4(1), 19-28. <https://doi.org/10.33449/jpmr.v4i1.7525>
- Surya, E., Putri, F.A., & Mukhtar. (2017). Improving mathematical problem-solving ability and self-confidence of high school students through contextual learning model. *Journal on Mathematics Education*, 8(1), 85-94. <https://doi.org/10.22342/jme.8.1.3324.85-94>
- Suryawati, E., & Osman, K. (2018). Contextual learning: innovative approach towards the development of students' scientific attitude and natural science performance. *EURASIA Journal of Mathematics, Science and Technology Education* 14(1), 61-76. DOI: [10.12973/ejmste/79329](https://doi.org/10.12973/ejmste/79329)
- Susialita, T. (2016). The development of audio-visual student portfolios (lks) contextual teaching and learning-based (ctl) on sound chapter of science subject for deaf students. *Jurnal Pendidikan IPA Indonesia*, 5(2), 192-198. Retrieved from <https://journal.unnes.ac.id/nju/index.php/jpii/article/view/6734/5451>
- Wahyuni, F.S., & Setiawan, D.C. (2019). Pengaruh model pembelajaran jinemam terhadap berpikir kritis siswa biologi. *JPBIO (Jurnal Pendidikan Biologi)*, 4(2), 60-66. <http://doi.org/10.31932/jpbio.v4i2.494>

- Wakijo & Siti, S. (2016). Implementasi pendekatan contextual teaching and learning (ctl) terhadap kemampuan berpikir kritis siswa. *Jurnal Pendidikan Ekonomi UM Metro*, 4(2), 43-49. <http://dx.doi.org/10.24127/ja.v4i2.637>
- Warni, Sunyono, & Rosidin. (2018). Measuring metacognitive ability based on science literacy in dynamic electricity topic. *Journal of Physics: Conference Series*, 948(1), 012041. <https://doi.org/10.1088/1742-6596/948/1/012041>
- Wuryaningrum, V., Sartono, N., & Dewahrani, Y. R. (2018). Developing bilingual student work sheet with contextual approach on human reproductive system topic. *Biosfer: Jurnal Pendidikan Biologi*, 7(1), 10-16. <https://doi.org/10.21009/biosferjpb.7-1.2>
- Yulinda, R. & Ilma, S. (2018). Learning interest of pre-service biology teachers on contextual-based Plant Morphology course. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 4 (2), 171-178. <https://doi.org/10.22219/jpbi.v4i2.5881>