



A Case Study of Students' Motivation in Learning Human Excretion System

¹Nurjannah Hanum Mahmudah Siagian, ²Anisa Rahmawati, ¹Eliyawati, ^{1*}Eka Cahya Prima

¹Department of Science Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

²SMP Kartika XIX-2, Bandung, Indonesia

*Corresponding Author e-mail: ekacahyaprima@upi.edu

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Abstract

This research investigates the influence of problem-based learning (PBL) on students' motivation within the context of the excretory system topic in the classroom. Despite introducing various innovative teaching models, student motivation still needs to improve to learn science, prompting the need for practical pedagogical approaches. This study used a case study design, utilizing validated observation sheets and questionnaires as instruments for data collection. With 25 students and one science teacher involved as a sample, qualitative and quantitative data are collected and analyzed through narrative descriptive and transcript analysis and the Rasch model, specifically employing Wright Map and Scalograms value. The findings indicate inadequate implementation of problem-based learning in the teaching excretory system, resulting in persistently low student motivation. Instead of implementing a problem-based learning model, the teacher adopts a teacher-centered approach to deliver the excretory system topic. This leads to minimal active student involvement and engagement in teaching and learning.

Keywords: motivation, excretory system, science classroom observation

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INTRODUCTION

Motivation is one of the most critical aspects students must possess during learning. It is recognized as a fundamental force that guiding student toward their goals. Motivation could be either intrinsic or extrinsic, and the other specific factors. In science, motivation is essential to enhance students' conceptual change processes, critical thinking, learning strategies, and achievement. It necessitates a high level of motivation from students, as it drives their enthusiasm to learn and develop the skills in scientific performance (Taştan et al., 2018).

Science education is widely considered to be pivotal for the knowledge-based economy and the intellectual growth, particularly in developing societies (Taştan et al., 2018). By instilling relevant skills in science education, it contributes to the development of students' life skills, including critical thinking and problem-solving abilities. In order to achieve that, science education should cultivate scientific reasoning by involving students in the process of analyzing and interpreting data, as well as constructing and evaluating experimental designs (Osborne, 2013).

To build such behavior, there is a term of continuing motivation. Continuing motivation, specifically in science learning, is deep interest in scientific content and activities comes from within and not reliant on external rewards. The motivation stays consistent across various

situation, even when alternative choices are available (Fortus & Vedder-Weiss, 2014). Continuing motivation is part of lifelong learning in this 21st century era. It means that having continuing motivation in the student will promote education for sustainability as well. Students' motivation to engage in science learning outside of school is essential to gain higher achievement and achieve the purpose of learning science.

Regrettably, the students' motivation in science learning in Indonesia, is relatively low. In a public school in Bandung, the motivation levels among students are distributed as 16% having low motivation, 77% having moderate motivation, and only 7% having high motivation (Hani & Suwarma, 2018). Similarly, in a public school in Bengkulu, 24 out of 36 students scored below the minimum standard of 75. It indicates lower learning achievement and motivation to learn science (Dayeni & Irawati, 2017). The leading causes of lower motivation among students in science learning are their perception that science is not fun and challenging to understand. This leads to a need for more initiative in their learning process. Additionally, this phenomenon may be influenced by several other factors, such as the teaching approach that still revolves around the teacher, the use of conventional lecture-based teaching methods, and the utilization of unengaging learning resources that fail to capture the attention of students (Widyawati & Prodjosantoso, 2015).

Teachers and researchers have led to innovative developments in teaching to increase students' motivation. They have been striving to innovate by utilizing appropriate media and implementing sophisticated teaching models and approaches. For instance, implementing the "moving class" approach has indirectly influenced students' learning motivation (Marina, 2019). Furthermore, developing science comics has been proven effective in enhancing students' motivation to learn (Widyawati & Prodjosantoso, 2015). Another approach that has shown promising results is project-based learning (PjBL). It is a student-centered educational approach, and its core principle is to have students involved in real-world activities, interact with each other, and share knowledge to achieve learning objectives (Kokotsaki et al., 2016).

Problem-based learning (PBL) also included being a part of the pedagogical strategies to enhance learning motivation. PBL begins with examining the contextual problem, followed by a phase of self-directed learning, and concludes with a subsequent reporting stage (Yew & Goh, 2016; Muhson, 2009). The previous research using the PBL model with audio-visual media also indicated the effectiveness toward student motivation (Novitasari et al., 2015). In addition, contextual problems in the PBL model have effectively enhanced students' curiosity and motivation (Suari, 2018). In line with the latter, integrating the PBL model in science classes improved students' motivation and learning outcomes (Sukmini Arief et al., 2016; Dayeni & Irawati, 2017).

The study on excretory systems for secondary school student has been existing. Most of them are focusing on developing learning media. For instance, developing a picture storybook, which can affect students' interest (Panjaitan et al., 2021). Then, developing problem-based learning with a project, it shows a positive impact on improving students' scientific and information literacy (Juleha et al., 2019). Next, the use of role-playing in the class, it showed the improvement on students' activity and cognitive learning outcomes (Adiba et al., 2018). And, developing cooperative integrated reading and composition learning model based on scientific approach (Cirsa) as more effective model for learning human excretory system (Djamahar et al., 2020).

On the other hand, there are also studies that are occupied by survey and investigation. Some of them will be elaborated in the following sentences. Firstly, the descriptive survey on human excretory system in junior high school, which investigate students' scientific literacy (Darmi Amir et al., 2023). Followed by a survey on students' scientific explanation skills focusing on human excretory system, which concludes with a moderate-low category (Farida et al., 2021).

As mentioned, students' motivation in science classrooms needs to be higher but no study has been conducted to investigate it. Specifically, there is no research has been conducted on

observing the real students' activities in the class and profiling their learning motivation towards science. In order to address this issue, this study necessitates a comprehensive understanding of the actual state of students' motivation in learning science, with a specific focus on the excretory system. Likewise, it is crucial to ascertain the actual implementation of the PBL model in the classroom and evaluate its effectiveness in enhancing students' motivation to learn about excretory systems. here

This research will describe students' activities, and teacher performance affect students' motivation in learning science, particularly in the excretory system. Therefore, this research will observe and analyze the relationship between students' motivation and classroom activities using problem-based learning approaches at one of the private schools in Bandung. This study aims to determine the level of student's motivation in learning the excretory system.

METHOD

This research used a case study design to investigate a classroom activity and process in-depth. The research process encompassed several steps. Firstly, a sample school and class were carefully selected. Subsequently, permission was obtained from the school and teacher to conduct the observation and collect the data. The instruments used in this study were thoroughly validated, and lastly, conducted the data collection followed by rigorous analysis and interpretation of the gathered information. The sample of this study is 25 students in VII grade and one science teacher expert in biology at one of the private schools in Bandung.

The instruments used include observation rubrics and a questionnaire. The observation rubrics were used to collect data on classroom management, teacher performance, and student activities within the class. These rubrics underwent validation by three lectures who are experts in science education, and they provided suggestions for revisions, most of them are “clear the statement or specify the questions”, and these issues have been incorporated.

On the other hand, the questionnaire is the tool for measuring students' motivation towards science learning. This questionnaire instrument was developed by Tuan (2005) and consist of 35 statement items. The Cronbach alpha of the items is 0.89, with each item's scale ranging from 0.70 to 0.89. This means the questionnaire has shown a significant correlation with students' science attitudes and science achievement test in the previous semesters, therefore, confirming its validity and reliability. However, in this research, the focus is on three scales: self-efficacy, active learning strategies, and the values of science learning, which results in the use of only 23 items of questions. The questionnaire was originally in English but has been translated into Bahasa since the students' native language is Bahasa. The translated questionnaire has also undergone validation by three lectures who are experts in science education and native speakers of Bahasa. They provided suggestion to use more common words or daily words, and the items have been revised accordingly before being administered to the students. A Likert Scale was employed to measure students' responses, featuring four options for answers. The scoring for each answer option is detailed in the Table 1. These rubrics underwent validation by lecturers who are experts in science education.

Table 1. A score for each answer

Alternative answer	Positive item score	Negative item score
Strongly agree	4	1
Agree	3	2
Disagree	2	3
Strongly disagree	1	4

Source: (Siregar, 2013)

The types of data collected include qualitative and quantitative data, which encompass the learning implementation process, data from teacher and student observations, rubrics,

students' motivation from questionnaire instruments, the recording of the session, lesson plan, student worksheet, and learning media used. This data is analyzed using narratives to describe the results qualitatively, moreover, by accurately describing the facts and qualities (Cresswell, 2017). Besides that, student motivation results were described by analyzing students' responses using Wright Maps and Scalograms with the Rasch model assisted by Minister software. The Wright Map is a tool that presents a visual representation of items, illustrating the difficulty of the questions about the test takers' abilities. It provides information to compare the candidate's performance with the difficulty of the questions (Mary et al., 2010). The greater the person's measure, the higher their test performance. Conversely, a lower personal measure corresponds to poorer test performance (Boone, 2016). Wright Map displays the mean (M) and two standard deviation points (S and T) for both measured candidate ability and item difficulty.

On the other hand, a graphical scalogram presents the data matrix in a unique triangular pattern representing an ideal scale (Abdi, 2010). The analysis of Wright Map data can provide insights into identifying genuinely motivated students and those who are not. Additionally, using a scalogram can help determine the level of seriousness exhibited by students in their responses.

RESULTS AND DISCUSSION

Students' activities in the science classroom

At the beginning of the teaching-learning activities, the teacher initiated the class by greeting the students and inquiring about their preparedness for the science lesson. The students responded affirmatively, expressing their readiness to engage in the learning process. However, careful observation showed that the students' non-verbal cues and attitudes did not align with their verbal responses. For instance, a group of students was observed engaging in casual conversations. In contrast, in another area of the class, a student was engrossed in social media activities on their mobile phone. The teacher endeavored to foster student engagement by establishing a connection between the concept of excretion within the framework of everyday life. However, the students displayed moderate interest, yet their overall participation remained passive. They primarily responded to the teacher's basic inquiries, providing concise answers with little inclination towards active participation or extensive elaboration. Classroom activities can be seen at Figure 1.



Figure 1. Classroom activities

Teacher: In the previous meeting, I explained that the excretory system is related to trash.

Students: Trash, miss?

Teacher: Yes. It relates to metabolism. So, for example, hmm, what will you do in this school if there is a pile of trash?

Student: Throw it away.

Teacher: Yeah, it works the same way with our body. Our body also has that kind of system called the metabolism system. This metabolism system results in waste substances piling up inside our bodies. Moreover, if this trash is not excreted out of our bodies, what will happen?

Student: It can cause disease.

The conversation above revealed a classroom scenario where the teacher held the central role while student participation was minimal. The level of student engagement remained limited, with only a small subset of students actively participating in class activities. Regrettably, most students lacked proactive involvement, as evidenced by the absence of raised hands for questions or sharing opinions. Notably, a student posed a question, although it did not simulate an intellectually stimulating discussion that encourages mutual learning or higher-order thinking skills.

Student: Is the liver different from the heart, Miss? (Not raising her hands, she asked directly to the teacher)

Teacher: Yes, it is.

Student: If we are experiencing a broken heart? What is that, Miss?

Furthermore, it was observed that a few students needed help to maintain attentive listening during the class and frequently interrupted one another. This behavior not only disrupted the flow of the lesson but also interfered with effective communication among the students. Additionally, one student kept playing with his phone from the beginning of the lesson, disregarding the teacher's instructions. Consequently, the teacher was compelled to confiscate the phone to promote a more focused learning atmosphere. The classroom observation depicted a teaching-learning situation where the teacher-centered approach was applied. The teacher tried to engage students and relate the excretory system materials to their daily lives. However, student participation remained passive, with only a few students exhibiting interest and engaging in off-task behavior, such as chatting, phone usage, and interrupting one another. This lack of student participation hindered the overall learning experience and limited opportunities for gaining meaningful learning.

There are several reasons why students behave like that. First is the learning environment. Student learning environment is essential as the stimuli to enhance students' motivation and the conducive learning environment enabling student to learn well (Puspitarini & Hanif, 2019). 2011). Conversely, the learning environment in the class is not conducive at all. There are many noises from the outside, which are more attractive to students to listen to rather than the lecturing from the teacher.

Second, the learning media. Learning media is a tool for presenting information in teaching and learning process also to attract students' attention. As the utilization of student learning media, it has a simultaneous and substantial impact on student learning outcomes (Yuliansih et al., 2021). It helps the teacher to deliver the materials and make students be more easily to comprehend the instructional media (Tamrin et al., 2017). Nevertheless, in the real situation, the media that the teacher used is not appropriate for junior high school students.

As shown at Figure 2 below, the PowerPoint has many words and fewer pictures. Teacher did not use variation of color in the background or words to emphasize the material. Teacher only gives a definition and simple examples on the media. The media is not attracting for students at all. Additionally, the video shown during the lesson did not provide an audio

because of lacking facilities. Even so, the audio is the easiest things to attract students' attention and make them more focus.

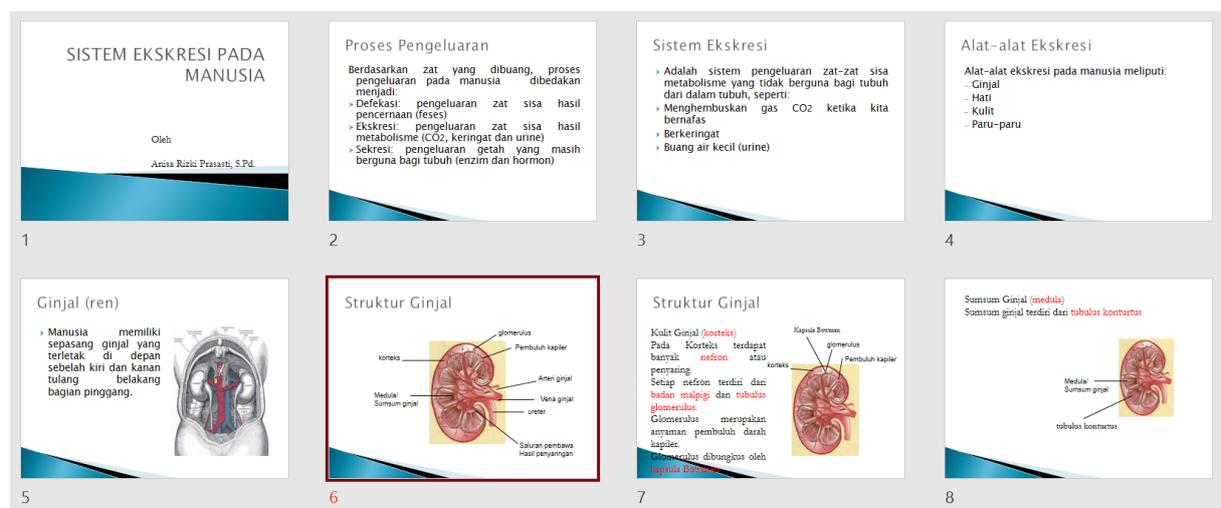


Figure 2. PowerPoint Human Excretory System

Third, the teaching model and approach. The lesson plan stated that the excretory system class will use problem-based learning. In contrast, the teacher only carried out lecturing mode and more into a teacher-centered approach. Teacher did not provide contextual problem for student to engage in the lesson and only asks students participation on answering simple question which the answer has been provided in the text book or PowerPoint.

Teacher's performance in teaching human excretion system

The teacher demonstrates a deep understanding of the excretory system and always employs analogies that make it easy to understand. For instance, the teacher poses questions about activities involving excretion, such as sports or urination, and explains how the bladder works with a bottle analogy. However, the teacher assumes a dominant role in the conversation, primarily asking students straightforward questions like "fill-in-the-blank" style queries.

While teaching the excretory system, the teacher applied the remembering stage of the teaching-learning process. This is proven as the teacher repeatedly asked the same questions, aiming to help students recall and retain the steps involved in the excretory system.

Teacher: Okay, let us repeat it. The first process in urine production, what initiates it?

Students: Filtration

Teacher: What is filtration?

Students: Filtering

After a couple of minutes, the teacher asked again

Teacher: So, how many steps are there in urine production?

Students: Three

Teacher: What is the first step?

Students: Filtration

The teacher is significantly consolidating the students' memory. This delivers the student into lower-order thinking skills. The teacher did not provoke the students to ask critical thinking questions. In inlines with the idea of Bloom's taxonomy, cognitive skills are divided into six levels, the first three levels are remembered, understand, and apply, which are commonly known as lower-order thinking skills (LOTS), and the following three levels are analyzed, evaluate, and create. The remembering stage is at the very bottom of Bloom's taxonomy, and only the level of thinking represents memorizing or recalling information (Qaswari & Beni, 2020). Two main factors are causing the lower level of cognitive skills. First, the nature of the science curriculum. And second, the learning environment (Saido, 2018). This

research ensures that the learning environment built by the teacher discourages the student from beginning to think scientifically and disengages the student in thinking.

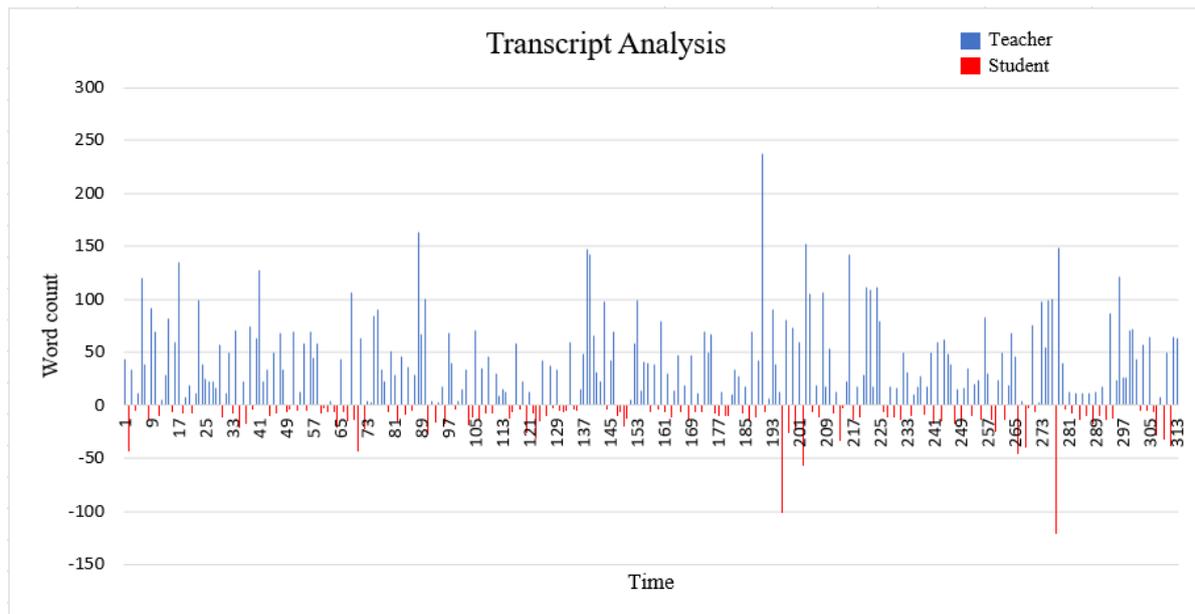


Figure 3. Transcript analysis

In addition, based on transcript analysis, as illustrated in Figure 3, provides valuable insights into the dynamic of the classroom conversation. The chart displays the number of letters retrieved from the entire transcript. The blue lines of the chart represents the teacher's dialogue, while the red lines shows the transcript of the student's dialogue. The vertical line indicates the index value, denoting the recorded dialogue throughout the transcript. The learning transcript analysis results show that the teacher plays a central role during the lesson, and students are not actively participating in the class. This observation shows that the teacher's performance was needed to sufficiently engage the student's involvement and represent the inquiry teaching-learning style.

In line with the previous results, the teacher is positively making a teacher-centered approach during the teaching excretory system. This approach is a traditional teaching style in which the teacher is the center of knowledge and in charge of all learning activities, and the students usually passively receive information. The effectiveness of traditional teaching methods, such as lecturing, must be reconsidered to foster students' competencies (Cebrián et al., 2020).

In teaching, the teacher tends to need more motivation to possess innovation in the teaching process. Furthermore, the teacher will directly answer the questions the teacher raises without concerning students' involvement (Emaliana, 2017). It can cause students to get bored quickly and miss valuable opportunities to share the inquiry process with their peers.

Students' Motivation in the Learning Human Excretion System

The inadequate implementation of problem-based learning (PBL) by the teacher, who predominantly relied on a teacher-centered approach to teach the excretory system, has had a noticeable impact on student's motivation. It can be substantiated by the data in the figure below, which presents empirical data illustrating a notable decline in students' motivation.

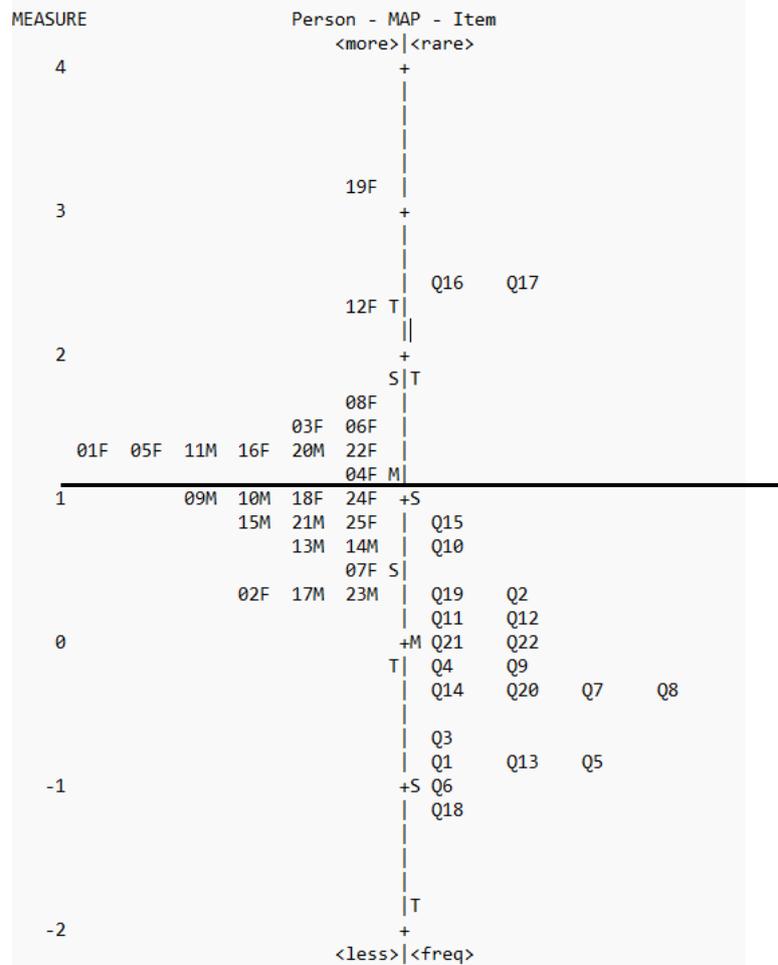


Figure 4. Wright maps data

The logit mean value of 1.16 is a threshold in the provided figure, represented by a straight line. Students who attain scores below this threshold need more motivation to learn the excretory system. Conversely, students who achieve scores above 1.16 are regarded as displaying motivation during the learning process. It is remarkable that the majority of students, 14 out of 25, namely, 02F, 17M, 23M, 07F, 13M, 14M, 15M, 21M, 25F, 09M, 10M, 18F, 24F, and 04F, are categorized as lacking motivation. In contrast, only 11 out of 25 students, specifically 01F, 05F, 11M, 16F, 20M, 22F, 03F, 06F, 08F, 12F, and 19F, are identified as demonstrating motivation. These findings indicate that over half of the class did not actively participate in the teaching-learning process, resulting in limited acquisition of scientific knowledge and low individual or group performance among the students. Teachers' influence plays a significant role in student motivation, as the teacher does not encourage students' interest in the classroom, thereby it can lower students' overall motivation (Saro, 2023).

The observed phenomenon can likely be attributed to the absence of an interactive and student-centered learning environment. Problem-based learning fosters a student-centered approach, promoting active problem-solving and critical-thinking engagement. The deficiency of such an environment has led to a decrease in students' intrinsic motivation. Consequently, the lack of opportunities for hands-on activity, collaboration, and authentic problem-solving has inhibited students' overall interest in learning the excretory system.

GUTTMAN SCALOGRAM OF RESPONSES:

Person	Item		
	1 1 21 2211 11111		
	8613537804492112290567		

19	+4444343444444434433423	19F	
12	+4444444343433244342224	12F	
8	+34344433344333333322	08F	
3	+3343344324442244334312	03F	
6	+3434433334333333332	06F	
1	+4444431444144414443111	01F	
5	+43433433323343333422	05F	
11	+34334333443332333331	11M	
16	+443343332443323232432	16F	
20	+44333334343332342232	20M	
22	+43433343343333323322	22F	
4	+443433433243433343111	04F	
9	+23333443343333332322	09M	
10	+243343333343323323323	10M	
18	+43333332433232333432	18F	
24	+4333333334333323322	24F	
25	+44444434223323333111	25F	
15	+43433343322233333222	15M	
21	+333333343432342332312	21M	
13	+433332342224433233222	13M	
14	+33333332333333222	14M	
7	+333333323333322322	07F	
2	+23342344333223323311	02F	
23	+223333333332232422	23M	
17	+4233323342224433123222	17M	

Figure 5. Scalograms data

Using scalogram data serves as supporting data to ascertain the extent to which students have answered the questionnaire with seriousness and sincerity. Notably, upon analysis, a few students exhibit an inconsistent response pattern, potentially indicating a lack of seriousness in responding to the questionnaire. Specifically, students 09M, 10M, 02F, and 23M have raised suspicions due to their inability to provide responses that align with the most common answers given by their peers. This inconsistency raises concerns about the extent to which these students actively engaged in the questionnaire. It underscores the need to further examine their level of commitment and involvement during the data collection process.

CONCLUSION

Implementing problem-based learning in the classroom is essential for enhancing students' motivation. However, based on the results and discussion, it can be concluded that students' motivation needs to be higher in learning an excretory system with a problem-based learning approach. This study revealed that problem-based learning models need to be more effectively integrated into teaching excretory system processes in the classroom. The teacher's inclination towards a teacher-centered approach diminished student involvement, resulting in low motivation.

RECOMMENDATION

This study used general students' motivation questionnaires to be measured; perhaps the specific questionnaire for problem-based learning models might be used for future research.

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