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Enhance student ict literacy and conceptual understanding using selm (simas eric learning model)

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ABSTRACT

The Biology learning process at MAN 2 Surakarta has yet to be able to utilize technology as adequate learning support. Students still use their gadgets for things that are not related to learning. The assignments given by the teacher have yet to make much use of technology. An innovative learning model is needed to bridge technological advances in the learning process. SELM (Simas Eric Learning Model) is used in learning to determine the effect of the model on ICT literacy and conceptual understanding of class XI MAN 2 Surakarta students. There are two research instruments for ICT literacy using questionnaires and conceptual understanding using pretest and posttest on excretory system material. This study used a quasi-experimental research type with a pretest-posttest non-equivalent control group design. The data analysis technique was divided into two questionnaires using normative tests and a pretest and posttest using the N-Gain and sample tests. The results showed that the experimental class got an ICT literacy score of 81.5%, and the control class got 75%. The value of students' understanding of the concept of the experimental class got a score of 51.6%, and the control class got a score of 24.8%. The SELM is significant for increasing students' understanding of concepts and being able to increase students' ICT literacy.

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INTRODUCTION

Modern learning adapts to the learning ecology by prioritizing understanding through authentic experiences and practice and providing learning experiences in schools and outdoor learning activities (Rahayu et al., 2022). The learning curriculum also develops following the times so that students can grow to have knowledge and master 21st-century skills. Presented by Prayitno (2013), 21st-century skills that students must have, namely 1) the ability to think or way of thinking, (2) the ability to work or ways of working, (3) the ability to master tools for work or tools for working (4) Ability to live a 21st-century life or Skills for living in the world.

One of the skills in the 21st century is to familiarize students with the use of Technology, Information and Communication quickly, effectively, sustainably and efficiently (Aivazidi & Michalakelis, 2022). The urgency of using technology in a learning context has been conveyed by Asmani (2011) is that Technology Information and Communication can improve the quality of human resources. Applying technology in education, especially when learning, is innovative. Innovation to balance and equip students to keep up with the times (Helaludin, 2019). The research results from Hadayani et al. (2020) prove that technology-based learning dramatically improves learning outcomes and student motivation. The ability to use technology, information and communication media appropriately and effectively is the definition of ICT literacy (Astini, 2019).

The use of technology has begun to be applied in the high school (SMA) environment, namely technology as a learning medium and technology as a source of student learning Nuriyah & Prihatin (2020). Sudarisman (2015) states that science, including biology, physics, and chemistry, has a significant contribution to the development of technology, namely as the basic science that underlies the development of technology. Suherman (2021) also explained the importance of ICT for students, especially in biology subjects, namely being able to prepare a life that is critical, creative, competitive, able to solve problems and dare to make decisions quickly and precisely.

After making observations at MAN 2 Surakarta and interviews with biology teachers, the result is that the use of technology by class XI students is not effective and evenly distributed due to several influencing factors, including (1) Students have not used gadgets to find learning resources that can be accounted for, (2) Less use various features in applications on gadgets to do assignments because the assignments given do not require using existing applications on gadgets, (3) Many students are late in submitting assignments and late for attendance using e-learning due to signal constraints. Even so, the use of technology at MAN 2 Surakarta has begun to be updated using Ministry of Religion e-learning for online learning, and e-learning is developed using the modddle application; students can access subject matter, attendance, upload assignments, take tests with the CBT system, the biology teacher conveyed this. This website is designed to make it easier for teachers to monitor students remotely. Students can also access the material anytime and anywhere, even after the learning process in class is over. The use of e-learning is quite good; around 80% of this use is quite effective during online learning due to the Covid-19 pandemic. In addition to using this website, teachers also use other digital media such as YouTube and Google Classroom to support learning activities.

In addition to the use of technology in learning activities in the classroom and its constraints, based on the results of observations, it is also shown that the application of conventional learning models is more dominant teacher centre and dominant student listening; there is no visible contribution that varies from students. Based on the Learning Implementation Plan of the biology teacher at MAN 2 Surakarta, the learning model used is less varied. Even so, the biology teacher also said he had applied various learning models several times, namely discovery learning, STAD, and contextual learning models.

Besides the problem of low mastery of technology, understanding concepts in Biology learning could be higher. This shared understanding of concepts is caused by several factors: (1) many students are not active in asking questions, (2) they are often late in submitting worksheets, (3) they are not enthusiastic about the learning process, and (4) many students secretly activate their cellphones to be able to access social networks. Learning Biology aims to provide students with an understanding of biological concepts and their applications in everyday life. Biology discusses various basic concepts related to living processes. Referring to these characteristics, in addition to strengthening the material from the teacher, students must be able to actively search for information on their own through reading activities and study the contents independently.

A learning model that combines skimming syntax, mind mapping, questioning, exploring, writing, and communicating. SELM is a model designed to help teachers monitor student learning processes, students can make study plans, and students can evaluate their learning outcomes (Darmawan et al., 2018; Darmawan et al., 2020). Through SELM, it is hoped that the habit of using technology in learning and improving learning outcomes can be grown to increase the ability to construct initial knowledge, which can have an impact on increasing understanding of the basic concepts of biology subjects.

In each of these SELM syntaxes, researchers try to utilize technology into these syntaxes to train students' ICT literacy skills. Skimming utilizes ebooks and scientific journals from the internet to practice speed reading using digital sources that can be accounted for. Mind mapping uses applications from computers controlled by students, such as Canva, PowerPoint, and others. Writing uses the Microsoft Word application or applications that students can access. In addition, based on research (Darmawan et al., 2018a; Darmawan et al., 2020b; Alvionita et al., 2020), SELM can improve critical thinking skills, metacognitive, and student learning outcomes. So the purpose of this study was to determine the effect of SELM on ICT literacy and conceptual understanding of class XI IPA MAN 2 Surakarta, Indonesia.

METHODS

Research Design

This research is a quasi-experimental research with a non-equivalent control group design.

Table 1.
Research Design

Group	Pre Test	Treatment	Post Test
A	O_1	X_1	O_2
B	O_3	X_2	O_4

O1, O3 : Pre test concept understanding
O2, O4 : Post test concept understanding
X1, X3 : Treatment with SELM
X2, X4 : Treatment with conventional model

Research Population and Samples

The sampling technique is random because the population consists of several groups. The population is students of class XI MAN 2 Surakarta, for determining the sample through homogeneity and normality tests that have met the research criteria. This study showed that IPA 3 class was the control class and IPA 5 class was the experimental class. The research instrument used a questionnaire and a written test. The questionnaire used in this study to determine ICT literacy refers to Al Khateeb (2017) with adaptation. Then a written test to measure students' understanding of the concept.

Instrument

The instruments used in this study include treatment instruments and measurement instruments. Treatment instruments are instruments that are used to direct the process of implementing learning in class, which includes: (1) syllabus, (2) Learning Implementation Plans (RPP), (3) student worksheets, and (4) observation sheets of learning implementation. While the measurement instruments are instruments used to direct the process of measuring conceptual understanding data, which include: (1) pre-test and post-test questions for understanding concepts, (2) answer keys and pre-test and post-test scoring guidelines.

Procedure

The research procedure was carried out in the following stages (Table 2): (1) testing the equivalence of research subjects in the population for determining the sample, (2) carrying out pre-tests for understanding concepts, (3) applying SELM, and applying conventional learning models to classes of high and low academic abilities, (4) implementation of the post-test understanding of the concept, (5) data analysis.

The test instrument used for research has been validated by experts, namely, Biology Education lecturers, with a validation score of 87% with very valid criteria. Then the instrument was tested, and

content validation was calculated, including the validity of 25 valid questions and a reliability score of 0.74 > 0.6 (coefficient r); the results were reliable.

Table 2.
Quasi Experiment Research Design Nonequivalent control group design

Treatment	Group	
	Experiment	Control
Pre-test and post-test	√	√
Questionnaire	√	√
SELM	√	-

Data Analysis Techniques

The conceptual understanding data collected based on the implementation of the pre-test and post-test are first tested with prerequisites to ensure that the data distribution is normal and homogeneous. The concept understanding data normality test was conducted to test whether all data groups were normally distributed. The normality test used the Kolmogorov-Smirnov test with a significance level of 0.05. The homogeneity test was carried out by Levene's Test of Equality of Error Variances at a significance level of 0.05. Normal and homogeneous data analysis was followed by hypothesis testing using Covariance Analysis in SPSS software.

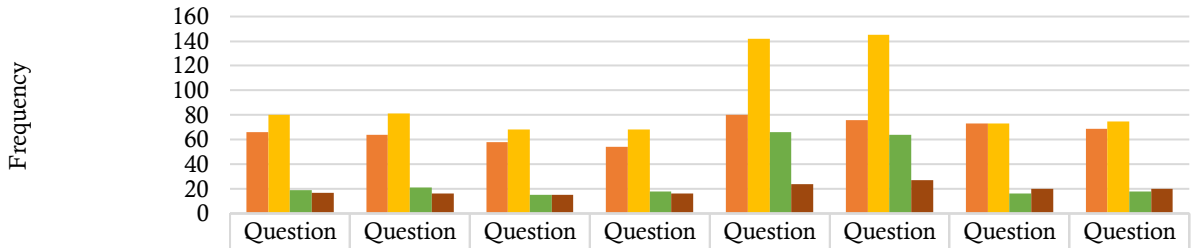
This study's hypothesis (H0) is that conceptual understanding is the same between students who take SELM and those who take conventional learning. While the research hypothesis is that there are differences in conceptual understanding between students who follow the SELM learning model and conventional learning. Hypothesis testing is based on a significance level of 0.05, where if the P-value <0.05, then H0 is rejected, and the research hypothesis is accepted. The data analysis technique used is a normative test to find out the results of the ICT literacy questionnaire and the N-Gain test, the independent sample t-test to measure conceptual understanding.

RESULTS AND DISCUSSION

Based on the research that has been done, we get an overview of (1) a description of the data on understanding the concept according to academic ability and (2) the results of the prerequisite test and hypothesis testing.

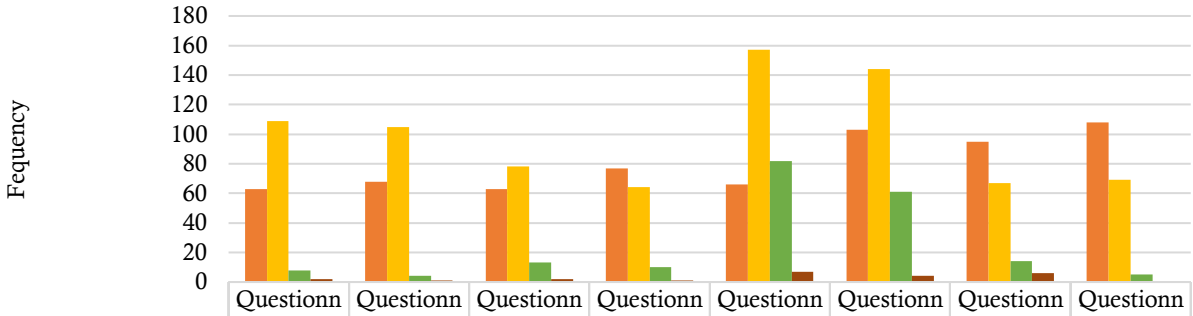
Description of students' ICT Literacy Data

This study used a sample of 50 students in class XI IPA 3 as the control class and XI IPA 5 as the experimental class from January 24 to February 23, 2022. The ICT literacy questionnaire uses a Likert scale with closed statements and four answer choices: strongly agree, agree, disagree, and strongly disagree. To find out the results of the normative test, first look for the frequency of student answers. The results of the frequency analysis are described in the graph as follows. The frequency of answers to the literacy questionnaire is shown in Figure 2.



	Information Literacy		Computer Literacy		Digital Literacy		Internet Literacy	
	Questionnaire 1	Questionnaire 2	Questionnaire1	Questionnaire 2	Questionnaire 1	Questionnaire 2	Questionnaire 1	Questionnaire 2
Strongly Agree	66	64	58	54	80	76	73	69
Agree	80	81	68	68	142	145	73	75
Disagree	19	21	15	18	66	64	16	18
Strongly Disagree	17	16	15	16	24	27	20	20

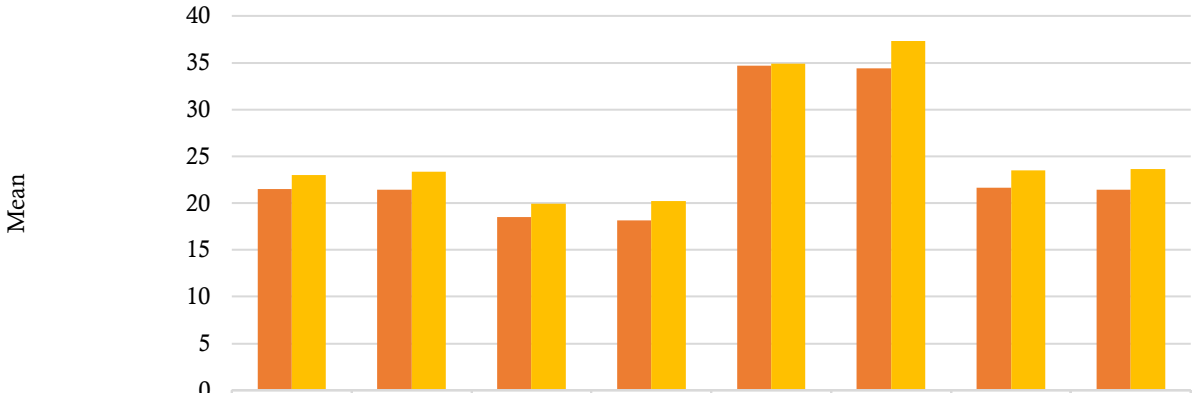
Figure 1. Frequency of Answers to the Tick Literacy Questionnaire in the Control Class



	Questionnaire 1	Questionnaire 2	Questionnaire 1	Questionnaire 2	Questionnaire 1	Questionnaire 2	Questionniret 1	Questionnaire 2
	Information Literacy		Computer Literacy		Digital Literacy		Internet Literacy	
Strongly Agree	63	68	63	77	66	103	95	108
Agree	109	105	78	64	157	144	67	69
Disagree	8	4	13	10	82	61	14	5
Strongly Disagree	2	1	2	1	7	4	6	0

Figure 2. Frequency of Tick Literacy Questionnaire Answers in the Experimental Class

The control class graph shows fewer numbers than the experimental class. The experimental class graph shows a higher number. In the second questionnaire, in the control class, there was a decrease in the number. In the control class, there was no significant increase in ICT literacy. While the experimental class in the second questionnaire there was an increase in numbers, there were significant differences in the first and second questionnaires in the experimental class. After knowing the frequency results, the mean in control and experimental classes is obtained as follows (Figure 3).



	Pretest	Postest	Pretest	Postest	Pretest	Postest	Pretest	Postest
	Information Literacy		Computer Literacy		Digital Literacy		Internet Literacy	
Mean Control	21.5	21.42	18.5	18.15	34.69	34.38	21.65	21.42
Mean Experiment	23	23.38	19.96	20.24	34.92	37.31	23.52	23.65

Figure 3. Graph of mean Literacy Questionnaire

Based on the average score of the ICT Literacy questionnaire, control class students got a lower average than the experimental class. The class that used SELM got a higher score than the control class that did not use SELM. The normative test of the control class for the number of first and second questionnaires was 75.6%, with a strong category and an average total score of 623.125. The normative test of the experimental class in the first and second questionnaires amounted to 81.7%, with a firm category and an average total score of 671.13. The difference in the normative test results for the control and normative classes was 6.1% higher than the experimental classes. Based on normative test results, which are in the range of 80% - 100% with a firm category. The results of the normative test are described in the graph as follows.

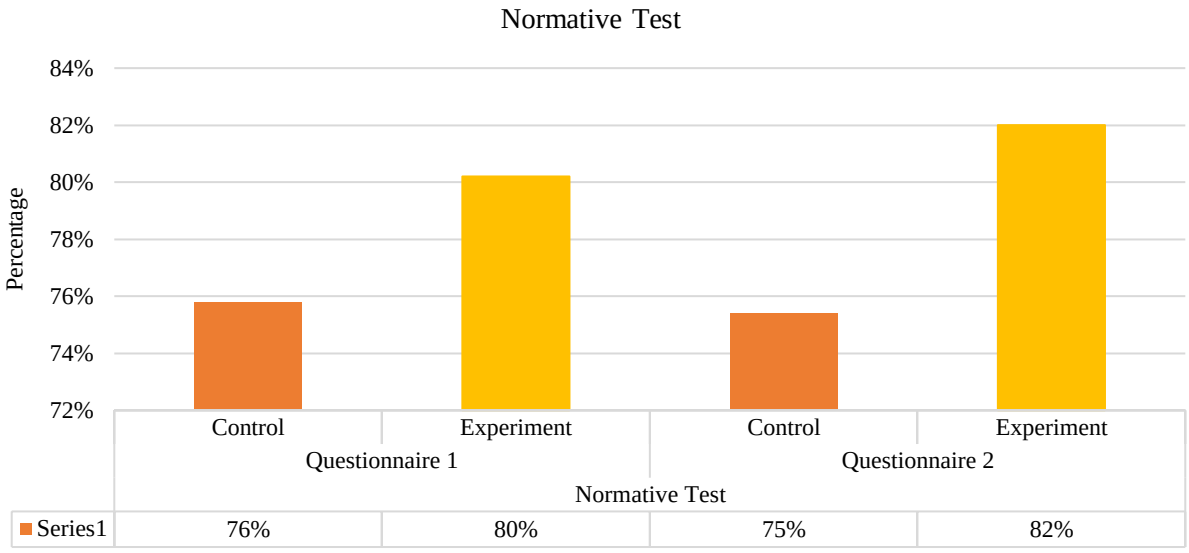


Figure 4. ICT literacy questionnaire normative test graph

Concept Understanding Data Description

Concept understanding scores were measured using the pretest and posttest in the control and experimental classes. The N-Gain test is carried out to determine whether there is an increase. The N-Gain test results for both classes are described in the following Table 3.

Tabel 3.
N-gain test results

Class	Score Average		N-Gain
	Pre-test	Post-test	
Control	33.76	49.20	24.8%
Experiment	42.56	71.52	51.6%

Based on the N-Gain test in table 4.3, the N-Gain value obtained by the control class was 24.8% which was classified as low. The N-Gain value for the experimental class was 51.6% which was classified as a medium based on the N-Gain test score category in the table, and the difference was 26,8% higher experimental class. With a significant difference in the N-Gain value between the experimental class and the control class, it can define the application of the SELM in the experimental class more effectively than conventional learning models in the control class. To strengthen the results of the N-Gain value, an independent sample test was carried out to obtain actual results that can be defined using existing theory. The t-test value used is E.variances assumed because the data is typically distributed and homogeneous, then in the Sig column. (2-tailed) can be called significant if the value is less than α (0.05). In the Sig. 2-tailed table, the results show a significance of 0.000 <0.05, so it can be said that SELM is influential and can improve students' understanding of the concepts of class XI MAN 2 Surakarta. SELM on excretory system material is more effective than the conventional learning model, namely lectures. The test results of the independent sample test are as follows (Table 4).

The effect of SELM on students' ICT literacy

Referring to the cognitive domain, according to Bloom which will be achieved in learning and paying attention to the unique characteristics of SELM, SELM has the potential to meet these learning demands. This is because SELM, in its learning stages, allows students to force themselves to read, look for essential parts of the material, create mindmaps, make questions and then enable collaborative work to answer their questions (Darmawan et al., 2017).

SELM facilitates students with cooperative work, providing opportunities for students to convey ideas, listen to other people's ideas, and reflect on their ideas on other people's ideas. This is a form of individual empowerment experience (Silva, 2021). The interactive process with colleagues helps construct knowledge (Pohl et al., 2021). Social interaction is essential in forming cognition (Richmond

& Striley, 2001). According to Slavin (2009), collaborative work will improve student relationships in groups, enable peer tutoring for high and low academic students, and increase self-esteem (individual assessment of the results achieved). In line with Vygotsky's (1978) theory regarding the Zone of proximal development (ZPD), Shabani et al. (2010) explained that for students, the best learning time is when working in collaborative groups, studying with peers who are more intelligent and who teach the material and then can internalize new concepts.

Tabel 4.
Independent sample t-test test results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
N-Gain	Equal variances assumed	.053	.819	4.564	48	.000	26.83109	5.87893	15.01071	38.65147
	Equal variances not assumed			4.564	47.684	.000	26.83109	5.87893	15.00869	38.65349

SELM is one lesson that encourages students to construct knowledge and skills personally. Allowing students to submit answers to questions, listen to other people's ideas, and reflect on their ideas on other people's ideas is a form of individual empowerment experience, as stated by Salmon & Barrera (2021). The interactive process with colleagues helps the knowledge construction process. SELM adheres to a constructivist view, which allows students to get information not only from prior knowledge but also discussions with colleagues; where according to Muslim et al. (2020), students are generally directed to read the material, foster independence in making mindmaps, increase collaboration among students, increase motivation to learn, and improve understanding of the concept.

During the skimming and mind mapping stages, students conduct a study and, seek important information from the material, organize the material to be read; the next step is to create a mindmap which will activate previous knowledge, sorting out material that is deemed appropriate for the development of constructive knowledge (Zubaidah, 2014). At the questioning, exploring, and writing stages, students are accustomed to asking questions to build their knowledge, make decisions and solve problems which, in the end, can combine and create relationships with new concepts. The learning conditions created by SELM will be able to develop the habit of thinking hierarchically, in line with the statement of Wang & Yoon (2021); with this habituation, new knowledge will easily associate with old knowledge that students already have. In particular, the linkage between the syntax sequence and the dependent variable is as follows.

Skimming is a speed reading technique for a specific time (Romlah, 2019). The skimming reading technique is a metacognitive skill by digging up information independently to get the essence correctly (Darmawan et al., 2020). Syntax skimming is carried out by students independently at home; this skimming is a series of independent learning to gather information about the material to be studied together in class. Students are free to read from various sources that can be accounted for by the information in them and free access to scientific journals, ebooks, and websites other than blogspot. According to Bhandari, Chopra & Singh (2020), students prepare themselves and seek information in advance before studying in class, which is a good habit to teach students. Through self-directed learning, students come to know that learning is a necessity. The importance of independent learning is also conveyed in Ibrahim's research (2012), which states that the benefits of independent learning before class learning are fostering responsibility, creative thinking, critical thinking, and fostering strong self-confidence.

Using technology to find and process information effectively is one of the skills in ICT literacy, namely information literacy (Yustika & Iswati, 2020). Skimming steps can be done by utilizing reading sources from the internet, namely scientific journals, ebooks, and official websites other than blogspot.

This activity trains students to sort information from scientific sources on the internet. The results of the questionnaire show that the mean information literacy has increased, although slightly, namely 0.23. Even so, based on the researcher's notes in the class, students became proficient at sorting out information from the internet. Student skimming activities can be seen from the mind maps made by students; the information conveyed follows the material to be discussed, there are main ideas, and the students themselves can understand them.

Mind mapping is the result of reflection from skimming; then, students create works by pouring information from what they read by making mind maps (Darmawan et al., 2015). This syntax is done independently by students at home. The media students use to make mind maps uses applications that are mastered; students can use Canva, Microsoft PowerPoint, etc. This study did not use print or written media because researchers associated it with ICT literacy skills. The result is that students are creative and free to do work. There was a study in 2010 which linked the mind mapping method to improving speed reading skills or skimming. The study concluded that mind maps could improve speed reading skills with a t count of 4.62, more remarkable than t table 2.62 with a significant category (Firdaus, 2010). The mind map method can also improve speed reading or skimming skills. Skimming reading techniques can improve critical thinking skills (Martinis, 2012). So this mind-mapping method can also train students' thinking level abilities (Astriani et al., 2020; Machado et al., 2020).

Besides improving speed reading and critical thinking skills, mind maps can train computer and digital literacy skills (Zheng et al., 2020). The results of this study in the experimental class increased the computer literacy score by 2%, from 82% to 84%. Besides that, during class learning, students were skilled in operating laptops and LCD projectors and using various applications such as Microsoft Word. and PowerPoint. In line with the opinion of Pentury et al. (2020) stated that mind maps can train critical thinking and communication skills and initiative and curiosity.

Questioning is vital to improving the quality of learning processes and outcomes. Asking questions is also part of successful classroom management (Royani & Muslim, 2014). Asking questions can describe individual mindsets; thus, students who ask show their inner mindset; students think about something, then discussions occur between themselves, and questions arise based on the knowledge within them (Yamin, 2007).

Asking questions in this study was carried out independently by students after speed reading and making mind maps. Questions can be written on the mind map, written on google classroom, or submitted during learning; the questions made are directed to the types of high-level questions, namely why and how. The obstacle in this study was that no students wrote questions on the mind map, but many students submitted questions during the lesson. Excretory system material is a body's metabolic process, so students ask a lot about excretory system disorders and urine formation.

Students who ask many questions have more enthusiasm than students who do not ask; besides that, students who ask a lot can answer friends' questions in a language that is easy to understand. This was conveyed by Darmawan et al. (2020), which stated that asking questions is one of the higher-order thinking skills. This was also conveyed by Yamin (2007); asking is a form of mindset, and asking is included in the thinking process.

Students who ask have read and have done the mind map. Many questions arose during the discussion, and students asked and helped each other answer. By asking for a discussion activity will appear, students can respond to each other's questions and can answer with the knowledge they have, so students who are not focused can refocus because of exciting discussions, the appreciation given by the teacher is also critical because it can increase student enthusiasm (Hsu, 2018).

Active discussion from students and correct feedback from the teacher can make learning more exciting and active. Communication skills with other people are very beneficial for students; these results are conveyed by asking questions which have functions including (1) Can foster curiosity, (2) Encouraging students to learn actively, (3) Practising problem-solving skills, (4) Conveying knowledge that students understand after learning, improves argumentation skills, (5) Discusses, thinks, and draws conclusions, (6) Builds an attitude of openness to accept other people's opinions, (8) Familiarizes students to be able to think quickly and swiftly on new information and respond swiftly.

In Exploring syntax, Darmawan et al. (2015) conveyed that exploring the syntax of SELM is examining questions to find answers. Then it experiences an expansion of meaning; the teacher gives students time to discuss in groups to find solutions (Darmawan et al., 2020). This activity takes place during class discussions.

Questioning and exploring in research are almost no different, but according to SELM syntax, questioning activities are carried out independently at home by making questions on mind map sheets. Because students do not include questions on mind maps, questioning activities take place in class together with exploring the syntax. So in this syntax, new students submit questions orally then other students look for answers by opening printed and internet learning resources to reach conclusions and agreement on answers.

During exploring activities, students focus on learning to discuss, answer, and seek answers. When exploring, students make the most of their five senses to interact with the environment in the classroom; from this activity, it is hoped that an imbalance will appear in their mental structure so that questions arise that lead to questions of why and how (Dasna & Rahayu, 2005). Furthermore, it is conveyed in the exploring phase, one of the signs that students are ready to take on the next phase, namely the concept introduction phase. Based on this opinion, the exploring phase is one of the syntaxes that can increase students' understanding of concepts.

Writing syntax is part of language activities that are active and productive (Abbas, 2020). The writing syntax in this study used the Microsoft Word application, PowerPoint, or written media as a writing medium, then scanned and downloaded on Google Classroom. It could not be collected immediately; some students had yet to finish completing their writing assignments after learning was given one day. The benefit of this writing activity is that in the next meeting when asked questions about the previous week's meeting material, some students still remember because students make a summary of the answers to the previous meeting's questions.

Writing has benefits for students to support learning and improve students' thinking levels, conveyed by Suparno and Yunus (2007) regarding the benefits of writing, among others, clarifying concepts and ideas, helping to absorb and process information, and training yourself to think actively. Writing makes it easier for students to remember the material and trains students to make summaries efficiently. Writing skills from excellent and correct information can be appropriately stored in the brain. More precisely, for students who are used to reading good and correct information and writing in their notes, the brain will store it properly for a certain period (Abbas, 2020).

Syntax communicating in this learning model is an activity in which the teacher gives time for students to present mind maps and discuss with students the available learning time (Darmawan et al., 2020). This research was conducted to confirm the answers to the questions and to be able to conclude the material that has been studied. Communication is included in students' metacognitive skills. In communicating activities, learning and teaching activities occur between students (Sato & Dussuel, 2021). Discussion activities in the classroom took place effectively; many students were enthusiastic about discussing with the groups that had been formed. After the discussions, the students also conveyed answers to each other's questions, and the language conveyed was easily understood by the questioner. Not all students actively discussed students who actively discussed from the first meeting using the SELM; there were only a few 3-5 people because they were still not used to asking questions. At the end of the lesson, students also dared to convey conclusions about the excretory system material that had been studied during the learning activities. Communication and writing skills are included in verbal-linguistic intelligence (Iyan & Irvaniyah, 2013). Furthermore, Salfa & Chaniago (2020) conveyed that linguistic intelligence is the advantage of using vocabulary to form sentences orally and in writing. The implication of the findings of this study in learning is that increasing understanding of concepts can be done by involving students in complex tasks and exposing students to problem-solving. Challenging students to answer questions or problems through analysis, synthesis, and evaluation provides an authentic learning environment that can help students improve their problem-solving skills collaboratively.

CONCLUSION

SELM affects the ICT literacy of class XI MAN 2 Surakarta students with a normative test percentage of 83% which is 8% higher than the control class, which is equal to 75%. Understanding the SELM concept can increase the ability to understand concepts based on the n-Gain test. The results of the experimental class get a score of 51.6% in the medium category, which is higher than the control class, with 24.8% in the low category. The results of calculating the corrected average have also been carried out to find differences in the increase in understanding of concepts that occur in students after learning with SELM and conventional models. Based on the calculation of the corrected average, the

increase in conceptual understanding of students who studied with the conventional model was 22.4%, while for students who studied with SELM was 143.92%. When compared, in the SELM, students experience an increase in conceptual understanding of 88.67% higher than in the conventional model.

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