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Identifying Student Learning Motivation Towards Acid-Base Material Through STEM-Based Multimedia Learning Using Lumio

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A B S T R A C T

This study aims to investigate the level of student motivation in learning acid-base material through the application of the STEM learning method enriched with Lumio interactive tools at SMA Negeri 11 Muaro Jambi. The method used is quantitative descriptive, involving students of class XI F1A as subjects. Information was collected using learning motivation questionnaire, which covered aspects such as learning independence, interest in acid-base topics, conceptual understanding, and enthusiasm during the learning process. From the analysis, the highest motivation score was 136 (Xmax), while the lowest was 116 (Xmin), with an ideal average of 126 (Mi) and an ideal standard deviation of 3.33 (SBi). Based on interval calculations, student motivation was categorized into five levels: Very High (if X > 130.99), High (127.67–130.99), Moderate (124.33–127.67), Low (121.01–124.33), and Very Low (if X < 121.01). The distribution results show that 50% of students are in the High category, 20% in Medium, 20% in Low, and 10% in Very Low. These findings indicate that the application of Lumio in STEM learning has a positive impact on increasing student learning motivation, as this interactive method is also effective in strengthening conceptual understanding and increasing interest in chemistry lessons.

1. Introduction

Education serves as a structured mechanism that aims to build a conducive learning environment, enabling students to actively hone their skills (Pangaribuan & Jahro, 2024). This development aspect includes spiritual and religious elements, self-management skills, character building, intellectual skills, moral values, and skills relevant to daily life and social interaction. In the same context, student motivation plays a crucial role in ensuring the success of learning activities. Strong motivation encourages students to achieve maximum learning outcomes, serves as an indicator

of ability and achievement, and contributes to the continuity of education as a whole (Schunk, D. H., Pintrich, P. R., & Meece, 2014).

Learning motivation is defined as internal-external drives that encourage active student engagement, including interest, effort, and persistence in subjects such as acids and bases. Because many students find it difficult to clearly visualize the concepts of acid and base indicators (S Putra, Abrar. And Zainul, 2024).These drives can be enhanced through STEM-based multimedia on the Lumio platform. 's ARCS theory (Attention, Relevance, Confidence, Satisfaction) measures motivation through key indicators: attention (visual interest via acid-base reaction animations on Lumio), relevance (connection to everyday life, such as pH measurement using natural indicators), confidence (belief in overcoming abstract concepts through acid-base projects), and satisfaction (feelings of satisfaction after interaction, with increased motivation) (Keller, 1987). These indicators are operationalized via a Likert questionnaire to identify variations in motivation, supported by ARCS studies in digital chemistry learning.

Chemistry learning in high school is often challenging due to its hierarchical and interrelated concepts, where a lack of basic understanding hinders complex comprehension (Ekawisudawati et al., 2021). hemistry possesses distinct features that set it apart from other areas of science (Tafani, T., & Widjajanti LFX, 2025). Acid-base material, with its complex concepts and in-depth calculations, is a difficult topic that lowers motivation (Hidayanti et al., 2022). Initial observations of this study at SMA Negeri 11 Muaro Jambi show that 65% of students in class IX F1A have difficulty understanding acid-base material. This is due to limited understanding of the material, lack of motivation, and a learning process that relies on printed materials, PowerPoint, and worksheets, which, although adequate, are not implemented optimally. Students need additional learning resources to support school-home activities. Previous studies have mentioned motivational factors: learning environment, student ability, and teacher efforts. Classroom facilities disrupt concentration, while lecture methods using only a blackboard reduce engagement. Then one of the main reasons is that learning in the classroom is often boring and requires more creative strategies to attract students' attention optimally (Avianda et al., 2024). As a result, there is an urgent need for creative instructional approaches that can make science learning more engaging, active, and meaningful (Ali, F. F., & Sari, 2025).

Previous studies show that interactive multimedia such as Lumio is effective with features such as quizzes, games, and visualizations that facilitate visual-practical understanding of acids and bases as well as student collaboration (Prayogo et al., 2024). Learning multimedia using Lumio allows students to interact actively and directly. Interactive and engaging learning aids have been proven to elicit positive responses and encourage student motivation (Mutma'inna, 2024). This can motivate students in classroom learning. In addition, the development of student skills is highly dependent on the role of teachers in imparting knowledge, so that the potential of these skills can be realized optimally (Bayindir, N., & Inan, 2008). Teachers are expected to use learning models that encourage students to develop

creative thinking skills. One strategy that is considered effective in training creative thinking skills is the application of a STEM-based learning approach, which integrates elements of science, technology, engineering, and mathematics (Irmita, 2018; Juraidah et al., 2025; Pujoko et al., 2025; Novitasari et al., 2026). An integrative STEM approach is necessary for contextual experiences, increasing motivation and engagement (Bybee, 2013).

This study aims to analyze student learning motivation in acid-base material based on STEM using Lumio. It is also expected that this study will produce a deeper understanding of student learning motivation, including the potential for increasing student motivation, as well as the use of Lumio that can be reapplied in other schools. The benefits of this study include theoretical contributions in the development of motivation measurement instruments in the STEM approach. It also provides practical support for teachers in Muaro Jambi to improve chemistry learning outcomes through observation of existing conditions, as well as socio-economic impacts in the form of increased student interest in science majors, which is in line with national education targets (Ministry of Education and Culture, 2023) and Sustainable Development Goal (SDG) number 4 on quality education.

2. Methodology

This study uses a quantitative descriptive method intended to examine, understand, and describe the research object systematically based on data in the form of language and respondent responses. Data were collected through questionnaires given to students in class XI Phase F1A at SMAN 11 Muaro Jambi. The research instrument contained a number of written questions that were answered directly by the respondents without the researcher's intervention. This research was conducted at SMAN 11 Muaro Jambi with the main data source coming from students in class XI Phase F1A. The learning media used had undergone a validation process by experts, while the classification of the validation results was determined.

In this study, the instrument used consisted of several statements presented to students during the learning process. The questionnaire was used to measure students' learning motivation in chemistry on the topic of acids and bases, which was designed using a STEM approach with the help of the Lumio interactive platform.

Table 1. Student Motivation Indicators

No Indicator	Student Motivation Indicators	Question Number
1	Initiative for independent learning	1
2	Learning Objectives	2
3	Sources of Motivation	3
4	Understanding of concepts	4
5	Interest in acids and bases	5
6	Ease of access to media	6
7	pH simulations in STEM multimedia such as Lumio will capture students' attention while learning. (attention)	7

8	Acid-base material is relevant to my daily life, such as the pH of food, especially when aided by Lumio. (relevance)	8
9	Media can help understand acid-base experiments without much difficulty. (confidence)	9
10	Interactive learning tools like Lumio will make me enjoy learning chemistry. (satisfaction)	10
11	Enthusiasm in learning	11
12	Curiosity about acids and bases	12
13	Clear learning objectives	13
14	Perseverance in the face of difficulties	14

The validated data was then processed to obtain information including comments, suggestions, and input from respondents. Next, the level of student motivation in learning chemistry was calculated based on the intervals presented in Table 2 below:

Table 2. Interval of Ability Level Scores

No	Ability Interval	Level
1	$Mi + 1.5\ Sbi < 0$	Very High
2	$Mi + 0.5\ Sbi < 0 \leq Mi + 1.5\ Sbi$	High
3	$Mi - 0.5\ Sbi < 0 \leq Mi - 1.5\ Sbi$	Medium
4	$Mi - 1.5\ Sbi < 0 \leq Mi - 0.5\ Sbi$	Low
5	$0 < Mi - 1.5\ Sbi$	Very Low

With:
- Mi: ideal mean
- Sbi : ideal standard deviation
- Xmax: highest score
- Xmin: lowest score

3. Results and Discussion

T Results The validation process was carried out to ensure that the indicators used were truly effective in measuring the expected achievements or competencies at the time of evaluation. The results of the instrument validation showed a score of 58 in the very feasible category and an average score of 4.4, in accordance with the instrument assessment criteria that are as stated by (Widoyoko, 2012) . In addition, the validators also provided a number of inputs and comments that were used as a reference in conducting the research. The results of identifying student learning motivation in STEM-based acid-base chemistry learning show the average value, standard deviation, highest score, and lowest score presented in Table 3 below.

Table 3. Summary of Motivation Data

Parameter	Value
Mi	45.33
Sbi	5.47
Xmak	53
Xmin	39

Table 3 presents the results of descriptive analysis, which includes the mean, ideal standard deviation, highest score, and lowest score obtained from the student motivation questionnaire. The mean (Mi) of 45.33 and standard deviation of 5.47 were used as the basis for determining the categories of student learning motivation.

Table 4. Ability Level Score Intervals

No	Ability Interval	Level
1	53.53< 0	Very High
2	48.06–53.53	High
3	42.5–48.06	Medium
4	37.12–42.59	Low
5	0 < 37.12	Very Low

Table 4 presents the value intervals used to group student motivation levels calculated using a formula based on Mi and SBi values. Motivation levels are divided into several categories, namely Very High, High, Medium, Low, and Very Low.

Table 5. Value Intervals for Ability Levels

Interval	Number of Student	%
Very High	0	0
High	5	50
Medium	2	20
Low	2	20
Very Low	1	10

Table 5 illustrates the distribution of students based on five levels of motivation, namely High (50%), Medium (20%), Low (20%), and Very Low (10%), where the majority of students are in the High category (Figure 1). Acccording to Wati et al., (2024) motivation is very important as an internal and external driver for students, which serves as a measure of individual success in the learning process. Based on research on student learning motivation in acid-base material using the STEM approach through the Lumio platform, it was found that student motivation showed varying degrees of variation. The data obtained indicates that motivation levels can be classified into four categories: High, Medium, Low, and Very Low, while no students were classified as Very High, indicating that there were no students with very strong motivation. This condition is likely influenced by several factors, such as limited learning support, a lack of variety in technology-based learning activities, and low levels of independent learning habits among students. To overcome this problem, teachers can provide additional stimulation through academic challenges, project-based learning, and constructive feedback so that students' learning potential can develop optimally.

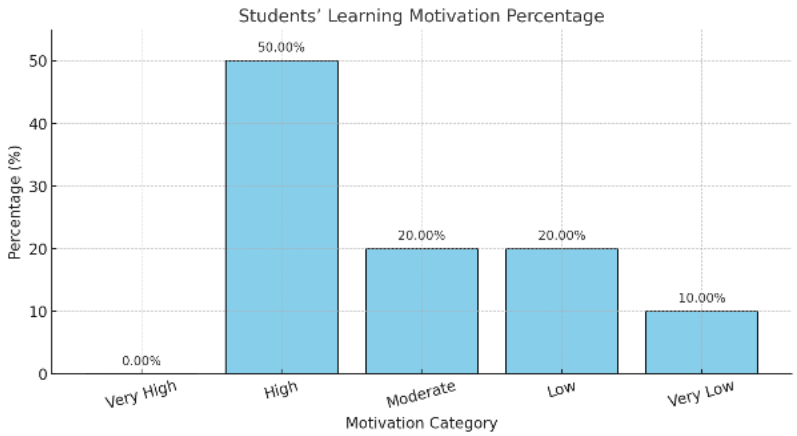

Figure 1. Student Learning Motivation Percentage

In the High category, 50% or 5 students were included in this group, indicating that they had sufficient motivation and understanding of learning. In line with research that STEM-based projects tend to be more appealing to students because they involve active participation and personal control, which in turn increases their motivation to learn and engage. In addition, STEM projects encourage collaboration among students to hone communication skills, helping them understand concepts through discussion and exchange of ideas (Wati et al., 2024; Khairunnisa et al., 2025; Juraidah et al., 2025; Juraidah et al., 2025). These findings confirm that the application of STEM-based learning media which can be combined with other methods can make chemistry learning more interesting and effective. Simply implementing an engaging learning model is not enough. To increase its effectiveness, support from learning media that is effective in stimulating students' motivation and interest in learning is needed (Herwati et al., 2025). However, support from schools and parents is still needed to maintain and increase student motivation to learn. Motivation can be increased through emotional support, the creation of a positive learning environment, and academic guidance. In addition to, enrichment and remedial programs can be implemented for this group to optimize learning outcomes, while high-achieving students should be given additional challenges to keep them motivated and continue to develop.

Motivation plays an important role in the success of the learning process, as it can foster enthusiasm, increase excitement, and make learning activities more enjoyable. With strong motivation, students' understanding and learning outcomes, including activities such as reading aloud, tend to achieve optimal results. Given the influence of motivation on student achievement and behavior, various experts have provided their views on this concept. In general, motivation can be defined as a drive that arises from stimuli, both internal and external, which encourages students to make changes in a more positive direction (Jiwa, 2022). The application of STEM-based learning also increases student motivation because they can see the direct relationship between the subject matter and its application in everyday life (Pinandhita et al., 2025).

Based on the data collected, students' motivation in learning acid-base material through STEM-based learning media using Lumio showed a fairly high level of

enthusiasm during the learning process. The implementation of Lumio encourages students to be more confident and actively participate in the learning process. Educators have responded positively to this tool, considering it an effective means of delivering lesson material and increasing student engagement (Darmayoga & Anastasya, 2025). As a result, it has the potential to strengthen student motivation to learn. Motivation is one of the key factors that determine learning success, where the greater the motivation of students, the higher the achievements that can be attained, while low motivation has the potential to hinder learning outcomes. To maintain the enthusiasm for learning in this group, teachers can implement strategies such as project-based learning and group discussions.

In the Moderate category, 20% or 2 students are included in this group. Although their motivation is fairly good, students in this category still need additional encouragement to achieve a higher level of motivation. Implementing more interesting learning activities, such as interactive experiments or educational games, can be an effective strategy to increase their motivation to learn. The Low category consists of 20% or 2 students, indicating that this group requires special attention. Low learning motivation may be caused by a lack of interest in chemistry and limited understanding of concepts. To increase motivation, teachers can provide additional support through a personal approach and intensive guidance, such as implementing a mentoring system. This is because internal factors such as learning motivation are one of the main determinants of a person's success in learning. Thanks to strong motivation, the process of discovering and forming new knowledge structures in learners will be more effective. Therefore, efforts to increase learning motivation are essential in order to achieve the best possible educational outcomes (Rustiningsih, 2021).

Meanwhile, the Very Low category consists of 1 student (10%), who is likely to face significant difficulties in following the learning process. The causes of low motivation can stem from fear of failure, lack of support from the environment, or limited access to learning resources. To help these students, interventions are needed in the form of remedial programs, additional motivational encouragement, and active support from parents. Overall, the distribution of students shows that the majority, namely 50%, are in the High category, indicating that most of them have good learning motivation. Meanwhile, 20% of students are in the Low category and 10% are in the Very Low category. This shows that the use of STEM-based learning media through Lumio has a positive effect on increasing student learning motivation.

4. Conclusion

Research at Muaro Jambi State High School 11 examined student learning motivation using STEM-based Lumio multimedia on acid-base material. The results showed that 50% of students were highly motivated, while the other 30% were in the low and very low categories. These findings indicate that Lumio has the potential to increase motivation, but its implementation still requires supporting strategies. This is because low motivation is influenced by several factors, such as

weak understanding of chemistry concepts, low interest in learning, limited digital skills, unstable internet connection, and suboptimal teacher guidance.Therefore, more innovative and adaptive strategies are needed, such as integrating experiments, improving digital literacy, and adopting a personalized approach to increase student participation. Overall, STEM media through Lumio has a positive impact, but its effectiveness needs to be improved with adequate technological readiness, teacher guidance, and supporting facilities

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