Evaluation of Mobile-based Learning Media Application for Python Programming Learning

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Abstract

Various applications of Python programming learning on the Google Play making this programming learning resources easy to accessed. This study aims to evaluate various mobile applications that are used as learning media for Python programming. The evaluation is carried out based on the usability aspect to measure the level of usability and aspects of learning achievement to measure the level of application suitability based on the accuracy with student learning outcomes. This study used a qualitative approach with a grounded theory. The data source in this research is a mobile application that contains Python programming learning. Data analysis was carried out through several stages, namely observation, filtering, and application scoring based on an assessment using the Learning Object Review Instrument (LORI). Meanwhile, the ranking of data is measured using a Likert scale. The results of this study show that the Python programming learning media available on the Google Play is of good quality in terms of learning outcomes. The average score from this aspect is 36.50 out of 40.00 with a percentage of 91% from 85 applications, therefore it falls into the very suitable category (has good material). On the other hand, in terms of usability, the average score obtained was 63.62 out of 80.00 with a percentage of 75% of 85 applications, making it to be included in the category of feasible use with some improvements. The high rating of an application on the Google Play Store does not affect the analysis results because 60% of applications, namely 50 of the total 85 applications that have high ratings on the Google Play Store, have high ratings on the results of the analysis. In addition, at the end of the paper, the five best Python learning applications with the highest usability scores and aspects of learning outcomes are presented.

Keywords

mobile application, mobile learning platform, programming learning, python programming

1. Introduction

Technology on mobile application brings new aspects to learning. The development of mobile learning in education has implications for student learning, the role of teachers, and educational institutions (Moura & Carvalho, 2008). Learning using mobile application has been accepted and in demand by the community, especially students (Sung et al., 2014). Mobile learning is an interactive learning media that utilizes technological developments to attract student interest in learning. As for the usage, mobile learning can be accessed using a mobile device connected to the internet (Ismail et al., 2016). Mobile learning is designed based on e-learning and mobility (Kottari et al., 2013), therefore mobile learning as a learning medium can be accessed anywhere and anytime (Kukulska-Hulme & Viberg, 2018). Mobile learning is expected to facilitate learning to be more innovative and effective, so that it can attract students' interest in learning and improve the quality of learning (Al-Arabiat et al., 2016). Python is a high-level programming language developed by Guido van Rossym in 1989 and was first introduced in 1991. Python is a programming language that ranks first, followed by the Java programming language as a popular programming language. This Python trend has continued to increase by 19% in the last five years (Carbonnelle, 2022). Python has several features that are relatively easy to understand (Adawadkar, 2017) because it has a simple syntactic system. Therefore, Python is easier to read than other programming languages (Nagpal & Gabrani, 2019). In addition, Python has dynamic memory management and can interact with other programming languages (Hwang et al., 2019). And finally, the code in Python can call other programming languages and Python can also be called by other programming languages (Briggs, 2012). Several studies on evaluation of mobile applications have been conducted. Among them are a research in 2019 who Jamal Salem and Rohaida did. They conducted research with the aim of analyzing mobile learning applications available on the application market in utilizing various programming techniques to support learning (Amro & Romli, 2019). In

2005, Almut Herzog and Nahid Shahmeri conducted research by analyzing the security risks of Container Classes in Java Applications (Herzog & Shahmehri, 2005). In 2017, Michael Backes et al. conducted research by presenting interprocedural analysis techniques for PHP applications based on code property graphs (Backes et al., 2017). In 2011, Kalita et al. conducted research by studying how a web application works to evaluate the techniques used to develop the web application (Kalita et al., 2011). Google Play Store has lots of Python programming learning content applications, for example the "Learn Python" application, "Python Programming", and "Python Tutorial". However, it is not yet known whether the quality of the application is appropriate as a learning support media or not. Therefore, those mobile applications need to be analyzed in detail to find out how easy it is to use the mobile application for users in terms of ease or better known as usability. Usability is a quality attribute used to assess a mobile application or software based on the ease with which users can use the application (Lodhi, 2010).

According to the International Organization for Standardization (ISO), usability is an assessment of the extent to which a product can be used based on effectiveness, efficiency of use, and satisfaction as assessed by users (Harrison et al., 2013). Therefore, usability is assessed from the user's point of view in using a particular application which is assessed in terms of ease and effectiveness (Wang & Huang, 2015). In addition, user satisfaction, level of efficiency, and learning outcomes also need to be measured. There are several general learning outcomes topics that are referenced based on a combination of several websites, namely canvas.uw.edu, condefruxtechnology.com, and edube.org. To evaluate some aspects above, it can be done using the Learning Object Review Instrument (LORI) developed by Vargo, Nesbit, Belfer, and Archambault which was further developed by Nesbit and Li in 2004 (Akpinar, 2008). Learning Object Review Instrument is an evaluation rubric used to evaluate the quality of a product or application (Leacock & Nesbit, 2007) (Hannafin et al., 2002) (Prince, 2004) by assessing some of the ratings contained in the application. These assessments include content quality, alignment of learning objectives, feedback and adaptation, motivation, presentation design, usability, accessibility, reusability, and conformity standards (Talib et al., 2019). This study aims to evaluate various mobile applications used as learning media for Python programming on the Google Play Store. The evaluation is carried out based on the usability aspect to measure the level of usability and aspects of learning achievement to measure the level of application suitability based on the accuracy with the student's results in learning Python programming.

2. Methods

This research uses a grounded theory qualitative approach (Martin & Turner, 1986). The data in this study is a collection of mobile applications used as learning media for Python programming on the Google Play Store. Data sources collection was carried out through application searches based on relevant keywords without any minimum and maximum number limitations. The keywords used in this study are: "Python learning", "Python learning app", "Learn Python", "Python for android, "Python", "Belajar Python", "Learn to Code", "Python Programs", "Python Programming", "Python Programming App", "Code in Python", and "Python Tutorial". Based on these keywords, there were 271 applications found. Furthermore, the analysis of the application was carried out in six stages. The six stages are presented in Figure 1 as follows
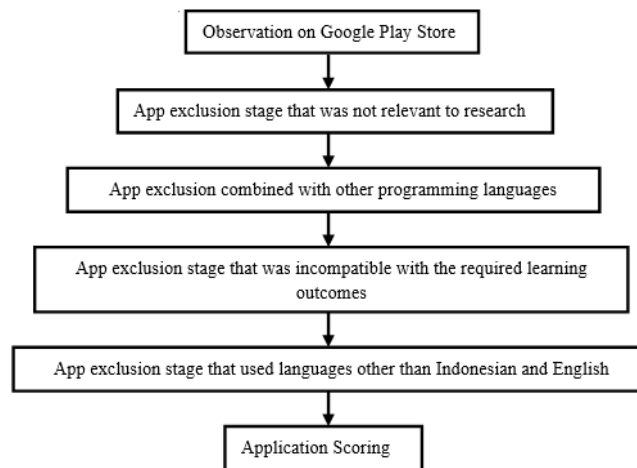

Figure 1. Application Analysis Stage

Based on Figure 1, stage 1 in the application analysis is to make observations by searching for applications on the Google Play Store using relevant keywords. Stage 2, excluding applications that are irrelevant or not in accordance

with the research. Stage 3, the exclusion of combined applications with other programming languages (research is focused on applications as a learning media for Python programming only). Stage 4, excluding applications that are not in accordance with the learning outcomes under study. Stage 5, excluding applications that use languages other than Indonesian and English. And the last stage is scoring application. Application scoring refers to conformity with usability and learning outcomes using the Learning Object Review Instrument (LORI) attribute (Leacock & Nesbit, 2007, Nesbit et al., 2009).

Table 1. Instruments of usability and learning outcome in LORI

Category	Description
Content Quality	- Accuracy in Python material - Quality in Python material - Regularity in presenting Python material - Accuracy in achieving material details
Learning Goal Alignment	- Following the learning objectives of Python - In accordance with Python learning activities - In accordance with research in learning Python - In accordance with the characteristics of students
Feedback and Adaptation	The existence of feedback and adaptation provides effectiveness in learning Python
Motivation	The ability to motivate and attract student interest
Presentation Design	- Multimedia (visual and audio) design to improve and streamline Python learning - Attractive appearance and not boring
Usability	- Ease of navigation in the Python application - The features in the Python application have been automatically updated - Features in the Python application are accompanied by captions - The appearance of the Python application is not confusing - The installation process is smooth, the application can be opened - There is a help feature in the Python application - All icons are as described and displayed - The application can run simultaneously with other applications - The language used is easy to understand
Accessibility	- Ease of accessing Python applications - Design of controls and presentation formats for Python applications
Reusability	Abilities are used various learning context and with students from various backgrounds
Standards Compliance	Satisfy International specifications

There are 25 assessments in LORI which are used as application scoring guidelines. In content quality, there are four assessment points, in the learning goal alignment component there are four assessment points, in the feedback and adaptation component there is one assessment point, in the motivation component there is one assessment point, in the presentation design there are two assessment points, on the usability component there are nine assessment points, on the accessibility component there are two assessment points, on the reusability component there is one assessment point, and on the standard compliance component there is one assessment point. Each assessment is assigned a score on a scale of 1 (low quality) to 5 (high quality). The score given depends on the quality of each assessment on the application. The scores obtained from the overall assessment are added together then divided by the ideal score and then multiplied by 100%.

The following calculation system is used:

$$P = 100\% \; x \; \frac{Score\ Obtained}{Ideal\ Score} \qquad (1)$$

with P as total percentage.

3. Results and Discussion

Based on the evaluation, Figure 2 shows the application release process and the application filtering results
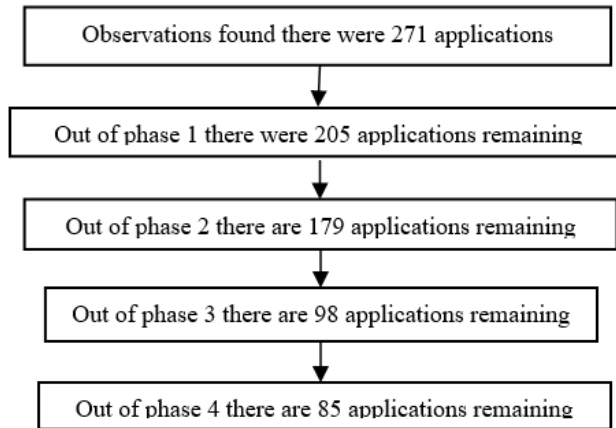

Figure 2. Application exclusion process and application filtering results

From Figure 2, it can be seen that there are 271 applications found in the Google Play Store application market using the relevant keywords. Next, the application release stage is carried out which is described as follows:

3.1 Phase 1 Application Exclusion

The exclusion of phase 1 applications is the stage of excluding applications that are not relevant to the research. Applications that are not related to Python learning media will be excluded at this stage. From a total of 271 applications obtained, there were 66 applications that were not relevant to this study. Therefore, the remaining applications from this stage were 205 applications.

3.2 Phase 2 Application Exclusion

The exclusion of phase 2 applications is the application release stage which is a combination of other programming languages. In this phase 2 application release, 26 applications were found that discuss several combined programming languages. At this stage, 26 applications were excluded, leaving 179 applications remaining.

3.3 Phase 3 Application Exclusion

The exclusion of phase 3 applications is the stage of excluding applications that are not in accordance with the required learning outcomes. At this stage, 81 applications were found that did not match the required learning outcomes. At this stage, 81 applications were excluded, leaving 98 of them remaining.

3.4 Phase 4 Application Exclusion

The exclusion of phase 4 applications is the stage of excluding applications that use languages other than Indonesian and English. In phase 4, there were 13 applications that used languages other than Indonesian and English. After the 13 applications were excluded, there were 85 remaining.

3.5 Discussion

After obtaining 85 applications through the filtering process, the scoring was carried out for each application. Scoring is done using LORI. Before scoring, all of these applications were installed on a smartphone or tablet with specifications: Android version 8.1.0, Qualcomm SDM450 Processor Eight core, Ram 2. There are nine assessments on LORI that is being analyzed, namely content quality, alignment of learning objectives, feedback and adaptation, motivation, presentation design, usability, accessibility, reusability, and conformity standards. Figure 3 shows the percentage results of all analyzed applications.

4. Conclusion

Following a systematic review of several previous research articles discussing STEAM learning and constructivism approaches, it was discovered that STEAM can be integrated with several learning methods, with project-based learning methods being one of the most dominant methods for defining steam's integrated education objectives because project-based learning emphasizes the importance of learning. Increase interest in and assist students in developing the skills they will require in the workplace. Furthermore, constructivism-based learning outcomes produce nearly identical results for students, such as the ability to increase collaboration, independence, responsibility, comprehensive thinking, and cognitive abilities of other students. However, none of the articles organized by topic have comprehensively discussed how to integrate STEAM or the constructiveness approach, so more in-depth research on integrating STEAM with basic learning competencies using a constructivism approach with project-based learning methods will be conducted.
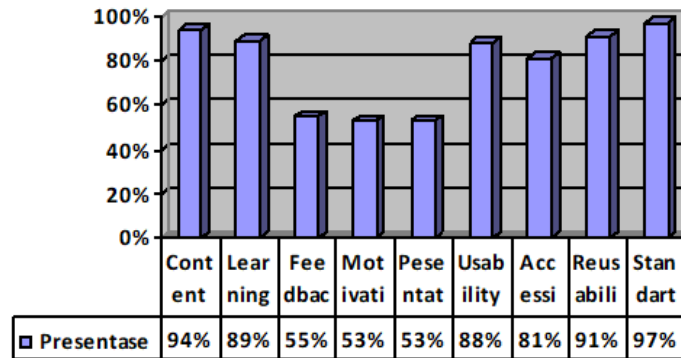

Figure 3. Application Percentage Results

Based on Figure 3, it is known that the overall the results of the analysis and evaluation of mobile applications on the Google Play Store are good and suitable for use as learning media for Python programming as they are in accordance with the aspects of usability and learning outcomes. Conformity with learning outcomes is very good, the material is completely presented, with orderly presentation, in accordance with the objectives, activities, assessment, and student characteristics as evidenced by the presentation results of the content quality aspect which is 91% and the learning aspect of goal alignment of 89%. The lowest score is in the learning aspect (learning goal alignment) on indicators of learning activities. Some applications that have low scores on these indicators have limited learning activities in these applications. Conformity with usability aspects can be declared suitable for use, but it is better if improvements are made in several aspects. The average number of usability is 63.62 with a percentage of 75%.

The feedback and adaptation aspects (feedback goal alignment) have a total score of 234 out of a total score of 425 with a percentage of 55%. This indicates that half of the applications analyzed are less than optimal and need to be improved. There are even some applications that do not have feedback and adaptation aspects (feedback goal alignment). The motivation aspect has a total score of 226 out of a total score of 425 with a percentage of 53%. As with the previous aspects, the motivation aspect needs to be improved in order to further motivate its users. For example, by adding content that is relevant to the goals and personal interests of the intended learner, adding interactive learning activities or adding challenges such as tests, practice questions, coding exercises, games and quizzes and adding features that may pull interests.

The presentation design aspect has a total score of 451 out of a total score of 850 with a percentage of 53%. Low scores on this aspect occur because of the aesthetic value or lack of production. For example, there is unclear writing, errors in text and fonts, misalignment in size selection, and poor video or audio quality. Therefore, it is necessary to improve the presentation design aspects. There are nine indicators on the usage interaction aspect. This aspect has a total score of 3007 out of a total score of 3825 with a percentage of 88%. The indicator on the usage interaction aspect that has the lowest number is the quality of the help feature. There are two indicators on the accessibility aspect. The total score in this aspect is 689 out of a total score of 850 with a percentage of 81%. The aspect of easy access to applications is already good.

The reuse and standard compliance aspects have a total score of 389 sequentially from a total score of 425 with a percentage of 91% and 412 of a total score of 425 with a percentage of 97%. This means that the applications are good in both aspects. Of the 85 applications, there are two applications that have the lowest score which is "0". Both applications cannot be opened after installation. The next lowest score is 62, namely the "Learn OOP Python" from

application developer Interview Questions with a rating of 2.5. The material in this application is presented in full, but not grouped so that it is not easy to learn and there are no application supporting features.

There are five recommendations for mobile-based applications as learning media for Python programming based on the best total score, namely: "Learn Python: Programmiz" by Programmiz with a rating of 4.6 and with a total score of 98%, "Learn Python Programming - Offline Tutorial" by Apk Zube with a rating 4.2 and with a total score of 96%, "Learn Python - Quiz & Top Interview Questions" by Ws CubeTech with a rating of 3.9 and with a total score of 96%, "Python Foundation Learning: Python Tutorials" by Awwalsoft with a rating of 4.1 and with total score of 96%, "Learn Python: Python Tutorial" by Avraam Piperidis with a rating of 4.6 and with a total score of 94%.

The high rating of an application on the Google Play Store does not affect the analysis results, for example the application "Learn Python Programming" by Binarytuts which gets 80% analysis results even though the rating on the Play Store is 3.3. In addition, the application "Kid's Python & Scratch Program" by WAGmob obtained an analysis result of 82% even though the rating on the Play Store was 2.6. And the last one is the application "Python Interview Question" by Kewal Gangar which obtained 72% analysis results even though the rating on the Play Store was 3.2. Based on the scoring results of the 85 applications, it can be seen that 83 of the 85 applications are feasible in terms of learning outcomes and usability.

5.1 Conclusion and Future Work

At the level of suitability of Python programming learning media on the Google Play Store, the usability aspect of all indicators has an average of 63.62 out of 80.00 with a percentage of 75%. Based on this, the usability aspect can be categorized as feasible with some improvements. Furthermore, the level of suitability of the mobile learning Python programming in terms of the overall learning achievement aspect of the indicators has an average of 36.50 out of 40.00 with a percentage of 91%. Therefore, it can be said that mobile learning is included in the very feasible category. Applications with high rating on the Google Play Store doesn't affect the results of the analysis because the rating is an assessment from user preferences based on their experience while using it. In addition, this preference is also based on the user's psychological and emotional state when interacting with the application without analyzing usability aspects and learning outcomes based on LORI.

Based on the evaluation results, there are five recommendations for the best Python learning applications, they are "Learn Python: Programmiz", "Learn Python Programming - Offline Tutorial", "Learn Python - Quiz & Top Interview Questions", "Python Foundation Learning: Python Tutorials", and "Learn Python: Python Tutorial". Based on this research, there is a suggestion for further research to conduct a special evaluation of the user interface satisfaction of an application. It is because with a creative learning design, learning media applications may be able to be more innovative, interesting, and further increase user interest in learning.

References

Adawadkar, K. Python Programming-Applications and Future. *International Journal of Advance Engineering and Research Development*, vol 4 no 04, 1–4. 2017.

Akpinar, Y. Validation of a Learning Object Review Instrument: Relationship between Ratings of Learning Objects and Actual Learning Outcomes. *Interdisciplinary Journal of E-Skills and Lifelong Learning*, vol 4, 291–302. 2008.

Al-Arabiat, D., Ahmad, W. F. W., & Sarlan, A. Cloud computing role to address Mobile Learning barriers: An exploratory study of HEIs in Malaysia. *2016 3rd International Conference on Computer and Information Sciences, ICCOINS 2016 - Proceedings*, 553–558. 2016.

Amro, J. S., & Romli, R. Investigation on the Learning Programming Techniques via Mobile Learning Application. *ICRAIE 2019 - 4th International Conference and Workshops on Recent Advances and Innovations in Engineering: Thriving Technologies*, *2019*(November), 27–29. 2019.

Backes, M., Rieck, K., Skoruppa, M., Stock, B., & Yamaguchi, F. Efficient and Flexible Discovery of PHP Application Vulnerabilities. *Proceedings - 2nd IEEE European Symposium on Security and Privacy, EuroS and P 2017*, 334–349. 2017.

Briggs, J. R. *Python for kids: A playful introduction to programming*. no starch press. 2012

Carbonnelle, P. *PYPL PopularitY of Programming Language*. https://pypl.github.io/PYPL.html. 2022

Hannafin, M. J., Hill, J. R., & McCarthy, J. E. Designing Resource-Based Learning and Performance Support Systems. In *The Instructional Use of Learning Objects*. www.ait.net. 2002.

Harrison, R., Flood, D., & Duce, D. Usability of mobile applications: literature review and rationale for a new usability model. *Journal of Interaction Science*, vol 1 no 1. 2013.

Herzog, A., & Shahmehri, N. An evaluation of Java application containers according to security requirements.

Proceedings of the Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises, WETICE, 2005, 178–183. 2005.

Hwang, Y., Choi, D., An, H., Shin, S., & Lee, C. G. Development of Python-MATLAB interface program for optical communication system simulation. *Proceedings - 2019 7th International Conference on Green and Human Information Technology, ICGHIT 2019*, 46–48. 2019.

Ismail, I., Azizan, S. N., & Gunasegaran, T. Mobile learning in Malaysian universities: Are students ready? *International Journal of Interactive Mobile Technologies*, vol *10* no 3, 17–23. 2016.

Kalita, M., Khanikar, S., & Bezboruah, T. Investigation on performance testing and evaluation of PReWebN: A Java technique for implementing web application. *IET Software*, vol *5* no 5, 434–444. 2011.

Kottari, V., Kamath, G. V., Saldanha, L. P., & Mohan, C. A Survey on Mobile Cloud Computing: Concept , Applications and Challenges. *International Journal of Advances and Innovative Research*, vol *2 no* 3, 487–492. 2013

Kukulska-Hulme, A., & Viberg, O. Mobile collaborative language learning: State of the art. *British Journal of Educational Technology*, *49*(2), 207–218. 2018.

Leacock, T. L., & Nesbit, J. C. A Framework for Evaluating the Quality of Multimedia Learning Resources- Special Issue on "Quality Research for Learning, Education, and Training." *Journal of Educational Technology & Society-*, vol *10* no 2, 15. 2007.

Lodhi, A. Usability heuristics as an assessment parameter: For performing usability testing. *ICSTE 2010 - 2010 2nd International Conference on Software Technology and Engineering, Proceedings*, *2*, 256–259. 2010

Martin, P. Y., & Turner, B. A. Grounded Theory and Organizational Research. *The Journal of Applied Behavioral Science*, Vol *22* No 2, 141–157. 1986

Moura, A., & Carvalho, A. A. Mobile learning: Teaching and learning with mobile phones and Podcasts. *Proceedings - The 8th IEEE International Conference on Advanced Learning Technologies, ICALT 2008*, 631–633. 2008

Nagpal, A., & Gabrani, G. Python for Data Analytics, Scientific and Technical Applications. *Proceedings - 2019 Amity International Conference on Artificial Intelligence, AICAI 2019*, 140–145. 2019.

Nesbit, J., Belfer, K., & Leacock, T. Learning Object review Instrument (LORI) User Manual. *Nuevos Sistemas de Comunicación e Información*, 2013–2015. 2009.

Prince, M. Does active learning work? A review of the research. *Journal of Engineering Education*, vol 93 no 3, 223–231. 2004.

Sung, H. Y., Hwang, G. J., Liu, S. Y., & Chiu, I. H. A prompt-based annotation approach to conducting mobile learning activities for architecture design courses. *Computers and Education*, vol *76*, 80–90. 2014.

Talib, C. A., Aliyu, H., Malik, A. M. A., Siang, K. H., Novopashenny, I., & Ali, M. Sakai: A mobile learning platform. *International Journal of Interactive Mobile Technologies*, vol *13* no 11, 95–110. 2019.

Wang, C. M., & Huang, C. H. A study of usability principles and interface design for mobile e-books. *Ergonomics*, vol 58 no 8, 1253–1265. 2015.

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