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Development of MolBEST (STEM-Based Mobile Learning) on Elasticity Materials

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Abstract

Several researchers have researched mobile learning development, but it is different from MolBEST (STEM-Based Mobile Learning). This is because MolBEST developed has features that can train scientific literacy and 21st-century skills that integrate science, technology, engineering, and mathematics. This research aims to develop a mobile learning form of MolBEST and to describe the feasibility (validity, effectiveness, and practicality) of mobile learning. This study uses a developmental design of the Hannafin & Peck model using material and media validation instruments, pretest posttest, and assisted learning implementation observation sheets MolBEST. Based on the analysis of research data, the percentage of MolBEST on the elasticity material from two expert lecturers is classified as very valid with a percentage of 95%. As for the effectiveness, there was an increase in students' scientific literacy skills with an N-gain of 0.64 having moderate criteria and 91% of student responses having very good criteria. The level of practicality in learning is 84% and is categorized as very good. Referring to the results of the validity, effectiveness, and practicality of using MolBEST in learning, it can be concluded that MolBEST is suitable for physics learning. Mobile learning helps increase motivation to learn, understand the material and learn independently easily anywhere and anytime.

Keywords*:* MolBEST, mobile learning, STEM approach, science literacy, media feasibility

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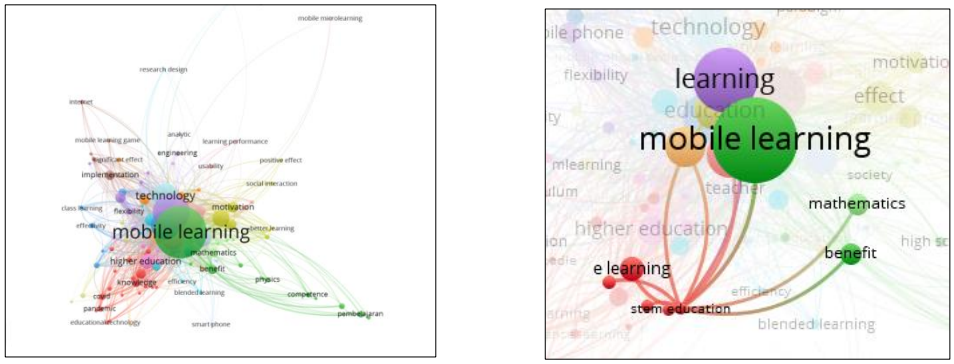
INTRODUCTION

Research related to learning media in the form of mobile learning based on the title of the article in the Google Scholar database from 2017 to 2022 there are 12.500 articles. This shows that a lot of research related to mobile learning has been done, but MolBEST (STEM-Based Mobile Learning) is different from previous studies. Figure 1(a) shows an overall picture of research on mobile learning taken from 810 articles in the Google Scholar database. Judging from the relationship between mobile learning and the STEM (Science, Technology, Engineering, and Mathematics) approach, research on mobile learning related to the STEM approach has not been done too much which can be visualized in Figure 1(b).

MolBEST learning media is mobile learning developed by integrating the STEM approach, namely aspects of science, engineering, technology, and mathematics. Research on the development of MolBEST learning media can provide alternatives to support learning media that can be used during learning in pandemic situations and normal situations.



(a) (b)

Figure 1. (a) Overview of mobile learning research in 2017-2022 (b) Mobile learning in relating to STEM

The COVID-19 pandemic over the past two years has hit most countries, including Indonesia. The impact of the COVID-19 pandemic has caused a paradigm shift. The paradigm in the world of education has also changed, namely learning which is usually done indoors using existing facilities, needs to be carried out online or hybrid (Salsabila et al., 2020). Online learning certainly has its impact. (Afriani & Fitria, 2021) explain that students are only given teaching materials and assignments when learning online. Most of the students complained that they did not understand the material given. Learning only through giving assignments was often boring, so students were not motivated to complete the tasks given. On the other hand, Asmuni (2020) stated that some teachers have limited abilities in implementing technology and information-based learning. Therefore, it is necessary to introduce and develop a learning media that can be used to motivate and improve student learning outcomes.

In this era, students are also required to master 21st-century skills to face the global era in the digital era. This is also supported in Permendikbud of the Republic of Indonesia Number 36 of 2018, which emphasizes learning that applies 21st-century skills. Scientific literacy is one of the 21st-century skills needed in life, so students need to practice it. However, based on the results of the PISA in 2018, it was stated that students in Indonesia obtained an average scientific literacy score of 396, which was categorized as low. This is because using learning media does not results in students losing interest in the material in teaching and learning activities (Ramdani et al., 2020).

In line with the era of the industrial revolution 4.0, technology can be used to develop learning media that are interactive, innovative, and can be operated by anyone. Smartphones used by students can be a medium to support the learning process called mobile learning. Mobile learning makes it easier for students to learn because it does not have a time limit and can be used anywhere (Pramadanti & Harijanto, 2021). Mobile learning can make learning not boring and fun so that it keeps students motivated in learning activities (Budyastomo, 2020). The utilization of information and communication technology is expected to make the teaching and learning process run efficiently following the needs and developments of the times, considering that most Indonesian people have used the internet. Based on data from the Hootsuite report (We are Social): Indonesian Digital Reports in 2022, it states that 73.7% of the total population in Indonesia has used the internet.

In this regard, the use of mobile learning in learning to support the achievement of scientific literacy skills can collaborate with a learning approach. Therefore, the STEM approach is one suitable and applicable learning approach (Stehle & Peters-Burton, 2019). STEM is an approach that combines the integration of aspects of science, technology, engineering, and mathematics into one student learning experience. STEM-based learning can improve students' ability to understand the material, increase learning motivation, improve scientific literacy, solve real-life problems, and draw conclusions according to the STEM approach (Supriyatun, 2019).

There are several studies related to the development of mobile learning in physics subjects carried out with different objectives, including (1) developing mobile learning on fluid materials that are suitable for use in learning (Atika et al., 2022); (2) developing mobile learning material on momentum and impulses to produce media that are suitable for developing critical thinking skills (Ngurahrai et al., 2019); (3) developing mobile learning with smart apps creators that can simplify and motivate students' learning processes (Yuberti et al., 2021); (4) developing mobile learning of static electricity material produces mobile learning that is suitable for use to support independent learning (Sari et al., 2019). Based on this description, the development of mobile learning in physics subjects that has been done previously has not integrated science, technology, engineering, and mathematics. The integration of the STEM approach has been aligned with the 2013 curriculum applied in Indonesia. However, the STEM approach in Indonesia is not yet popular as a learning approach and many teachers do not know about the STEM approach, so it is not fully realized (Harahap et al., 2022).

This research on STEM-based mobile learning, which will be called MolBEST, is different from other research. The difference is that in MolBEST, features can train understanding concepts related to STEM and scientific literacy skills. This study aims to describe the feasibility (validity, effectiveness, and practicality) of MolBEST as a feasible and useful mobile learning in physics learning on elasticity material. Validity is seen from the results of the validation test. The effectiveness of MolBEST is seen from response student results and its effectiveness in improving students' scientific literacy skills. Meanwhile, practicality is seen from the results of the implementation of learning using MolBEST.

METHOD

This research is development research with the research model used is Hannafin & Peck. There are three main phases in this model, namely: (1) the needs analysis phase, (2) the design phase, and (3) the development and implementation phase. These phases involve (4) an evaluation phase, as shown in Figure 2.

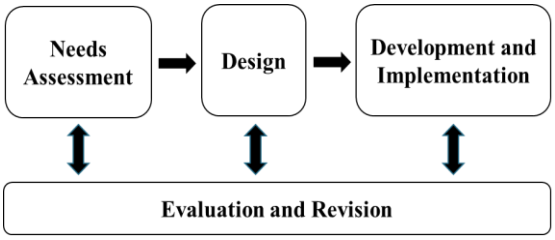


Figure 2. Phases of the Hannafin and Peck development model (Tegeh, et al., 2014)

Starts with the needs analysis phase, namely the phase when determining learning objectives and lesson materials, conducting analysis related to the use of multimedia such as applications on smartphones, and analyzing learning media that can be implemented on students. Followed by the design phase, which can produce a list of MolBEST application content, menus/sub menus illustrated with flowcharts, interface designs, and storyboards. In the third phase, namely the development and implementation of the MolBEST by developing all components, such as image, text, and animation objects that will be combined into one to produce an interactive media product to support the teaching and learning process. If the MolBEST is ready, then an evaluation is carried out in the form of validation of the developed product. MolBEST evaluated by two expert lecturers, will be used as input to improve the developed application. Next is the implementation phase, where MolBEST will be applied in learning.

The media the author has developed is then tested for validity by two expert lecturers using a research instrument in the form of a validation research sheet. Each aspect used to assess validity, response, and practicality is given a value according to the Likert scale score,

as shown in Table 1. The validity score obtained will be converted into a percentage using Equation (1) and then interpreted based on Table 2.

Table 1. Likert scale scores for the assessment of validity and response (Riduwan, Skala Pengukuran Variabel-Variabel Penelitian, 2015)

Score	Description
5	Very Good
4	Well
3	Currently
2	Bad
1	Very Bad

$$P\ (\%) = \frac{Total\ score}{\text{Max score} \times \sum\text{Rated aspect} \times \sum\text{Respondent}} \times 100\% \quad (1)$$

Table 2. Interference validity criteria (Riduwan, Skala Pengukuran Variabel-Variabel Penelitian, 2015)

Percentage (%)	Description
0 - 20	Invalid
21 - 40	Not Valid
41 - 60	Quite Valid
61 - 80	Valid
81 - 100	Verry Valid

The validated mobile learning results will be tested on 20 students of class X MIPA 1 at SMA Tamansiswa Kota Mojokerto to get the results of the effectiveness and practicality of MolBEST when used in learning. The effectiveness test was analyzed based on learning outcomes and student responses after participating in the learning using MolBEST. In contrast, the practicality test was obtained from the observer's assessment of the implementation of learning using MolBEST.

The research subject responses and practicality results were assessed using an assessment category based on Table 1. The scoring scores obtained were then interpreted based on Table 3.

Table 3. Interference criteria for trial responses (Sugiyono, 2015)

Percentage (%)	Description
0 – 20	Very Bad
21 – 40	Bad
41 – 60	Currently
61 – 80	Well
81 – 100	Very Good

Student learning outcomes can be analyzed with the N-gain test using Equation (2) and the criteria as in Table (4). The N-gain test is needed to show the increase in students' scientific literacy skills after participating in learning using MolBEST.

$$\text{N-gain} = \frac{Posttest\ Score - Pretest\ Score}{Ideal\ Score - Pretest\ Score} \quad (2)$$

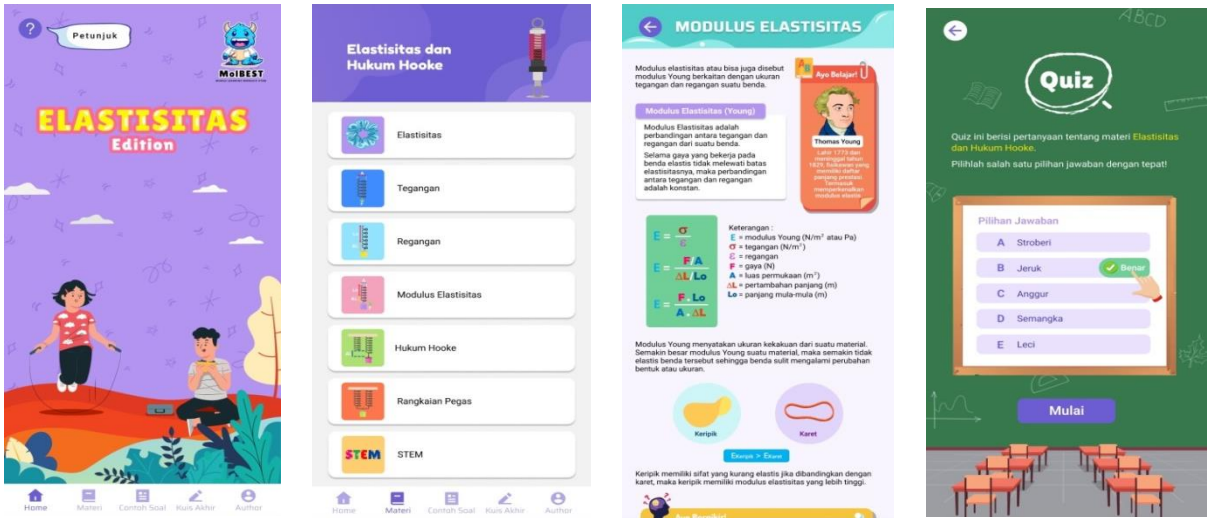
Table 4. Criteria for interpretation of the N-gain (Sugiyono, 2017)

Score	Criteria
$g > 0{,}7$	High
$0{,}3 \leq g \leq 0{,}7$	Medium
$g < 0{,}3$	Low

RESULT AND DISCUSSION

This research produces a learning media product form of MolBEST (STEM-Based Mobile Learning) on elasticity material. Developing interesting and interactive mobile learning results can make it easier for students to understand the concepts they want to master. The MolBEST application was developed using the Figma application, which makes MolBEST accessible via smartphones and desktops.

MolBEST has several components: the homepage, application menus such as instructions, materials, sample questions, final quizzes, and the author, as shown in Figure 3. The display home in Figure 3(a) is deliberately designed with an attractive appearance and logo so that when students opened MolBEST, the first impression they get is that the learning media used does not appear to contain difficult and boring material.



(a) (b) (c) (d)

Figure 3. Display of MolBEST (a) Home display, (b) Material menu display, (c) Display of one of the sub-materials, (d) Final quiz menu display

Figure 4 shows the material on MolBEST, which integrates STEM aspects, namely science, technology, engineering, and mathematics. In addition, efforts were made to further support STEM learning, as well as provide scientific literacy aspect content. The scientific literacy aspect contained is "Let's Learn!" which represents the purpose of science as the body of knowledge, “Let's Try!” represents the goal of science as a way of investigating, “Let's Think!” represents the purpose of science as a way of thinking, and “Science in life” represents the purpose of the interaction between science, technology, and society. The display of scientific literacy content is shown in Figure 5.

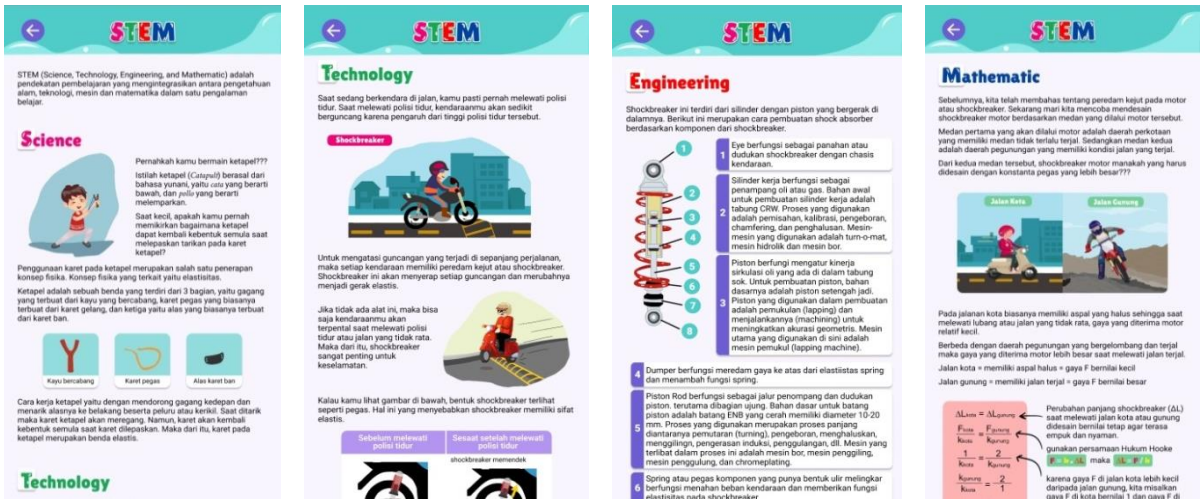


Figure 4. Display of STEM integrated elasticity material

Figure 5. Content display of scientific literacy aspect

The results of the MolBEST validation were carried out by two validators using a validation assessment sheet for each aspect, as shown in Figure 6.

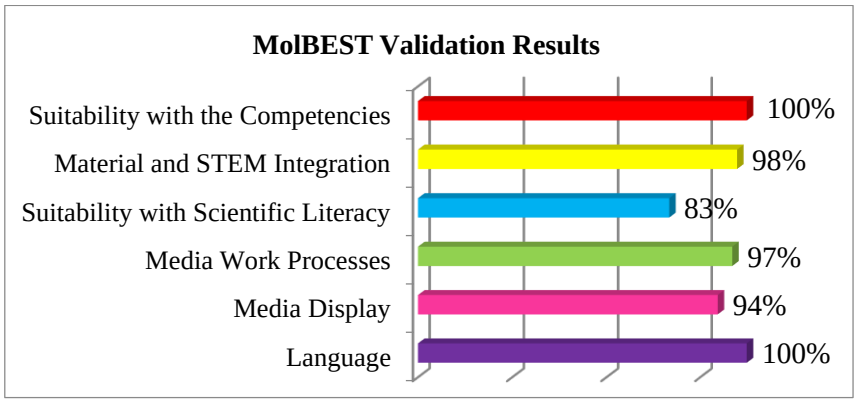


Figure 6. MolBEST validity result chart

Figure 6 shows the validation assessment in several aspects: conformity with the competencies to be achieved, material and STEM integration, suitability of material with scientific literacy, media work processes, media display, and language. All aspects of the validity of MolBEST except the scientific literacy aspect have a high value, which means that MolBEST has advantages in STEM integrated materials that are by learning competencies, appearance, language, and efficiency of media use. The conformity with scientific literacy has a lower validity value than other aspects because it is necessary to add more examples of the elasticity phenomenon in everyday life as a link to the development of scientific literacy. Based on the validation results from all aspects of MolBEST that were developed, the average percentage of validity was 95% and had very valid criteria, it can be said that MolBEST is valid and can be used in learning the elasticity material.

The next step is to test the product that has been valid on students to assess the effectiveness of MolBEST. The effectiveness is calculated based on the pre-test, post-test, and students' responses regarding the use of MolBEST. A Pre-test is given before the learning process takes place to measure students' initial abilities, while post-tests are given to measure students' final abilities after using MolBEST. Next, the N-gain is calculated to determine the criteria for scientific literacy ability. The results of the N-gain are presented in Table 5.

Tabel 5. Results of the calculation of the N-gain

Components	***Pre-test***	***Post-test***
Lowest Score	5,00	45,00
Highest Score	40,00	90,00
Average	19,50	70,50
Average Difference	80,50	
N-gain	0,63	
Criteria	Medium	

Table 5 is the result of the N-gain score based on the value of learning outcomes showing that students' scientific literacy skills increase after participating in learning using MolBEST, as evidenced by an increase in learning outcomes. Before using MolBEST, the students' scientific literacy ability obtained a low average score of 19.50. After learning using MolBEST, the average value of students' scientific literacy skills increased to 70.50. The result of the calculation of N-gain in this study is 0.63. It is categorized as moderate so that it can be concluded that MolBEST is effectively used in physics learning of elasticity material.

Students are also asked to respond using MolBEST by providing an assessment in the form of a score for each question asked. The percentage of student responses to MolBEST is shown in Figure 7.

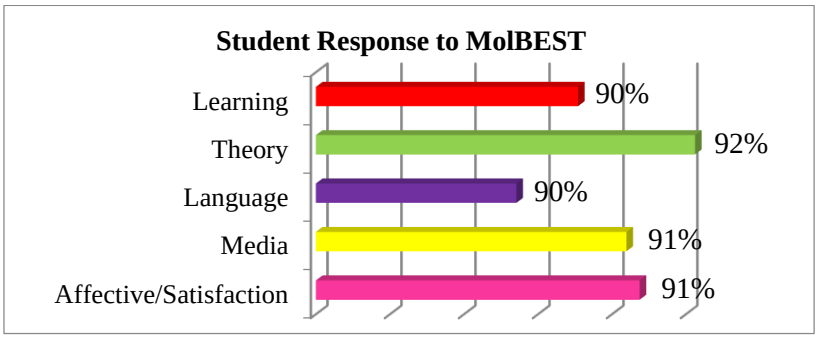


Figure 7. Diagram of student responses to MolBEST

Figure 7 shows the results of the percentage of responses given by students to MolBEST in every aspect. Overall aspects of the use of MolBEST from the response results obtained an average percentage of 91%, which has very good criteria. Student responses based on learning aspects obtained a percentage of 90% with very good criteria related to the usefulness of using MolBEST in physics learning. Based on the questionnaire response analysis, students revealed that MolBEST could make it easier to understand the material and support independent learning. This is in line with the opinion expressed by Robbi & Churiyah (2021) that mobile learning media supports the implementation of independent learning anywhere and anytime.

Students responded to the material aspect by 92% with very good criteria because MolBEST contains interesting material so that students easily understand the elasticity material presented. This is evidenced by the result that the value of scientific literacy skills obtained has increased after using MolBEST.

The percentage is 90% in the language aspect with very good criteria. MolBEST uses language according to EYD so that it helps students understand the elasticity material. Research by Cahdriyana & Richardo (2016) also suggests that learning media that uses communicative and standard language can make it easier for students to understand the material.

In the media aspect, it also obtained a high percentage of 91% with very good criteria. MolBEST presents a display according to the material that is packaged in an attractive and high quality so that the display presented can be seen clearly. In addition, the selection of colors, fonts, and sizes used are correct so that it is easy to read. Research by Permana, Zulhijatiningsih, & Kurniasih (2021) said that learning media should pay attention to screen design and was strengthened by the opinion expressed by Nurcahyo and Setyowati (2020), who also said that mobile learning can provide various, interesting and even easily accessible visualizations.

Student responses on the aspect of satisfaction obtained a percentage of 91%, having very good criteria. Most of the students agree that MolBEST is easy and convenient to operate. Student satisfaction with MolBEST is also influenced by material and media aspects. Aspects of media and material get a high score because the attractive display and material stimuli can make it easier for students to receive and process information to increase learning

motivation. This causes the aspect of student satisfaction to also get a high score. This study's results align with those conveyed by Anandari, Kurniawati, Marlina, Piyana, Melinda, Meidiawati, & Fajar (2019) if using interesting media can affect the increase learning motivation and reduce students' boredom.

The results of the implementation of the learning were obtained from the observer's assessment of the learning process using MolBEST. The results of the implementation of this learning are used as the practical value of the MolBEST developed. The results of the implementation of learning are presented in Figure 8.

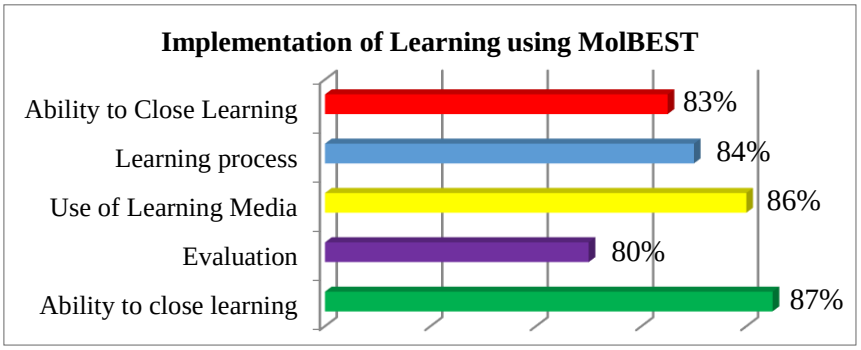


Figure 8. Diagram of the result of implementation MolBEST

Figure 8 shows the percentage of learning implementation using MolBEST in every aspect. All aspects of learning using MolBEST get an average percentage of 84%, which is categorized as very good, so it can be concluded that MolBEST is practically used in learning activities.

MolBEST is mobile learning equipped with various menus, images, and STEM-integrated elasticity materials, so it is hoped that after using MOlBEST, students can better analyze the concept of elasticity in aspects of science, technology, engineering, and mathematics. The STEM integrated materials in MolBEST are found in the STEM content menu. In the STEM material menu, students are taught to analyze readings about elasticity material integrated with STEM and are presented with questions on the Final Quiz menu that refer to scientific literacy competencies. The scientific literacy content, namely Let's Learn, Let's Try, Let's Think, and Science in Life, can be found in each sub-chapter of the material. Scientific literacy content is almost the same as the STEM menu, presenting information and questions that students can answer. The reading of elasticity-related phenomena in everyday life in MolBEST make it possible to further practice scientific literacy skills when students answer reading-related questions.

The application of STEM positively impacts the motivation and activeness of students in science and engineering learning activities. Based on the research results, students after using MolBEST, can apply STEM aspects in a learning experience and scientific literacy competencies. Students can understand and work on the questions in the content of scientific literacy and the questions in the Final Quiz menu. Competencies of scientific literacy skills that must be mastered are the ability to explain phenomena scientifically, identify problems scientifically, design scientific research, interpret data, and draw conclusions based on the available evidence (Andaresta & Rachmadiarti, 2021; Febriyanti & Sari, 2022).

The results of this study are supported by the research of Widiastuti (2021), which states that physics learning using android-based mobile learning affects increasing scientific literacy skills and cognitive abilities of students. This is reinforced by research by Pramadanti, Subiki, & Harijanto (2021), which states that smartphones as physics learning media with a STEM approach are very effective in improving learning outcomes with a percentage of 87.27%. In addition, the research by Putri, Asrizal, and Usmeldi (2022) is also in line with this study, which suggests that the STEM approach is very effective in increasing students' scientific literacy at a high level.

CONCLUSION

The results of MolBEST that have been developed indicate that MolBEST is feasible to use to improve students' scientific literacy in learning physics based on the criteria for assessing validity, effectiveness, and practicality, which show very good criteria. The validity of MolBEST in terms of conformity with competence, STEM integrated material, suitability of material with scientific literacy, media work processes, media display, and language scores 95% with very valid criteria. The effectiveness of MolBEST in terms of the N-gain, which is 0.64 is categorized as moderate and the response of students who get a score of 90% with very good criteria, while practicality in learning implementation gets a score of 84% with very good criteria.

RECOMMENDATION

Mobile learning in the form of MolBEST that has been produced in this research only contains material on elasticity physics. For this reason, it is necessary to develop mobile learning in other subjects to increase the use of mobile learning that can help students' learning process.

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