

Development of Android-Based E-Learning Platform with RBL - STEM Approach to Improve Digital Literacy

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Abstract: The utilization of technology is very important in learning in today's digital era. A research-based learning approach that focuses on STEM disciplines is perfect for maximizing the use of technology. The purpose of this study was to determine the feasibility of android-based E-learning Platform with RBL-STEM approach in terms of content validity and construct validity, and android-based e-learning platform with RBL-STEM approach in terms of improving digital literacy skills of TEP graduate students. Development of Android-based E-Learning Platform with RBL - STEM Approach to Improve Digital Literacy of TEP Graduate Students Universitas PGRI Argopuro Jember using Research and Development (R&D) method with ADDIE development model (Analysis, Design, Development, Implementation and Evaluation). The results of data analysis and discussion can be concluded that the Android-Based E-Learning Platform with the RBL - STEM Approach developed is declared to meet the eligibility requirements in terms of content validity and construct validity with a mode value (Mo) ≥ 4 , and the Android-Based E-Learning Platform with the RBL - STEM Approach developed is declared effective in improving the Digital Literacy skills of TEP Postgraduate Students of Universitas PGRI Argopuro Jember with an N-Gain percentage of 15% in the medium category (0.30-0.70) and 85% in the high category (0.7-1). Thus, Android-Based E-Learning Platform with RBL - STEM Approach can be used to improve the Digital Literacy ability of TEP Graduate Students of Universitas PGRI Argopuro Jember

Keywords: ADDIE Defelopment, Digital Literacy, Elearning, RBL-STEM

Introduction

Education is a benchmark for the development of a civilization. Education is also part of improving the quality of a nation's human resources. The quality of education in Indonesia is still not well resolved so it is necessary to improve the quality of the learning and teaching process (Damayanti, 2023). Therefore, various innovations and developments in the world of education, especially in higher education, need to be carried out in order to create quality Indonesian education, which makes Indonesian people have superior personalities (Dharma et al., 2020).

Efforts to improve the quality of education in Indonesia have been carried out in various ways, the Merdeka Learning Policy - Merdeka Campus is one of them. This is done in order to keep up with developments in life and science in the 21st century, which has indeed experienced a shift in the learning model. Learning transformation is needed to equip and prepare graduates to become a superior generation who are ready and sensitive to the challenges of the times without being uprooted from the nation's cultural roots. One of them is by developing android-based media (Purwanto et al., 2023).

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Nowadays, creativity has become an important keyword to ensure Indonesia's sustainable development. Students studying in higher education must prepare themselves to be true learners who are always competent, flexible and persistent (smart learner). One of the characteristics of an excellent researcher is competence in the form of creative thinking. Creative thinking is very important for today's young generation. (Yuliani et al., 2018). Creative thinking skills in the 21st century are essential to prepare Indonesians as productive, innovative, and creative individuals (Cahyadi, 2019). Besides that, the skills that guarantee transferable skills in the 21st century are the 4C (Critical Thinking, Communication, Creative Thinking, and Collaboration) skills. (Sinaga, 2023). The development of these 4Cs must be carried out in intra-curricular activities, namely through the content of lecture materials. The delivery of lecture content that is able to foster these 4C skills will be trained using Research Based Learning with a STEM approach. Therefore, universities must make creative thinking skills one of the learning outcomes of student graduates.

In the 21st century, four main competencies of Human Resources are needed, namely effective communication, high productivity, creative thinking and literacy (Yuni et al., 2016). This is emphasized by the results of the World Economic Forum survey which also found that students must have sixteen skills to survive in the 21st century, namely Basic Literacy, Traits and Competencies. (Risa Bagasta et al., 2018). Digital literacy is one of the sixteen relevant skills.

In the present digital era, digital literacy is an important requirement for students, especially those who are pursuing postgraduate education. Universitas PGRI Argopuro Jember, especially in the TEP

(Educational Technology) postgraduate program, needs to ensure that its students have sufficient skills in utilizing information technology, especially in the context of online learning. However, there are still challenges in improving students' digital literacy, especially in terms of utilizing e-learning platforms that suit their needs and technological developments.

Research on research-based learning and STEM has been carried out a lot and provides good results, namely a research-based learning approach (Research Based Learning) and a focus on STEM disciplines (Science, Technology, Engineering, and Mathematics) has proven effective in improving student understanding and skills (Aziza et al., 2021; Gita et al., 2021, 2022, 2023; Hidayatul et al., 2020; Wahyuni et al., 2020; Wangguway et al., 2020; Zhao et al., 2023). From these research studies, there must be an android-based digital platform that helps research-based learning with a STEM approach. Therefore, the purpose of this study is the development of an Android-based e-learning platform with an RBL-STEM approach to improve the digital literacy of TEP graduate students at Universitas PGRI Argopuro Jember.

Method

This research method is Research and Development. The research method in the research proposal uses the ADDIE model. The ADDIE model is five stages consisting of the analysis stage (Analysis), the design stage (Design), the development stage (Development), the implementation stage (Implementation) and the evaluation stage (Evaluation) which can be seen in Figure 1:

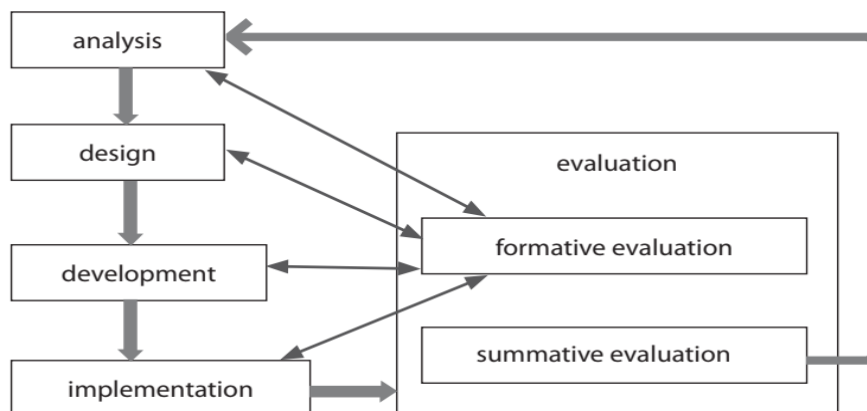


Figure 1. Attached figure in article (Novalić et al., 2021)

The ADDIE model scheme in Figure 1 has several stages in carrying out the development of the ADDIE model, including (a) Analysis, The steps taken by the researcher were (1) Analyzing the initial learning needs

of students; (2) Reviewing the literature; and (3) Determining the E-learning platform to be developed. (b) Design , Design of the developed E-learning. (c) Development, E-learning Content Creation, such as;

Learning materials, Learning videos, Research materials, Assignments etc. (d) Implementation, Implementation of learning using E-learning that has been developed, Setting up a learning environment, Lecturers and Students. (f) Evaluation, Evaluation can take two forms, formative and summative. Formative

evaluation is conducted during and between the stages described above. Summative evaluation is conducted after the final version has been implemented and is intended to evaluate the overall effectiveness of the learning.

Table 1. ADDIE Stages and their Indicators of Achievement

| ADIIIE Stages | Indicators of Achievement |
|--|---|
| Analys <ul style="list-style-type: none"> Analyze initial student learning requirements; Reviewing the literature; and Determine the E-learning platform to be developed. | <ul style="list-style-type: none"> Obtain requirement analysis results from initial observations and interviews with lecturers and students; Literature from articles in national and international journals; E-learning platform design with RBL-STEM approach |
| Design <ul style="list-style-type: none"> Design of the developed E-learning. Formative evaluation of the E-learning platform. | <ul style="list-style-type: none"> The developed E-learning design is appropriate. Design evaluation was conducted formatively with lecturers and experts. |
| Development <ul style="list-style-type: none"> E-learning content creation, such as; learning materials, learning videos, research materials, assignments etc.; Validation of the developed E-learning platform by E-learning expert validators. | <ul style="list-style-type: none"> E-learning content, such as; Learning materials, learning videos, research materials, assignments etc. have been developed according to the design and are ready for validation testing; Has been declared valid and feasible by media expert validators |
| Implementation <ul style="list-style-type: none"> Implementation of learning using E-learning that has been developed, Setting up a learning environment, Lecturers and Students Direct observation, interviews and questionnaires to lecturers and students. | <ul style="list-style-type: none"> Learning has been carried out for 4 sessions on TEP Postgraduate students at PGRI Argopuro University. Obtain observation data, interviews and questionnaires to lecturers and students to measure the effectiveness of the E-learning Platform that has been developed. |
| Evaluation <ul style="list-style-type: none"> Formative evaluation; Summative evaluation. | <ul style="list-style-type: none"> Has completed formative evaluation at each stage; Summative evaluation by analyzing the effectiveness of the data obtained during the implementation stage. |

The data analysis technique used in research at the validation stage is an analysis of the validity level of the E-learning media developed through the analysis of the validation sheets of three experts. The percentage of this validation data is obtained based on the calculation of the linkert scale according to Table 1.

Table 2. Linkert Scale

| Skor | Nilai |
|------|-----------|
| 5 | Excellent |
| 4 | Good |
| 3 | Moderate |
| 2 | Poor |
| 1 | Very Poor |

The scores obtained are then summed up. The formula used to obtain the percentage is (Darma Wisada et al., 2019) :

$$\text{Percentage} = \frac{\text{Total Score Data Collection Criteria}}{\text{Criteria Score}} \times 100\% \quad (1)$$

Description:

- Total score of data collection criteria is the total number of validated aspects

- Criterion Score is the highest score times the number of aspects validated.
After knowing the percentage, the validation criteria are used as in Table 2 (Darma Wisada et al., 2019).

Table 3. Validation Criteria

| Percentage (%) | Criteria |
|----------------|------------|
| 0-20 | Very Less |
| 21-40 | Less |
| 41-60 | Fair |
| 61-80 | Valid |
| 81-100 | Very Valid |

Based on these criteria, the learning media is said to be valid if all aspects in the questionnaire get a percentage $\geq 61\%$ with valid and very valid criteria. Analysis of student responses was carried out directly through a questionnaire given to TEP postgraduate students.

After the pretest and posttest, the N-Gain was determined. N-Gain is a comparison of the gain score obtained by students with the highest possible gain score obtained by students. The N-Gain formula is in the equation.

$$N\text{-Gain} = \frac{\text{Posttest} - \text{Pretest}}{100 - \text{Pretest}} \times 100\% \quad (2)$$

Processing of N-Gain results is interpreted in the categories shown in Table 4. Interpretation is used as a measure of the effectiveness of the Android-Based E-Learning Platform with RBL - STEM Approach that students use.

Table 4. N-Gain Value Classification

| N-gain Value | Criterion |
|-----------------------|-----------|
| $G < 0.3$ | Low |
| $0.3 \leq G \leq 0.7$ | Moderate |
| $G \geq 0.7$ | High |

Based on the N-Gain value criteria, student worksheets are said to be effective if the average student gain value obtained is more than or equal to 0.3 ($G \geq 0.3$) or reaches the "Moderate" or "High" criteria (Vanzal & Dwiningsih, 2023).

Result and Discussion

The product of this development is Android-based E-Learning Platform with RBL - STEM Approach. The android-based platform makes it easy for students to access Elearning anytime and anywhere in realtime (Hanadwiputra et al., 2022; Purnamasari et al., 2014; Rahayu et al., 2022; Tanjung Sari & Hadi Cahyono, 2020).The following are the stages of development using the ADDIE model

Analysis

In the analysis stage carried out are as follows:

Table 5. Analysis

| Activity | Description |
|--------------------|---|
| Platform selection | The platform used is Laravel and Flutter. |
| Course Selection | The course focuses on Learning Media, especially research on learning media used by teachers from elementary school to high school / vocational level |
| Material Selection | Materials focus on Research-based Learning Utilization of Learning Media in Elementary Schools to Senior / Vocational High Schools |
| Target Audience | Target audience is postgraduate students of Learning Technology Universitas PGRI Argopuro Jember |

Design

The following stage is to determine the design. The design was carried out in two stages, namely the initial stage and the revision stage. The initial stage was carried out based on the results of the analysis stage while the

revision stage was carried out after consultation with language experts and design experts.

Table 6. Application design

| Desain | Awal | Revisi |
|--------------------|--|--|
| Login page | <ul style="list-style-type: none"> • Logo has not yet appeared • Login view is too small | <ul style="list-style-type: none"> • Logo and baground have appeared • Login page appears large and clear |
| Admin dashboard | <ul style="list-style-type: none"> • The icon and logo are not visible yet • Can't add lecturers and students directly • Adding students one by one | <ul style="list-style-type: none"> • Icon and logo are clearly visible • Can add lecturers and students directly • Direct student addition via csv file |
| Lecturer Dashboard | <ul style="list-style-type: none"> • Not yet able to upload materials | <ul style="list-style-type: none"> • Ability to upload materials |
| Android View | <ul style="list-style-type: none"> • Menu is too small and unclear | <ul style="list-style-type: none"> • Menu clearly visible |

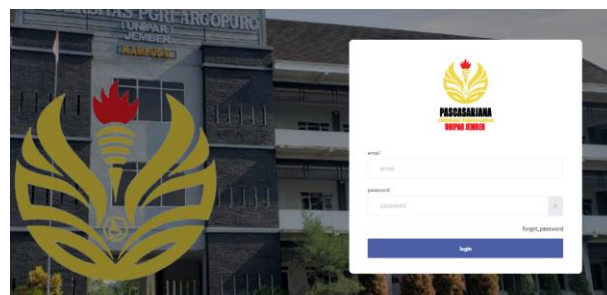


Figure 2. Admin and Lecturer Login Page View

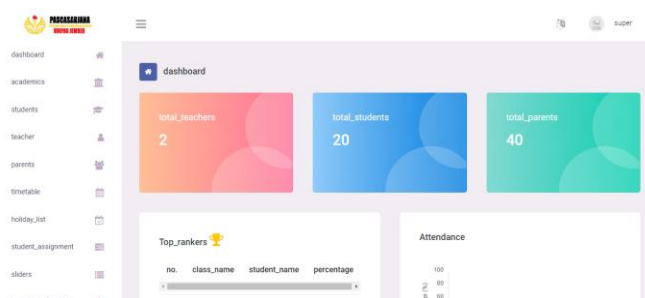


Figure 3. Dashboard View

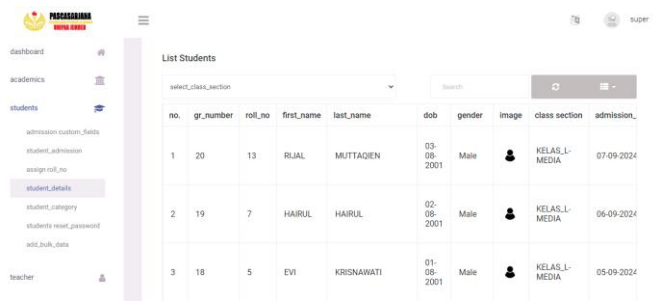


Figure 4. Student Data View

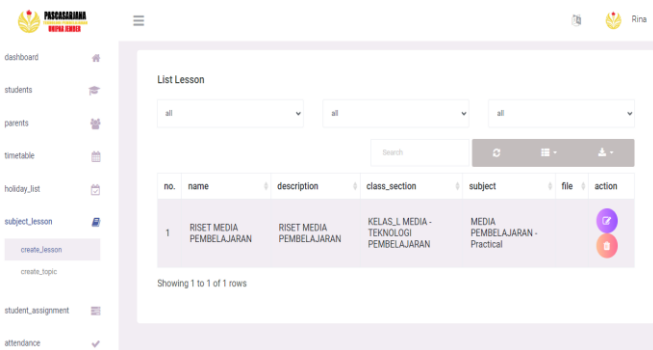


Figure 5. Course Data View

Expert Validation

Expert validation aims to validate the Elearning that has been made before being tested, and the validation results will be used to revise the initial product. Elearning that has been developed will then be assessed by material experts and media experts in terms of content validity and construct validity until it is declared valid. Validation is used as an improvement material for the perfection of the Elearning developed. Validators were asked to provide an assessment of the Elearning that had been developed based on the items on the assessment sheet and provide criticism and suggestions. Validation was conducted until the Elearning was declared valid to be implemented in learning activities. The validation results were analyzed and followed up by revising the Elearning according to the validator's criticisms and suggestions. This was done to get the validity value.

Table 7. Expert Validation

| Question Number | Score | | | | Criterion |
|-----------------|-------|----|----|----|-----------|
| | V1 | V2 | V3 | Mo | |
| 1 | 5 | 5 | 3 | 5 | Very good |
| 2 | 3 | 5 | 4 | 5 | Very good |
| 3 | 3 | 5 | 5 | 5 | Very good |
| 4 | 5 | 3 | 5 | 5 | Very good |
| 5 | 4 | 5 | 3 | 5 | Very good |
| 6 | 3 | 4 | 4 | 4 | Good |
| 7 | 3 | 4 | 5 | 5 | Very good |
| 8 | 5 | 5 | 3 | 5 | Very good |
| 9 | 4 | 3 | 4 | 4 | Good |
| 10 | 5 | 5 | 3 | 5 | Very good |

The results of content validation from the three validators in Table 6. obtained mode value (Mo) 4 and 5. From these results, it is processed using the formula to determine the percentage of validity, so that the following scores are obtained (Table 8).

According to the percentage of validation scores obtained, all aspects in the questionnaire received a percentage of $\geq 61\%$ with valid and very valid criteria.

Table 8. Validation Score

| Question Number | Score | | | | Criterion |
|-----------------|-------|----|----|-----|------------|
| | V1 | V2 | V3 | Mo | |
| 1 | 5 | 5 | 3 | 87% | Very Valid |
| 2 | 3 | 5 | 4 | 80% | Very Valid |
| 3 | 3 | 5 | 5 | 87% | Very Valid |
| 4 | 5 | 3 | 5 | 87% | Very Valid |
| 5 | 4 | 5 | 3 | 80% | Very Valid |
| 6 | 3 | 4 | 4 | 73% | Valid |
| 7 | 3 | 4 | 5 | 80% | Very Valid |
| 8 | 5 | 5 | 3 | 87% | Very Valid |
| 9 | 4 | 3 | 4 | 73% | Valid |
| 10 | 5 | 5 | 3 | 87% | Very Valid |

Development

After the design is made, the next stage is development. At this stage using a combination of several software used during the coding process. The following software is used,

Table 9. The software used

| Software | Keterangan |
|--------------------|--|
| Flutter | Support software for build apk extension |
| Android Studio | Support software for build apk extension |
| Visual Studio Code | Support software for build apk extension |
| Laravel | Software to create an admin dashboard |
| PHP MyAdmin | Software for the database used |
| exabytes.co.id | Hosting admin panel |

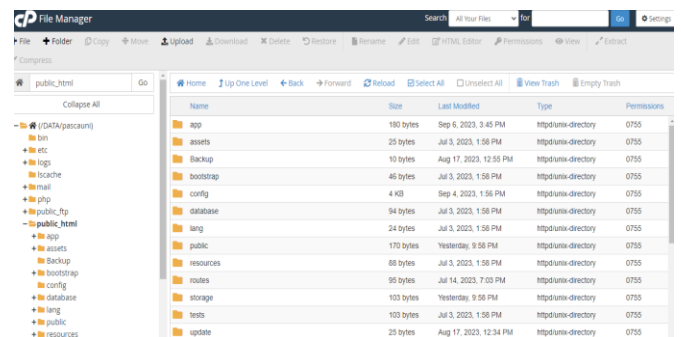


Figure 6. Data Folder View

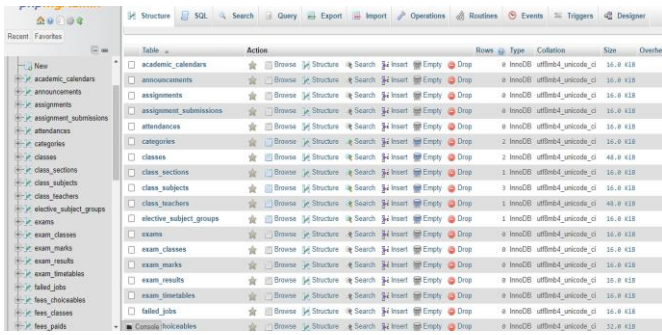


Figure 7. Data Base View

```

android > app > # build.gradle
1  def localProperties = new Properties()
2  def localPropertiesFile = rootProject.file('local.properties')
3  if (localPropertiesFile.exists()) {
4      localPropertiesFile.withReader('UTF-8') { reader ->
5          localProperties.load(reader)
6      }
7  }
8
9  def flutterRoot = localProperties.getProperty('flutter.sdk')
10 if (flutterRoot == null) {
11     throw new GradleException("Flutter SDK not found. Define location with flutter.sdk in the local.properties file.")
12 }
13
14 def flutterVersionCode = localProperties.getProperty('flutter.versionCode')
15 if (flutterVersionCode == null) {
16     flutterVersionCode = '1'
17 }
18
19 def flutterVersionName = localProperties.getProperty('flutter.versionName')
20 if (flutterVersionName == null) {
21     flutterVersionName = '1.0'
22 }
23
24 apply plugin: 'com.android.application'
25 apply plugin: 'com.google.gms.google-services'
26 apply plugin: 'kotlin-android'
27 apply from: "$flutterRoot/packages/flutter_tools/gradle/flutter.gradle"
28
29 def keystoreProperties = new Properties()
30 def keystorePropertiesFile = rootProject.file('key.properties')
31 if (keystorePropertiesFile.exists()) {
32     keystoreProperties.load(new FileInputStream(keystorePropertiesFile))
    
```

Figure 8. Gradle build android

Implementation

The next stage is implementation. At this stage the application is shared with students through the class whatsapp group so that all students can install the application on their smartphones. This implementation was carried out on L class graduate students with Learning Media courses.

Evaluation

The last stage is evaluation, following the evaluation results after testing on students. The following shows the results of the student pretest and posttest (Figure 9, 10, and 11).

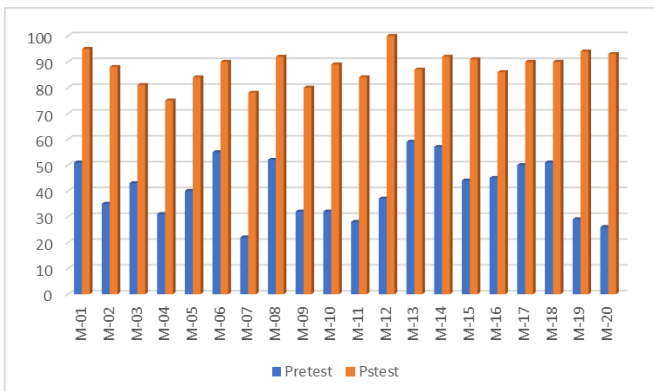


Figure 9. Pretest and Postest Graph

From the results of the pretest and post-test, N-gain was calculated with the following results:

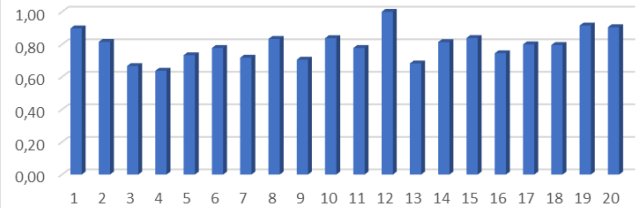


Figure 10. N-gain

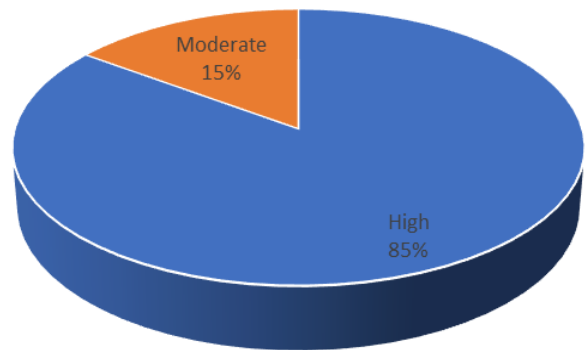


Figure 11. N-Gain percentage

This study developed an Android-based e-learning platform with an RBL-STEM approach that aims to improve the digital literacy of TEP graduate students at Universitas PGRI Argopuro Jember. Data were collected through pre-test and post-test, as well as questionnaires to measure digital literacy before and after using the platform. (1) Increased Digital Literacy, The results of the pretest and posttest of digital literacy skills in Figure 12 show a significant increase. This can be seen from the N-Gain percentage of 15% in the moderate category (0.3-0.7) and 85% in the high category (0.7-1) presented in the pie chart in figure 11. (2) User Satisfaction Level, From the questionnaires distributed, 85% of students expressed satisfaction with using this platform. Interactive features and materials that meet the needs of students are key factors in user satisfaction. (3) Student Engagement, Analysis of user activity on the platform showed that the level of student engagement in discussions and task completion increased. The average time spent per week by students to learn through the platform is 5 hours, which is higher than the conventional learning method.

The development of this e-learning platform successfully fulfills the main objective of the research, which is to improve students' digital literacy. The RBL-STEM approach implemented in the platform allows students to engage in more active and contextualized

learning, facilitating the development of critical and creative skills essential in the digital era. (1) Improved Digital Literacy, Improved digital literacy scores can be attributed to content designed to stimulate critical and analytical thinking. The use of the RBL (Problem-Based Learning) method encourages students to find real solutions to the problems they face, so that they are more familiar with the use of information and communication technology. (2) Interactive Features, Features such as discussion forums, interactive quizzes, and project-based learning modules greatly assist students in understanding STEM concepts more deeply. Interaction between students through the platform also strengthens their understanding and facilitates collaboration. (3) User Satisfaction and Engagement, The high level of user satisfaction indicates that the platform is not only academically effective, but also fun to use. High engagement in learning activities can be an indicator that students feel more connected and motivated to learn. (4) Implications for Further Development, While the results show positive impacts, it is important to continue evaluating and developing the platform. The addition of new features, such as analytics to monitor learning progress and more in-depth feedback, could increase the effectiveness of the platform. In addition, training for lecturers on how to utilize this platform should also be considered to support the learning process.

Learning using e-learning platforms has a significant impact in improving the quality of learning (Ambara, 2020; Assiddiqi et al., 2023; Ayu & Amelia, 2020; Bahroni & Purwanto, 2018; Izzudin Hasan et al., 2022; Sabarno Putra et al., 2024; Sajatmojo et al., 2021; Sari, 2015; Shodiq & Zainiyati, 2020). Overall, this study shows that the development of an Android-based e-learning platform with the RBL-STEM approach can be an effective alternative to improve the digital literacy of graduate students. This is in accordance with the effectiveness of android-based platforms in improving learning quality (Batubara, 2017; Baturaja et al., 2017; Hakky et al., 2018; Hendikawati et al., 2019; Kuswanto, 2020; Kuswanto & Radiansah, 2018; Ramdani et al., 2020; Riyan, 2021; Yektyastuti & Ikhsan, 2016; Yunus & Fransisca, 2020). Further research is needed to identify other factors that may influence the success of this platform in the broader educational context.

Conclusion

The conclusions obtained from the results of data analysis and discussion are as follows: The android-based e-learning platform with the RBL-STEM approach for TEP Postgraduate students at Universitas PGRI Argopuro Jember developed was declared to meet the eligibility requirements in terms of content validity and

construct validity with a mode value (M_o) ≥ 4 and the digital literacy skills of TEP Postgraduate students increased after the application of learning using the android-based e-learning platform developed was declared effective in improving students' digital literacy skills with an N-Gain percentage of 15% in the moderate category (0.30-0.70) and 85% in the high category (0.7-1).

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Author Contributions

All authors have made significant contributions to completing this manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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