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Analysis of the System Thinking Ability of Junior High School Students on the Main Material of the Digestive System

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Abstract: This research aims to describe students' systems thinking abilities on the main material of the Digestive System. The subjects of this research were 60 students of Junior High School 8 Bandar Lampung for the 2022/2023 academic year who were selected from a population of 275 students using a cluster sampling technique. This research uses an ex post facto design. System thinking ability data was obtained through description tests which were analyzed descriptively. The results of the research show that students' systems thinking abilities are in the sufficient category for 60% of students and in the deficient category for 40% of students. The highest systems thinking ability is in the indicator of the ability to examine the character of elements with an average value of 34.25 in the sufficient category, while the lowest systems thinking ability is in the indicator of correlating interconnections with an average value of 16.11 in the deficient category. Based on the results of data calculations, it can be concluded that in general students' systems thinking abilities are in the sufficient category.

Keywords: system thinking ability, digestive system

INTRODUCTION

Problems in various aspects of life have high complexity. The main cause of this complex problem is due to the increasing connectivity between components. Problems that can be broken down into their components and solved easily are very rare. Currently, problems are interrelated so that when a damaged component is repaired, it is not certain that you will get the same results before the damage occurred (Hidayatno, 2016). The complexity of this problem is a challenge in the world of education. Education is faced with very complex digital era challenges, to face these challenges it is important for someone to have the right system of thinking about something that consists of interrelated components.

Systems thinking is needed so that humans can view world problems more

comprehensively and in this way, decision making and action choices can be made more focused on the sources of problems that will change the system effectively (Hidayatno, 2016). Systems thinking is one of the most important abilities in the 21st century because systems thinking helps students organize their thoughts in a meaningful way and make connections between seemingly unrelated problems and become interrelated (Clark et al., 2017). According to UNESCO (in Rustaman & Meilinda, 2021) thinking systems need to be developed to equip 21st century competencies.

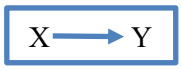
Biology is a branch of science that requires students to have systems thinking skills. Based on a literature study on systems in science learning, data was obtained that science studies the lives of living things and the surrounding environment as a system (Rustaman, 2012). So it can be said that science learning is learning about systems. According to PISA (OECD, 2012) there are 7 system hierarchies in science learning, namely cells, organs, organ systems, individuals, populations, ecosystems and biosphere. The digestive system material is included in the hierarchy of organ systems which requires students to be able to explain the purpose of the digestive system, the components in the digestive system, and the relationship between components in the digestive system. This is in line with the opinion of Assaraf, et al (2013) that the ability to think systems is very necessary for students in learning Biology. This is because in biology learning students are always emphasized on understanding concepts in biological material which are very complex and organized in systems. The ability to think systems is very necessary because when students have this ability the process of relating one material to another will be easier (Schuler, et al., 2017: 8). The ability to think systems is important because essentially this ability is intended so that students are able to overcome the problems they will face in the future. Good systems thinking skills will help students make decisions so that they avoid mistakes, because systems thinking is able to help make comprehensive decisions by looking at the impact of decisions or problems in other areas (Clark, et al., 2017).

Based on the facts obtained from the results of research by Nuraeni, et al (2020) on the systems thinking abilities of junior high school students in Sukabumi, the results showed that students' systems thinking abilities were still in the basic category and the deficient category. For this reason, it can be concluded that there is a need to increase students' systems thinking abilities. Based on a preliminary study conducted at Junior High School 8 Bandar Lampung, during the science learning process, teachers had not implemented systems thinking-based learning, apart from that, there had never been measurements of students' systems thinking abilities, so empowerment of systems thinking abilities had not been carried out. This is supported by the opinion of Gilessen, et al (2020) that learning in schools has not focused on systemic knowledge so that there has not been much measurement of systems thinking abilities so systems thinking abilities are difficult to develop.

METHOD

Research Design

This descriptive research uses an ex post facto design. This design is used to examine causality (cause-effect) relationships between variables that cannot be manipulated by researchers. An ex post facto design is different from an experiment because this design is intended to test what has happened to the research subject because one or more of the conditions being studied have an effect on other variables. The ex post facto design is described as follows.



Information:
X = Treatment carried out by educators in learning
Y = Results of students' systems thinking abilities

Population and Sample

The population in this research was all students of Junior High School 8 Bandar Lampung class VIII, totaling 275 people. The entire population is divided into 8 classes. Determining the sample for this study uses a formula developed by Isaac and Michael with an error rate of 10%.

Research Instrument

The type of data in this research was quantitative data. To see the level of students system thinking ability in the form of student score obtain from grades pretest and posttest then calculate the difference between the pretest and posttest in the form of ngain. The research instrument consists of 9 questions created based on systems thinking indicators.

RESULT AND DISCUSSION

Result of Research Procedure

Based on research conducted, the average students' systems thinking ability is in the sufficient category. The percentage of students' overall systems thinking abilities can be seen in Table 1 below.

Table 1. Students' Systems Thinking Ability.

Category	Number of Students (%)
Very Good	0%
Good	0%
Sufficient	60%
Deficient	40%

Based on Table 1, it is known that as many as 60% of students have systems thinking abilities in the sufficient category, while as many as 40% of

other students have systems thinking abilities in the deficient category.

Apart from that, students' systems thinking abilities are also calculated for each systems thinking indicator. Data on students' systems thinking abilities for each indicator can be seen in Table 2 below.

Table 2. Students' Systems Thinking Ability for Each Indicator.

No	Indicator	$\bar{X}$ ± Sd	Category
1	Inferring the purpose of the system	26,29 ± 0,60	Sufficient
2	Examine the character of the elements	34,25 ± 0,58	Sufficient
3	Correlating interconnections	16,11 ± 0,50	Deficient
	Average	25,55 ± 0,60	Sufficient

Based on Table 2, it can be seen that the average students' systems thinking ability is in the sufficient category with an average value of 25,55. The highest students' systems thinking ability is in the indicator of examining the character of elements with an average score of 34,25 on a scale of 100 with the sufficient category, while the lowest average students' systems thinking ability is in the indicator of correlating interconnections with an average value of 16,11 on a scale of 100 in the deficient category.

Table 3. Students' Systems Thinking Ability in Each Category.

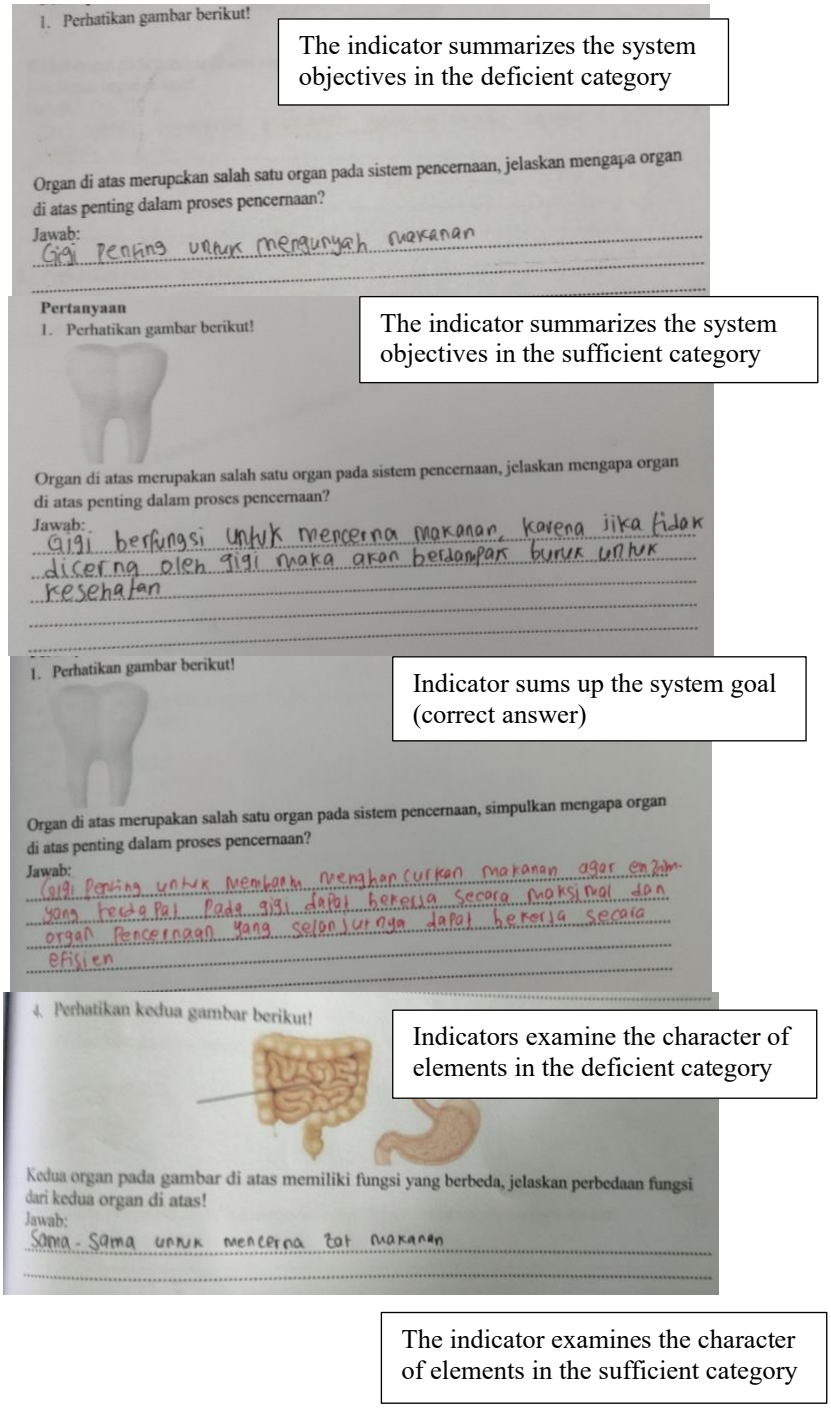
System Thinking Indicators	Category	Number of Students (%)
Inferring the purpose of the system	Very Good	0%
	Good	0%
	Sufficient	38,33%
	Deficient	61,66%
Examine the character of the elements	Very Good	0%
	Good	0%
	Sufficient	76,66%
	Deficient	23,33%
Correlating interconnections	Very Good	0%
	Good	0%
	Sufficient	11,66%
	Deficient	88,33%

Based on Table 3, it can be seen that in the indicators concluding the system objectives, 61,66% of students have systems thinking abilities in the deficient category, while 38,33% of students are in the sufficient category. In the indicator of examining the character of elements, 23,33% of students have systems thinking skills in the deficient category, while 76,66% of students are in the sufficient category. In the indicator that correlates interconnection, 88,33% of students have systems thinking abilities in the deficient category, while 11,66% of students have

systems thinking abilities in the sufficient category. As for each indicator, there are no students who have systems thinking skills in the good and very good categories.

Discussion

Based on data calculations obtained from assessments in the form of tests on students' systems thinking abilities at Junior High School 8 Bandar Lampung, it can be seen that as many as 60% of students have systems thinking abilities in the sufficient category, while the other 40% of students have systems thinking abilities in the sufficient category. less (Table 1).



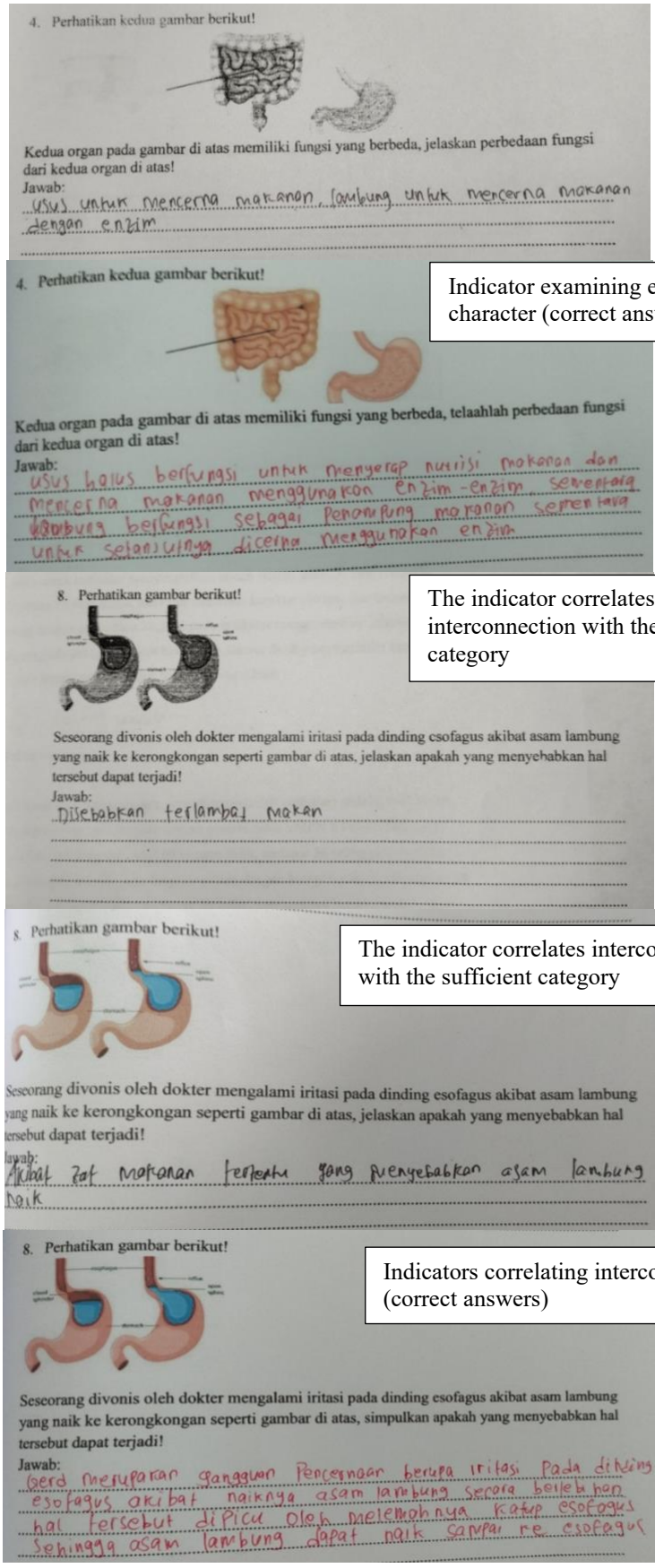


Figure 1. Students' answers to categories that appear and correct answers.

Table 2, it can be seen that on the indicator summarizing the purpose of the element, the average student gets a score of 26.29 out of a scale of 100 with the sufficient category, on the indicator of examining the character of the element, the average student gets a score of 34.25 out of on a scale of 100 in the sufficient category, and on the indicator correlating interconnections, the average student gets a score of 16.11 on a scale of 100 in the deficient category. This shows that the indicator of systems thinking ability with the highest average value is examining the character of elements, while the indicator with the lowest average value is correlating interconnections, which shows that students' ability to link components in the system is still in the deficient category. This is in accordance with research conducted by Nuraeni, et al (2020) that the indicator with the lowest score is the causality recognition indicator which has a definition similar to correlating interconnections. This is supported by the opinion of Arnold, et al (2015: 9) who define recognition of causality as a fundamental aspect of systems thinking in the form of the ability to understand cause and effect relationships and the interrelationships between system components.

Based on the calculation of the percentage of systems thinking ability in each category, the results show that students' systems thinking ability is in the poor category for the indicator of concluding the system's objectives with a percentage of the number of students of 61.66%, the sufficient category for the indicator of examining the character of elements with a percentage of the number of students of 61.66%. 76.66%, and the less category in the indicator that correlates interconnection with the percentage of students is 88.33%. This is in line with research conducted by Nuraeni, et al (2020) that students are in the category of lacking and basic systems thinking abilities. This can be proven by students' answers which show that students are only in the sufficient and insufficient categories. The following are students' answers in the sufficient and insufficient categories, as well as the correct answers that students should give.

Based on Figure 1, it can be seen that students' answers to each indicator are only in the sufficient and insufficient categories. When compared with correct answers, students' answers are still not able to show the purpose of the digestive system, the character of the elements in the digestive system, and the existence of interrelationships in the system. digestion. This is one of the impacts of implementing learning carried out conventionally and evaluations carried out without instruments based on systems thinking. This is in accordance with the opinion of Andriani & Hamdu (2021: 1326), that systems thinking abilities are in the high category if students have the ability to observe complex problems so they can answer questions by considering the relationship between one another as a whole. Apart from that, the students' answers in Figure 5 are evidence of students' low system thinking abilities. This is supported by the opinion of Rustaman & Meilinda (2021: 347) that students are not yet aware of the existence of a system in the content and context they study so that students do not experience difficulties in answering system-based questions. However, students' awareness is not sufficient if the implementation of the learning carried out is not based on systems thinking, because systems thinking abilities will increase if they

are trained in learning. The low system thinking ability of students shows that the learning implemented is not yet oriented towards improving systems thinking ability.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the system thinking abilities of class VIII students at Junior High School 8 Bandar Lampung on the main subject of the Digestive System are generally in the sufficient category

REFERENCES

Andriani, D., & Hamdu, G. (2021). Analisis Rubrik Penilaian Berbasis Education for Sustainable Development dan Konteks Berpikir Sistem di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 3(4): 1321-1336.

Arikunto, S. (2010). *Prosedur Penelitian*: *Suatu Pendekatan Praktek*. Rineka Cipta. Jakarta.

Arikunto, S. (2013). *Dasar-Dasar Evaluasi Pendidikan*. Bumi Aksara. Jakarta.

Arnold, R.D & Wade, J. (2015). *A Definition of Systems Thinking*: *A Systems Approach. Stevens Institute*, *Castle Point on Hudson*. Hoboken. NJ USA.

Assaraf, O. B., Dodick, J., & Tripto, J. (2013). High School Students‟ Understanding of the Human Body System. *Journal of Research in Science Education*, 43: 33-56.

Clark, S., Petersen, J. E., Frantz, C. M., Roose, D., Ginn, J., & Daneri, D. R. (2017). Teaching systems thinking to 4 th and 5 th graders using Environmental Dashboard display technology. *Journal of Plos One*, 12(4): 1-11.

Gilissen, M. R. G. Verhoeff, R.P., Knippels M.C.P.J., & W.R. van Joolingen. (2017). *Design Criteria for A Teaching Approach on Systems Thinking*. ESERA Conference. Dublin City University. Dublin Ireland.

Hasnunidah, N. (2017). *Metodologi Penelitian Pendidikan*. Media Akademi. Yogyakarta.

Hidayatno, A. (2016). Berpikir sistem: *Pola Berpikir untuk Pemahaman Masalah yang lebih baik*. Leutikaprio. Yogyakarta.

Nuraeni, Resti., & Himatul, A. (2020). *Analisis Kemampuan* Berpikir sistem *Siswa Kelas XI SMA pada Materi Sistem Pernapasan Manusia*. *Jurnal Pedagogi Hayati*, 4(1): 1-9.

OECD. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. PISA OECD Publishing. Paris. https://doi.org/10.1787/53f23881-en.

Plate, R., & Monroe, M. (2014). *A Structure for Assessing Systems Thinking. In The 2014 Creative Learning Exchange*.

Raved, L., & Yarden, A. (2014). Developing seventh grade students‟ systems thinking skills in the context of the human circulatory system. *Journal of Frontiers Public Health*, 2: 260.

Republik Indonesia. (2006). Undang-undang Republik Indonesia No 14 Tahun 2005 tentang Guru dan Dosen & Undang-undang Republik Indonesia No

20 Tahun 2003 tentang sisdiknas. Permana. Bandung.

Rustaman, N.Y. (2012). *Berpikir Sistem*. Modul 3 untuk program S2 Pendidikan IPA bagi PGSD. Universitas Terbuka. Bandung.

Rustaman, N.Y., & Meilinda. (2021). *Peran dan Proses Berpikir Sistem Dalam Pendidikan Sains*. Departemen Pendidikan Biologi, UPI. Bandung

Schuler, S., Fanta, D., Rosenkraenzer, F., & Riess, W. (2017). Systems thinking within the scope of education for sustainable development (ESD) – a heuristic competence model as a basis for (science) teacher education. *Journal of Geography in Higher Education*, *8265*: 1–13.

Sugiyono. (2010). *Metode Penelitian Pendidikan*: *Pendekatan Kuantitatif, Kualitatif, dan R & D*. Alfabeta. Bandung.

UNESCO. (2017). *Education for Sustainable Development Goals: Learning Objectives*. UNESCO. Paris.

Wade, J. (2011). *Systems Engineering*: *At the Crossroads of Complexity*. *In Kongsberg Systems Engineering Event*. Public AcessCo. San Diego.

Zoller, U., & Levy, N.T. (2012). From Teaching to „Know"-to Learning to „Think" in Science Education. In: Fraser, B., Tobin, K., McRobbie, C. (eds.), *2nd International Handbook of Science Education, 2nd Ed*, 1(16): 209-330.