

ASSESSING STUDENT UNDERSTANDING OF MOBILEPROGRAMMING (ANDROID) COMPETENCIES

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ABSTRACT

Mobile programming is a field of study focused on developing applications for mobile devices. While Java is a core language, specific platforms like Android may utilize different frameworks or libraries built upon it. This study aimed to analyze the curriculum of a mobile programming course with an Android focus. The analysis centered on evaluating students' comprehension of the Android-specific materials within the course. The method used is in the form of data collection by interviews and questionnaires by making a list of questions/questionnaires to students related to the material/competence of Mobile programming (Android). The number of respondents is 30 students. The Mobile Programming Materials are as follows: Introduction to Android and Review of Java Programming, Android UI - XML Layout, Activity Life Cycle and Intent, Widgets, Action Bar and Context Menu, Shared Preferences and Files, Audio and Video, Android Advanced UI Design, Implementing Fragment, Broadcast Receivers and Notifications, Location Based Service, Android PHP MySQL. The results of the analysis show that the level of student understanding of mobile programming material is 70% located on the Easy scale. However, it can be seen that the comparison of the average level of student understanding of competency units shows a declining graph, therefore it is necessary to review the curriculum for mobile programming courses in the learning model of each competency unit.

Keywords : Android; learning; mobile programming.

INTRODUCTION

In the digital age, mobile application development skills are becoming increasingly sought-after by employers across various industries (Garg et al., 2020). Universities have responded by including mobile programming courses, often focused on the Android platform, in their computer science and information technology curriculums (Long & Siemens, 2022). However, effectively assessing student understanding of the various competencies covered within these courses remains a challenge (Sun et al., 2021). Evaluating student proficiency in each unit allows instructors to identify areas where learning difficulties may exist and adapt their teaching methods to address these gaps. This study aims to assess student understanding of mobile programming (Android) competencies by analyzing their performance in each unit of the curriculum (Raj & Singh, 2021).

By identifying areas where student understanding may be lacking, the findings of this research can be used to inform the development of more effective learning materials and teaching approaches. This, in turn, can lead to improved student outcomes and a more prepared workforce equipped with the necessary skills to thrive in the ever-evolving mobile application development landscape (Wong et al., 2020).

Mobile Programming Competencies in Android Development (Wolf et al., 2021), Developing mobile applications requires a diverse set of skills and knowledge. In the context of Android development, core competencies include understanding of Android architecture, user interface design principles, activity lifecycle management, data storage solutions, and network programming concepts. Effectively assessing student understanding of these competencies is crucial for educators to ensure graduates are equipped with the necessary skills for the job market.

Assessment Methods in Mobile Programming Education (Sun et al., 2021), (Wong et al., 2020), (López-Cózar et al., 2020), Various methods have been employed to assess student learning outcomes in mobile programming courses. Traditional methods include written exams that test theoretical knowledge. However, practical skills are equally important in this field. Studies have shown the

effectiveness of using a combination of assessment methods, including coding assignments, project work, and peer reviews(Nurdyansyah et al., 2015).

Data Analysis Techniques (Nawaratne & Ranasinghe, 2021) (Bettini et al., 2020), The specific data analysis techniques employed in this research will depend on the chosen assessment methods. However, the focus will be on analyzing student performance data to identify areas where understanding may be lacking. This information can then be used to inform improvements in curriculum design and teaching approaches.

METHOD

This research investigates the level of student understanding of mobile programming (Android) course material(Prabowo & Wijayanto, 2018). Data collection employs a combination of interviews and questionnaires administered to 30 students enrolled in the mobile programming course(Prabowo, Wijayanto, et al., 2021). The interviews and questionnaires will focus on student understanding of key topics and themes covered in the course curriculum. The data obtained will include the number of submissions for various final project topics chosen by students across semesters.

Descriptive analysis will be utilized to analyze the data(Prabowo, ., et al., 2021)(Rusman & Riyana, 2011). This will involve creating a list of questions or a questionnaire related to the mobile programming material and competencies covered in the course. By analyzing the responses and the number of submissions for different final project topics, the study aims to identify areas where student understanding of the mobile programming course material (Android) may be lacking.

FINDINGS/RESULTS AND DISCUSSION

1. Student Comprehension Level

To find out the level of student understanding of mobile programming course material (*Android*) by making a list of questions /questionnaires to students related to Mobile programming material /competence (Android) The number of respondents was 30 students. The Mobile Programming Material is as follows:

AndroidIntroduction and *Review Java Programming, Android UI - XML Layout, Activity Life Cycle and Intent, Widgets, Action Bar and Context Menu, Shared Preferences and Files, Audio and Video, Android Advanced UI Design, Implementing Fragment, Broadcast Receivers and Notifications, Location Based Service, Android PHP MySQL*

1.1. Making a questionnaire of material/competency programming material /competency Mobile (Android).

List of questions /questionnaires to students related to Mobile programming material/competencies (Android). The respondents' rating scale chose one of the existing answers, answers (1-4) very difficult (1) 0-29, difficult (2) 29-59, easy (3) 60-79 and veryeasy (4) 80-100. From the results of the distribution of questionnaires to 30 students, the results of filling out the questionnaire can be seen in the Table below.

Table 1.Results of 30 Student Respondents

| Stude nt | UK 1 | UK 2 | UK 3 | UK 4 | UK 5 | UK 6 | UK 7 | UK 8 | UK 9 | UK1 0 | Su m |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|------------|
| 1 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 30 |
| 2 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 1 | 2 | 1 | 26 |
| 3 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 2 | 2 | 30 |
| 4 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 28 |
| 5 | 3 | 3 | 3 | 4 | 3 | 3 | 1 | 1 | 1 | 1 | 23 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 30 | 3 | 4 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 2 | 30 |
| | 107 | 104 | 99 | 99 | 97 | 89 | 62 | 70 | 53 | 54 | 834 |

1.2. Descriptive Statistics

From the results of Result Table 1, Respondent 30 Students carried out descriptive data analysis. The results of descriptive data analysis in Table 1 of the *Descriptive check box selection processing* in the Statistics dialog *box* obtained the average value and standard deviation for all variables. It can be found that the average value of UK1 (with a total of 30 data) is 3.57 with a standard deviation of 0.504. The average value of UK2 (with 30 data) is 3.47 with a standard deviation of 0.507. The average value of UK3 (with a total of 30 data) is 3.30 with a standard

deviation of.466. The average value of UK4 (with a total of 30 data) is 3.30 with a standard deviation of.466. The average value of UK5 (with a total of 30 data) is 3.23 with a standard deviation. 430.The average value of UK6 (with a total of 30 data) is 2.97 with a standard deviation of.615. The average value of UK7 (with a total of 30 data) is 2.07 with a standard deviation of.828. The average value of UK8 (with a total of 30 data) is 2.33 with a standard deviation. 959. The average value of UK9 (with a total of 30 data) is 1.77 with a standard deviation. 679. The average value of UK10 (with a total of 30 data) is 1.80with a standard deviation of.761. The results of descriptive data analysis are shown in Table 2.

Table 2. Descriptive Statistics of the level of understanding of student material

| <i>Statistics</i> | | | | | | | | | | | |
|-------------------------------|----------------|-------|-------|-------|-------|-------|------|-------|-------|------|-------|
| | | UK1 | UK2 | UK3 | UK4 | UK5 | UK6 | UK7 | UK8 | UK9 | UK10 |
| N | <i>Valid</i> | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| | <i>Missing</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <i>Mean</i> | | 3.57 | 3.47 | 3.30 | 3.30 | 3.23 | 2.97 | 2.07 | 2.33 | 1.77 | 1.80 |
| <i>Std. Error of Mean</i> | | .092 | .093 | .085 | .085 | .079 | .112 | .151 | .175 | .124 | .139 |
| <i>Median</i> | | 4.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 3.00 | 2.00 | 2.00 |
| <i>Std. Deviation</i> | | .504 | .507 | .466 | .466 | .430 | .615 | .828 | .959 | .679 | .761 |
| <i>Variance</i> | | .254 | .257 | .217 | .217 | .185 | .378 | .685 | .920 | .461 | .579 |
| <i>Skewness</i> | | -.283 | .141 | .920 | .920 | 1.328 | .016 | -.129 | -.745 | .323 | .362 |
| <i>Std. Error of Skewness</i> | | .427 | .427 | .427 | .427 | .427 | .427 | .427 | .427 | .427 | .427 |
| <i>Kurtosis</i> | | - | - | - | - | -.257 | - | - | - | - | - |
| | | 2.062 | 2.127 | 1.242 | 1.242 | | .092 | 1.530 | 1.554 | .722 | 1.141 |
| <i>Std. Error of Kurtosis</i> | | .833 | .833 | .833 | .833 | .833 | .833 | .833 | .833 | .833 | .833 |
| <i>Range</i> | | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| <i>Minimum</i> | | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 |
| <i>Maximum</i> | | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| <i>Percentiles</i> | 25 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | 50 | 4.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 3.00 | 2.00 | 2.00 |

| | | | | | | | | | | | |
|--|----|------|------|------|------|------|------|------|------|------|------|
| | 75 | 4.00 | 4.00 | 4.00 | 4.00 | 3.25 | 3.00 | 3.00 | 3.00 | 2.00 | 2.00 |
|--|----|------|------|------|------|------|------|------|------|------|------|

1.3. Student Comprehension Level by Unit of Competency

UK 1-Pengenalan Android dan *Review Java Programming*

Table 3. Competency Unit on Android Introduction and *Java Programming Review*

| UK 1 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 3 | 13 | 43.3 | 43.3 | 43.3 |
| | 4 | 17 | 56.7 | 56.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 3, it appears that the competency units on Android Introduction and *Java Programming Review* show that the level of understanding (with a total of 30 data) is on the easy(3) and very easy(4) scales. Easy scale (3) can be known as frequency value 13 with a percentage of 43.3% and very easy scale (4) at a *frequency* of 17 with a percentage of 56.7%.

UK 2-Android UI - XML Layout

Table 4. Unit of Competency about *Android UI - XML Layout*

| UK 2 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 3 | 16 | 53.3 | 53.3 | 53.3 |
| | 4 | 14 | 46.7 | 46.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 4, the unit of competency about *Android UI - XML Layout* shows that the level of understanding (with 30 *data* counts) is on the easy(3) and very easy(4) scales. The easy scale (3) can be known as the value of *frequency* 16 with a percentage of 53.3% and the very easy scale (4) at *frequency* 14 with a percentage of 46.7%.

UK 3-Activity Life Cycle and Intent

Table 5. Competency Units on *Activity Life Cycle and Intent*

| UK 3 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 3 | 21 | 70.0 | 70.0 | 70.0 |
| | 4 | 9 | 30.0 | 30.0 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 5, it appears that the unit of competency on *Activity Life Cycle and Intent* shows that the level of understanding (with a total of 30 data) is on the easy(3) and very easy(4) scales. Easy scale (3) can be known frequency value 21 with a percentage of 70% and very easy scale (4) at frequency 9 with a percentage of 30%.

UK 4-Widgets

Table 6. Competency Units on *Widgets*

| UK 4 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 3 | 21 | 70.0 | 70.0 | 70.0 |
| | 4 | 9 | 30.0 | 30.0 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 6, it appears that the unit of competency about *Widgets* shows that the level of comprehension (with 30 data) is on the easy(3) and very easy(4) scales. Easy scale (3) can be known as frequency value 21 with a percentage of 70.0 % and veryeasy scale (4) at frequency 9 with a percentage of 30.0%.

UK 5-Action Bar and Context Menu, Shared Preferences and Files

Table 7. Competency Units on Action Bar and Context Menu, Shared Preferences and Files

| UK 5 | | | | | |
|--------------|----------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 3 | 23 | 76.7 | 76.7 | 76.7 |
| | 4 | 7 | 23.3 | 23.3 | 100.0 |

| | | | | | |
|--|--------------|----|-------|-------|--|
| | Total | 30 | 100.0 | 100.0 | |
|--|--------------|----|-------|-------|--|

Based on Table 7, the competency units on *Action Bar and Context Menu, Shared Preferences, and Files* show that the level of understanding (with a total of 30 data) is on the easy(3) and very easy(4) scales. Easy scale (3) can be known as frequency value 23 with a percentage of 76.73% and very easy scale (4) at frequency 7 with a percentage of 23.3%.

UK 6-*Audio and Video*

Table 8. Units of Competency on *Audio and Video*

| UK 6 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 2 | 6 | 20.0 | 20.0 | 20.0 |
| | 3 | 19 | 63.3 | 63.3 | 83.3 |
| | 4 | 5 | 16.7 | 16.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 8, it appears that the competency units on *Audio and Video* show that the level of comprehension (with a total of 30 data) is on the scale of difficult(2), easy(3),and very easy(4). The difficult scale (2) can be known as the value of frequency 6 with a percentage of 20.0%, the easy scale (3) frequency 19 with a percentage of 63.3%, and the very easy scale (4) in frequency 5 with a percentage of 16.7%.

UK 7-*Android Advanced UI Design, Implementing Fragment*

Table 9. Competency Unit on Android Advanced UI Design, Implementing Fragment

| UK 7 | | | | | |
|--------------|----------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 1 | 9 | 30.0 | 30.0 | 30.0 |
| | 2 | 10 | 33.3 | 33.3 | 63.3 |
| | 3 | 11 | 36.7 | 36.7 | 100.0 |

| | | | | | |
|--|--------------|----|-------|-------|--|
| | Total | 30 | 100.0 | 100.0 | |
|--|--------------|----|-------|-------|--|

Based on Table 9, it appears that the competency units on *Android Advanced UI Design, Implementing Fragment* show that the level of understanding (with 30 total data) is on the scale of very difficult(1), difficult(2), and easy(3). The very difficult scale (1) can be known as the value of *frequency* 9 with a percentage of 30.0%, the difficult scale (2) *frequency* 10 with a percentage of 33.3%, and the easy scale (3) in *frequency* 11 with a percentage of 36.7%.

UK 8-Broadcast Receivers and Notifications

Table 10. Competency Units on Broadcast Receivers and Notifications

| UK 8 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 1 | 10 | 33.3 | 33.3 | 33.3 |
| | 3 | 20 | 66.7 | 66.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 10, it appears that the unit of competency on *Broadcast Receivers and Notifications* shows that the level of understanding (with a total of 30 data) is on a very difficult(1) and easy(3) scale. The very difficult scale (1) can be known as the value of *frequency* 10 with a percentage of 33.3%, and the easy scale (3) at *frequency* 20 with a percentage of 66.7%.

UK 9-Location Based Service

Table 11. Competency Units on Location-Based Service

| UK 9 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 1 | 11 | 36.7 | 36.7 | 36.7 |
| | 2 | 15 | 50.0 | 50.0 | 86.7 |
| | 3 | 4 | 13.3 | 13.3 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 11, it appears that the unit of competency on *Location Based*

Service shows that the level of understanding (with a total of 30 data) is on the scale of verydifficult(1), difficult(2), and easy(3). The very difficult scale (1) can be known as the value of *frequency* 11 with a percentage of 36.7%, the difficult scale (2) *frequency* 15 witha percentage of 50.0%, and the easy scale (3) in *frequency* 4 with a percentage of 13.3%.

UK 10-Android PHP MySQL

Table 12. Competency Units of *Android PHP MySQL*

| UK10 | | | | | |
|--------------|--------------|------------------|----------------|----------------------|---------------------------|
| | | <i>Frequency</i> | <i>Percent</i> | <i>Valid Percent</i> | <i>Cumulative Percent</i> |
| Valid | 1 | 12 | 40.0 | 40.0 | 40.0 |
| | 2 | 12 | 40.0 | 40.0 | 80.0 |
| | 3 | 6 | 20.0 | 20.0 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

Based on Table 12, it appears that the competency units about *Android PHP MySQL* show that the level of understanding (with a total of 30 data) is on the scale of very difficult(1), difficult(2), and easy(3). The very difficult scale (1) can be known as the value of *frequency* 12 with a percentage of 40.0%, the difficult scale (2) *frequency* 12 witha percentage of 40.0%, and the easy scale (3) in *frequency* 6 with a percentage of 20.0%.

Table 13. Number of student comprehension levels of competency units/materials based on respondent assessment scales

| | UK1 | UK2 | UK3 | UK4 | UK5 | UK6 | UK7 | UK8 | UK9 | UK10 |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Very difficult | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 10 | 11 | 12 |
| Difficult | 0 | 0 | 0 | 0 | 0 | 6 | 10 | 0 | 15 | 12 |
| Easy | 13 | 16 | 21 | 21 | 23 | 19 | 11 | 20 | 4 | 6 |
| It's Easy | 17 | 14 | 9 | 9 | 7 | 5 | 0 | 0 | 0 | 0 |

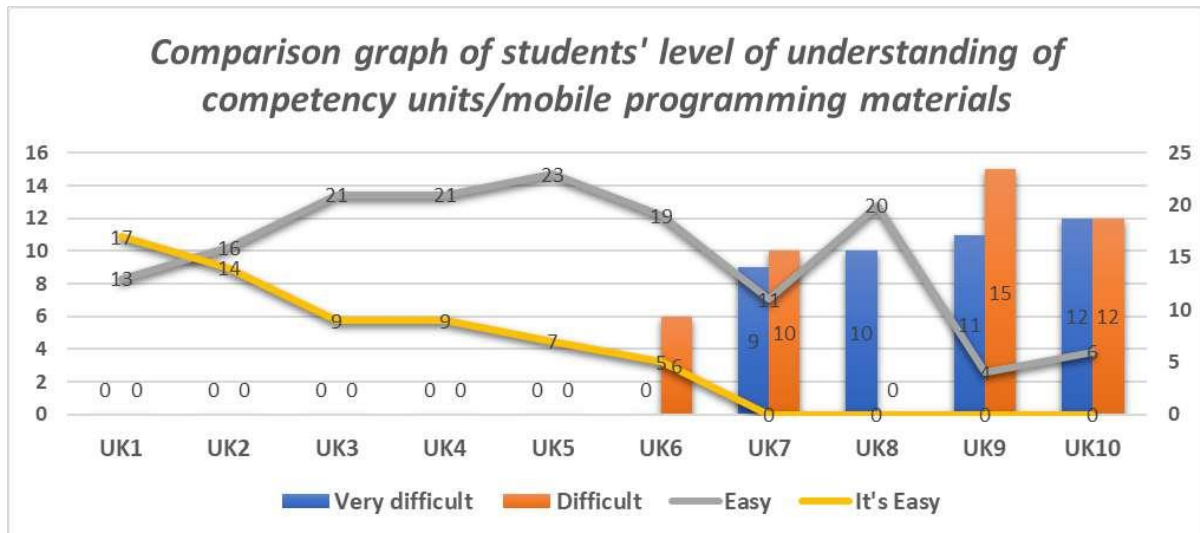


Figure 1. Comparison graph of students' level of understanding of competency units/mobile programming materials (Android)

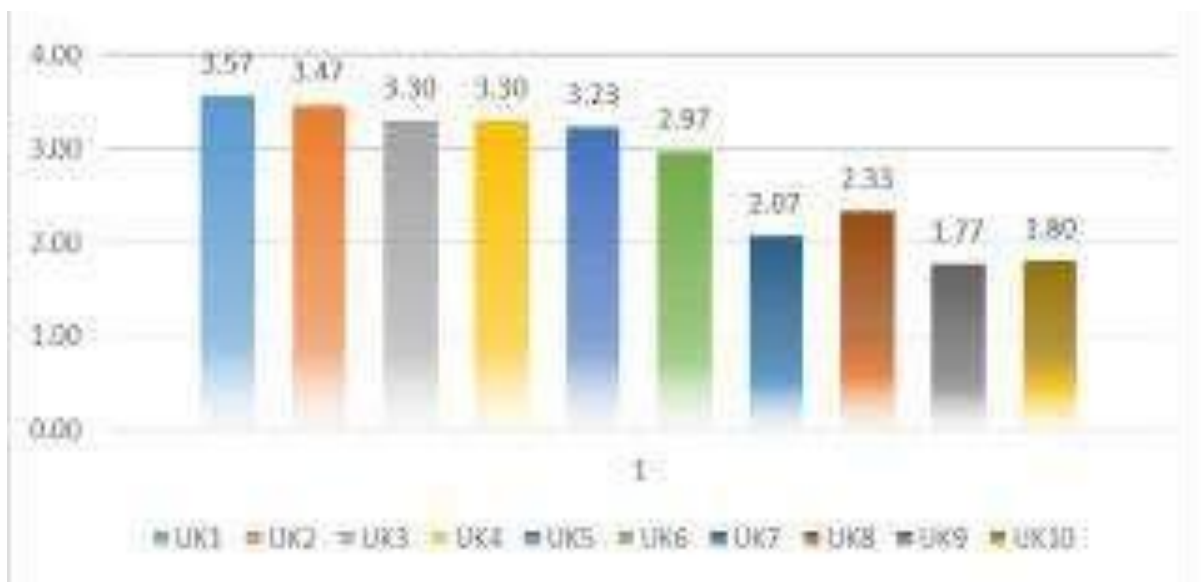


Figure 2. Comparison graph of the average Overall Level of Comprehension of students

Based on the Table s and figures above, the data recapitulation of the level of student understanding of competency units can be calculated by looking at the number of the highest scores for each item (Scale 1-4), the number of competency unit items/material, and the number of respondents (students). Results = highest score for each item (Scale 1-4) x number of items unit of competence/material x number of respondents (students). Result = 4 x 10 x 30, result = 1200. If the total score of the data collection results is 1200, the level of student

understanding of the competency unit/mobile programming material (android) according to 30 student respondents is: = 1200: 834 x 100%, results = 70% of the criteria that have been set. When interpreted, the **value of 70%** lies on the **scale of Easy(30) 60-79**. However, from the comparison picture of the average level of student understanding of competency units, it can be seen that students have difficulty starting from the 6th competency unit *Audio and Video*, to 7 *Android Advanced UI Design, Implementing Fragment*, to 8 *Broadcast Receivers and Notifications*, to 9 *Location Based Service* and to 10 *Android PHP MySQL*. Therefore, it is necessary to review the curriculum of mobile programming courses in the learning model of each competency unit, especially UK6, UK 7, UK 8, UK 9, and UK 10.

CONCLUSIONS

The results of the analysis show that the level of student understanding of mobile programming material by 70% is located on the Easy scale. However, it can be seen that the average comparison of students' level of understanding of competency units shows a decreasing graph, therefore it is necessary to review the curriculum of mobile programming courses in the learning model of each competency unit.

ACKNOWLEDGMENTS

Acknowledgments to the Head of the Directorate of Research and Community Service. Directorate General of Strengthening Research and Development of the Ministry of Research, Technology and Higher Education, which has supported funds through Beginner Lecturer Research activities in 2017 implementation 2018

REFERENCES

- Bettini, L., Dondossola, G., & Seriani, M. (2020). A mobile learning experience to develop computational thinking skills. *2020 15th International Conference on Emerging ELearning Technologies and Applications (ICETA)*, 147–152.
- Garg, S., Kumar, P., & Zheng, Y. (2020). *Mastering mobile application development (4th ed.)*. Packt Publishing Ltd.
- Long, D., & Siemens, A. (2022). The future of software engineering education. *2022 IEEE 46th Annual Computer Software and Applications Conference (COMPSAC)*, 1,1467–1476.

- López-Cózar, A., Romero-Zalamea, I., & Verhelst, M. (2020). A peer assessment framework for evaluating mobile application development projects. *2020 IEEE Global Engineering Education Conference (GEEC)*, 1–8.
- Nawaratne, N. C., & Ranasinghe, D. S. (2021). A framework for developing and assessing mobile application development skills for undergraduate students. *2021 Moratuwa Engineering Research Symposium (MERS)*, 303–308.
- Nurdyansyah, M., Pd, A., & Widodo, M. M. (2015). *Inovasi Teknologi Pembelajaran*. www.nizamiacenter.com
- Prabowo, I. A., . S., & Remawati, D. (2021). Analisis Mekanisme Pembelajaran Daring Secara Synchronous dan Asynchronous dimasa Pandemi Covid-19 di STMIK Sinar Nusantara. *Jurnal Ilmiah SINUS*, 19(1), 63. <https://doi.org/10.30646/sinus.v19i1.524>
- Prabowo, I. A., & Wijayanto, H. (2018). Analisa Penggunaan Aplikasi Android Terhadap Penentuan Topik Tugas Akhir Mahasiswa. *SNATIF*. <https://conference.umk.ac.id/index.php/snatif/article/view/46>
- Prabowo, I. A., Wijayanto, H., Yudanto, B. W., & Nugroho, S. (2021). *Buku Ajar: Pemrograman Mobile Berbasis Android (teori, latihan dan tugas mandiri)*. [books.google.com](https://books.google.com/books?hl=en&lr=&id=M3QrEAAAQBAJ&oi=fnd&p). <https://books.google.com/books?hl=en&lr=&id=M3QrEAAAQBAJ&oi=fnd&p>
[g=PR1&dq=%22iwan+ady+prabowo%22&ots=qY1dg4bVrD&sig=AfLjbOV0Nn5JbAUU-bp9KUMujf8](https://books.google.com/books?hl=en&lr=&id=M3QrEAAAQBAJ&oi=fnd&p)
- Raj, P., & Singh, M. (2021). The role of adaptability in curriculum design for emerging technologies in higher education. *Education and Training*, 63(8–9), 1032–1043.
- Rusman, D. K., & Riyana, C. (2011). Pembelajaran berbasis teknologi informasi dan komunikasi. *Bandung: Rajawali Pers*.
- Sun, Y., Yang, Y., & Liu, X. (2021). Evaluating the effectiveness of formative assessment in mobile application development courses. *2021 International Conference on Educational Technology and Computer Science (ETCS)*, 1, 52–57.
- Wolf, M., Rask, I., & Henning, M. (2021). *Android development with Kotlin: Developing powerful, scalable, and expressive apps* (3rd ed.). Manning Publications.
- Wong, H., Hassan, T. M., & Hussin, N. M. (2020). A framework for competency-based assessment in mobile application development education. *Journal of Applied Research in Higher Education*, 12(3), 1272–1289.