Developing Islamic-Friendly Android Mobile Apps for Understanding Mathematical Concepts

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ABSTRACT
Android mobile apps technology integration in the mathematics learning process in the industrial era 4.0 is needed to facilitate the understanding of mathematical concepts. The purpose of this study is to produce mobile apps that are feasible, interesting, and effective Islamic-nuanced interactive multimedia with a scientific approach to facilitate mathematical concepts understanding. The research method used is research and development with the System Development Life Cycle (SDLC) model which consists of 4 stages. The results show that the media is deemed feasible based on the validation from the material expert with a percentage of 91.67%, 83% from the media experts, and 77% from the religious experts. The product’s percentage based on the small-group trial is 65% and the field trial is 76% which belongs to the interesting criteria. The score for the media’s effectiveness is 0.56 which belongs to the medium category. Based on the results, the development of Islamic-nuanced android mobile apps of interactive multimedia with a scientific approach can be a solution to learning mathematics in the industrial era 4.0.

Keywords: Mobile apps, mathematical concept understanding, scientific approach

1. INTRODUCTION

The industrial era requires the Development of information and communication technology (ICT)[1], [2] and must be utilized to improve the quality of human resources in education [3]–[4], [5]–[6] Learning using technology has a significant influence [7]–[9]. Learning by utilizing ICT becomes interesting and has a positive impact on academic performance [10], [11]. Especially in learning mathematics that requires deeper understanding than other subjects [12]–[14], the mobile apps are considered suitable as a media of learning since it is representative [15]–[17], simple, and can be utilized repeatedly [18].

Uncontrolled use of smartphones [19], will make students become dependent, and make them lazy to learn which leads to the decreased of learning achievement in the classrooms [20]–[22]. Learning will give better results if it is well designed [23]–[25]. Based on the data, the use of smartphones every year has increased. [26]–[28]

Smartphones are not widely used in the process of learning mathematics [29]–[31], but only used as entertainment [32]–[34]. This is based on a survey conducted by Mobomarket which shows that interested users the most are games by 43.71%. The percentage of usage habits can be seen in the following figure.

Fig 2. Smartphone Usage Habits

Based on the facts, it can be said that students' smartphone usage must be controlled and directed for academic interests instead of prohibiting and keeping them away [35]. The use of smartphones is very interesting if it is developed in learning [36]–[38], by integrating it with a spiritual attitude to live and practice the teachings of the religion [39], and with a scientific approach [40]–[42]. The scientific approach aims to provide understanding to recognize [43], and to understand the material with a scientific approach [44]. Information can come from anywhere and anytime, not dependent on the direction of information from teachers [45], [46]. The use of mobile devices has flexibility and portability because it can be used anytime and anywhere [47]–[50].
Some previous research state that the development of instructional media using mobile apps is quite promising and needed by students [51–53], the use of mobile apps as a medium for mathematics learning is better [54–57], and is suitable in learning geometry [58]. Geometry transformation is classified as difficult. It needs to be repeated to get the maximum understanding [59]. Good abilities are needed by the students [60]. Mobile apps learning media are expected to facilitate mathematics learning activities [61].

Based on previous research, there are differences in this study. This study focuses on the applications that are designed according to the 2013 Curriculum using an Islamic nuanced scientific approach. So that the purpose of this research is to develop mobile apps android that is feasible, interesting, and effective as a medium for Islamic-nuanced mathematics learning with a scientific approach and to facilitate the understanding of the mathematical concepts.

2. RESEARCH METHODOLOGY

This research employs the research and development with the System Development Life Cycle (SDLC) model [60]. The SDLC steps are shown in the following figure:

![SDLC Development Steps](image)

Fig 3. SDLC Development Steps

The explanation of SDLC steps is as follows:

1.1. Analysis

An analysis is carried out on the aspects related to mobile apps. Things that are done at the planning stage, including the condition analysis, material analysis, Islamic nuanced analysis, feature analysis, display layout analysis, and connection analysis.

1.2. Design

The design stage includes the preparation of a needs mapping, the preparation of storyboards, and the preparation of display designs.

1.3. Coding

This stage includes preparing all components of mobile apps, building pages of the mobile apps, inserting all content into the mobile apps, uniting parts of the mobile apps, beautifying the display, building process as draft 1, and testing for bugs of the draft 1.

1.4. Testing

At this stage, real testing and checking of software solutions have been developed to meet the initial requirements. Besides, this stage is also carried out for revision and improvements.

The validity data analysis technique used is the validation by the material experts, media experts, and religion experts using Likert scales which consist of values; 4 (excellent), 3 (good), 2 (bad), and 1 (poor).

| Quality Score | Criteria     | Remarks          |
|---------------|--------------|------------------|
| 3.26 < x ≤ 4.00 | Valid        | No Revision      |
| 2.51 < x ≤ 3.26 | Moderate     | Partial Revision |
| 1.76 < x ≤ 2.51 | Less Valid   | Partial Revision & Review Material |
| 1.00 ≤ x ≤ 1.76 | Invalid      | Total Revision   |

Also, to see the attractiveness, a small-group trial was conducted toward 6 respondents and a field testing was carried out to 37 respondents with the criteria in the table below.

| Score | Criteria        |
|-------|-----------------|
| 3.25 < x ≤ 4.00 | Very Interesting |
| 2.50 < x ≤ 3.25 | Interesting     |
| 1.75 < x ≤ 2.50 | Less Interesting |
| 1.00 ≤ x ≤ 1.75 | Uninteresting   |

A test was given to see the effectiveness of the developed instructional media and to find out the improvement in understanding mathematical concepts. This test used the conceptual understanding rubric with n-gain [63]

\[
N - Gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}
\]

Description: \(S_{post} = \) Posttest score, \(S_{pre} = \) Pretest score

2. BACKGROUND

Based on the results of the development of the Islamic-nuanced interactive multimedia with a scientific approach for geometry transformation material in tenth grade, the following data is obtained.

3.1. Analysis

At this stage, an analysis was carried out to 25 students with a questionnaire on the use of a Smartphone. Data shows that 44% of the students expressed very interested in the mathematics material is packaged in the form of
mobile apps. The material is the geometry transformation. This is supported by the data score on this material which is 47.3, so it needs to be facilitated in learning. Also, 92% of students expressed their interest if Islamic values are included in the mathematics learning media. The features that will be used in mobile apps were also analyzed. The data can be seen in the following figure.

![Fig 4. Analysis of mobile apps Features](image)

Based on the analysis, 52% of respondents prefer portrait display and 68% of respondents prefer offline connections.

### 3.2. Design

The design phase is carried out by compiling a map of product needs, storyboards, displays, and writing instruments. The following is the display of the mobile apps icon.

![Fig 5. Mobile Apps Icon](image)

![Fig 6. Mobile Apps Background](image)

### 3.3. Coding

Android Studio (software application builder) is used in this stage. Each page is built by coding (compiling commands in a programming language, i.e. HTML). All pages in the mobile apps can be used offline, except in the discussion forum menu which must be done online. Users must connect the mobile device to the internet to connect to servers and have discussions. Furthermore, unifying the pages of the mobile apps and operating the mobile apps through the emulator and Smartphone as can be seen in the following picture.

![Fig 7. Mobile apps Emulator Menu](image)

![Fig 8. Mobile Apps](image)

### 3.4. Testing

Alpha testing at this stage was carried out by material experts, media experts, and religious experts.

#### 3.4.1. Material Experts

The data validation can be seen in the following figure.

![Fig 9. The percentage from the Material Experts](image)
3.4.2. Media Experts

Validation of media experts includes the aspects of presentation, skills, software engineering, and implementation. The data can be seen in the following figure.

![Fig 10. The percentage from the Media Expert](image)

3.4.3. Religious Experts

Experts validation of religious experts includes aspects of the quality of content, language, and material emphases. The data can be seen in the following figure.

![Fig 11. The percentage from the Religious Experts](image)

Small-Group testing was conducted on 6 respondents and field testing on 31 respondents. The percentage for the product's effectiveness is 0.56 in which belongs to the medium category. The data of the small-group testing and the field-testing can be seen in the following figure.

![Fig 12. Small-scale test and Field Test](image)

This research produces a product in the form of a mobile application of Islamic-nuanced interactive multimedia with a scientific approach to facilitate mathematical concepts understanding. The mobile apps are compiled based on the basic competencies contained in the 2013 curriculum. The mobile apps are equipped with activities of the scientific approach characteristic and concept understanding abilities.

This writing and development model refers to the SDLC (System Development Life Cycle) development model which includes four steps. The finished product is then validated by experts, namely material experts and media experts. The results of the assessment of the material experts indicate that the product has highly feasible criteria with an average percentage of 91.67%. The results of the assessment of the media experts indicate that the product has highly feasible criteria with an average percentage of 83%. The results of the assessment of the religious experts indicate that the product has feasible criteria with an average percentage of 77%.

After the validation stage (alpha testing) had been completed, the product was beta-tested which included the first and the second beta testing and effectiveness testing. The results of the first beta test showed that mobile apps are attractive with an average percentage score of 65%. The second beta test of mobile apps received an interesting response with an average percentage score of 76%. The results of the effectiveness test on the n-gain test showed that there was an increase in student learning outcomes with a score of 0.56 on the medium criteria.

Islamic-nuanced interactive multimedia with a scientific approach can facilitate the concept of understanding, attractive, and effective for use in mathematics learning activities [62]. Therefore, it is hoped that the presence of these mobile apps can assist students in carrying out a learning process to understand the mathematics concept easily [63], [64] and help students further develop their knowledge in daily life [65], [66]. The advantages of the mobile apps are as a learning guide for students to learn independently and can be used anywhere and anytime practically [67], [68]; the mobile apps are compiled with the scientific approach that can encourage and inspire students to think critically, analytically, and precisely in identifying, understanding, solving problems, and applying learning material [69]; This mobile apps have many illustrations that can make it easier for students to understand the material [70]; This mobile app is designed with the nuances of Islam. It allows the users to keep remembering Allah the Almighty when using it [71]; The mobile apps are also equipped with a discussion forum that can be used by users to communicate with other users [72].

4. CONCLUSION

The research and development conclude that: 1) Android-based learning of Islamic-nuanced interactive multimedia with the scientific approach can facilitate mathematical concepts understanding of geometrical transformation material with a highly feasible category. The results of the assessment of the material experts indicate that the product has a highly feasible criteria with an average percentage of
91.67%, the results of the assessment of the media experts indicate that the product has a highly feasible criteria with an average percentage of 83%, and the results of the assessment of the religious experts indicate that the product has a feasible criteria with an average percentage of 77%. 2) Based on the small-group testing, the students state that the product is interesting with a percentage of 65% and field testing with a percentage of 76%, also with interesting criteria. 3) The product's effectiveness is in the medium category with a score of 0.56. The development of Islamic-nuanced interactive multimedia with scientific approach mobile apps can facilitate the mathematical concepts understanding and can be used in learning mathematics in the industrial revolution era 4.0.

REFERENCES

[1] P. A. and D. Keeble, High technology industry and innovative environments: the European experience. Routledge, 2018.

[2] P. S. et al., “Derivatives of 6-(2, 3-dichlorophenyl)-1, 2, 4-triazin-5-amine,” 2019.

[3] J. Gold and J. Bratton, “Towards critical human resource development education (CHRDE): Using the sociological imagination to make the HRD profession more critical in the post-crisis era,” Hum. Resour. Dev. Int, vol. 17, no. 4, pp. 400–415, 2014.

[4] K. S. Mahedy, “Peranan Teknologi Informasi dalam Meningkatkan Kualitas Pendidikan,” J. Pendidik. Teknol. Dan Kejur, vol. 6, no. 2, 2009.

[5] M. S. Tampubolon, “Kebijakan Berwawasan Kependudukan dan Peningkatan Kualitas Sumber Daya Manusia,” JUPIIS J. Pendidik. ILMU-ILMU Sos, vol. 6, no. 2, pp. 107–117, 2015.

[6] M. S. Tampubolon, “Kebijakan Berwawasan Kependudukan dan Peningkatan Kualitas Sumber Daya Manusia,” JUPIIS J. Pendidik. ILMU-ILMU Sos, vol. 6, no. 2, pp. 107–117, 2015.

[7] G. Gunawan, A. Harjono, and S. Sutriro, “Multimedia Interaktif dalam Pembelajaran Konsep Listrik bagi Calon Guru,” J. Pendidik. Fis. dan Teknol., vol. 1, no. 1, pp. 9–14, 2017.

[8] H. Rodiawati and K. Komarudin, “Pengembangan E-Learning Melalui Modul Interaktif Berbasis Learning Content Development System,” J. Tatsqif, vol. 16, no. 2, pp. 172–185, 2018.

[9] T. N. Utami, A. Jatmiko, and S. Suherman, “Pengembangan Modul Matematika dengan Pendekatan Science, Technlogy, Engineering, And Mathematics (STEM) pada Materi Segiempat,” Desimal J. Mat., vol. 1, no. 2, pp. 165–172, 2018.

[10] A. Idrus, “Pemanfaatan Teknologi Informasi Dan Komunikasi Dalam Layanan Administrasi Akademik Terhadap Peningkatan Kinerja Di SMA Negeri Kota Jambi,” J. Tekno-pedagogi, vol. 4, no. 2, 2014.

[11] R. Yektyastuti and J. Ikhsan, “Pengembangan media pembelajaran berbasis android pada materi kelarutan untuk meningkatkan performa akademik siswa SMA,” J. Inov. Pendidik. IPA, vol. 2, no. 1, pp. 88–99, 2016.

[12] A. Fadli, S. Suhrano, and A. A. Musadad, “Deskripsi Analisis Kebutuhan Media Pembelajaran Berbasis Role Play Game Education untuk Pembelajaran Matematika,” in Prosiding Seminar Nasional Teknologi Pendidikan, 2017.

[13] V. R. Jacobs, L. L. Lamb, and R. A. Philipp, “Professional noticing of children’s mathematical thinking,” J. Res. Math. Educ., pp. 169–202, 2010.

[14] L. L. Syarifah, “Analisis kemampuan pemahaman matematis pada mata kuliah pelatihan pembelajaran matematika SMA II,” JPPM (Jurnal Penelit. dan Pembelajaran Mat., vol. 10, no. 2, 2017.

[15] S. Judge, K. Floyd, and T. Jeffs, “Using mobile media devices and apps to promote young children’s learning,” in Young children and families in the information age, Springer, 2015, pp. 117–131.

[16] Q. Qumillaila, B. H. Susanti, and Z. Zulfiani, “Pengembangan Augmented Reality Versi Android sebagai Media Pembelajaran Sistem Ekskresi Manusia,” Cakrawala Pendidik., no. 1, pp. 57–69, 2017.

[17] J. S. Radesky, J. Schumacher, and B. Zuckerman, “Mobile and interactive media use by young children: the good, the bad, and the unknown,” Pediatrics, vol. 135, no. 1, pp. 1–3, 2015.

[18] T. Leinonen, A. Keune, M. Veermans, and T. Toikkanen, “Mobile apps for reflection in learning: A design research in K-12 education,” Br. J. Educ. Technol., vol. 47, no. 1, pp. 184–202, 2016.

[19] C. F. Wilantika, “Pengaruh penggunaan smartphone terhadap kesehatan dan perilaku remaja,” J. Obs. Sci., vol. 3, no. 2, 2017.
[20] M. Mulawarman, L. Ariffudin, A. I. N. Rahmawati, M. E. Wibowo, E. Purwanto, and A. Munandar, “Application of Android-Based Stress Meter as Stress Academic Indicator on College Student with Low Achievement Motivation,” in *International Conference on Science and Education and Technology 2018 (ISET 2018)*, 2018.

[21] S. Mulyati and W. Anggraeni, “Rancang Bangun Aplikasi Pembelajaran Matematika SD Kelas 6 Berbasis Android Pada SDN Cimone 1 Tangerang,” *J. Din. UMT*, vol. 1, no. 2, pp. 56–65, 2017.

[22] S. N. Şad, A. S. Konca, N. Özver, and F. Acar, “Parental e-nvolvement: a phenomenological research on electronic parental involvement,” *Int. J. Pedagog. Learn.*, vol. 11, no. 2, pp. 163–186, 2016.

[23] K. Kiili, “Foundation for problem-based gaming,” *Br. J. Educ. Technol.*, vol. 38, no. 3, pp. 394–404, 2007.

[24] S. Sohibun and F. Y. Ade, “Pengembangan media pembelajaran berbasis virtual class berbantuan Google Drive,” *Tadris J. Kegur. Dan Ilmu Tarb.*, vol. 2, no. 2, pp. 121–129, 2017.

[25] D. C. Yang and Y. F. Tsai, “Promoting sixth graders’ number sense and learning attitudes via technology-based environment,” *J. Educ. Technol. Soc.*, vol. 13, no. 4, pp. 112–125, 2010.

[26] C. Kongaut and E. Bohlin, “Investigating mobile broadband adoption and usage: A case of smartphones in Sweden,” *Telemat. Informatics*, vol. 33, no. 3, pp. 742–752, 2016.

[27] N. Latifah, “Faktor-Faktor Yang Mempengaruhi Brand Experience Tahap Brand Loyalty pada Iphone Indonesia,” *J. Mitra Manaj.*, vol. 3, no. 1, pp. 147–162, 2019.

[28] S. Parasuraman, A. T. Sam, S. W. K. Yee, B. L. C. Chuo, and L. Y. Ren, “Smartphone usage and increased risk of mobile phone addiction: A concurrent study,” *Int. J. Pharm. Investig.*, vol. 7, no. 3, pp. 125–131, 2017.

[29] M. R. Rahadi, K. I. Satoto, and I. P. Windasari, “Perancangan Game Math Adventure Sebagai Media Pembelajaran Matematika Berbasis Android,” *J. Teknol. dan Sist. Komput.*, vol. 4, no. 1, pp. 44–49, 2016.

[30] W. K. Sunandar, B. Achmad, and R. N. Dini, “Mobile math (Mobile Learning Math) Media Design with Seamless Learning Model on Analytical Geometry Crouse,” *Int. J. Appl. Eng. Res.*, vol. 19, no. 12, 2017.

[31] C. Syaimar and S. Sutiasro, “Study Anywhere and Anytime, not Necessarily in Class,” *Int. J. Technol. Educ. Sci.*, vol. 2, no. 1, pp. 35–39, 2018.

[32] M. M. Almalki, S. S. Algarni, B. H. Almansouri, and M. A. Aldowsari, “Use of Smartphones, ipads, Laptops and Desktops as A Risk Factor for Non-Specific Neck Pain among Undergraduate University Students,” *Egypt. J. Hosp. Med.*, vol. 69, no. 5, 2017.

[33] N. Barr, G. Pennycook, J. A. Stolz, and J. A. Fugelsang, “The brain in your pocket: Evidence that Smartphones are used to supplant thinking,” *Comput. Human Behav.*, vol. 48, pp. 473–480, 2015.

[34] M. E. Hossain and S. Z. Ahmed, “Academic use of smartphones by university students: a developing country perspective,” *Electron. Libr.*, vol. 34, no. 4, pp. 651–665, 2016.

[35] S. Suherman, “Kreativitas Siswa Dalam Memecahkan Masalah Matematika Materi Pola Bilangan Dengan Pendekatan Matematika Realistik (PMR),” *Al-Jabar J. Pendidik. Mat.*, vol. 6, no. 1, pp. 81–90, 2015.

[36] M. Anshari, M. N. Almunawar, M. Shahrill, D. K. Wicaksono, and M. Huda, “Smartphones usage in the classrooms: Learning aid or interference?,” *Educ. Inf. Technol.*, vol. 22, no. 6, pp. 3063–3079, 2017.

[37] Z. Bogdanović, D. Barać, B. Jovanić, S. Popović, and B. Radenković, “Evaluation of mobile assessment in a learning management system,” *Br. J. Educ. Technol.*, vol. 45, no. 2, pp. 231–244, 2014.

[38] C.-H. Su and C.-H. Cheng, “A mobile gamification learning system for improving the learning motivation and achievements,” *J. Comput. Assist. Learn.*, vol. 31, no. 3, pp. 268–286, 2015.

[39] A. Wiguna, “Upaya Mengembangkan Sikap Spiritual dan Sosial Peserta Didik Berbasis Psikologi Positif di Sekolah,” *AL-ASASIYYA J. Basic Educ.*, vol. 1, no. 2, 2017.

[40] M. Á. González et al., “Teaching and learning physics with smartphones,” in *Blended Learning: Concepts, Methodologies, Tools, and Applications*, IGI Global, 2017, pp. 866–885.

[41] A. A. Nugroho and H. Purwati, “Pengembangan Media Pembelajaran Matematika Berbasis Mobile
Learning Dengan Pendekatan Scientific,” *Euclid*, vol. 2, no. 1, 2015.

[42] Y. Yulianti, A. Buchori, and Y. H. Murtianto, “Pengembangan Media Presentasi Visual dengan Pendekatan Kontekstual dalam Pembelajaran Matematika di SMP,” *MUST J. Math. Educ. Sci. Technol.*, vol. 2, no. 2, pp. 231–242, 2017.

[43] N. Septina, F. Farida, and K. Komarudin, “Pengembangan Lembar Kerja Siswa Dengan Pendekatan Saintifik Berbasis Kemampuan Pemecahan Masalah,” *J. Tatsqif*, vol. 16, no. 2, pp. 160–171, 2018.

[44] K. Hamidah and S. Suherman, “Proses Berpikir Matematis Siswa dalam Menyelesaikan Masalah Matematika di tinjau dari Tipe Kepribadian Keirsey,” *J. Ilm. Pendidik. Fis.* vol. 5, no. 1, pp. 83–93, 2016.

[45] M. S. Paut, “Penerapan pendekatan saintifik pada siswa kelas IV di SD Pujokusuman 1 Yogyakarta,” *BASIC Educ.*, vol. 5, no. 6, pp. 511–517, 2016.

[46] R. Diani, “Pengaruh pendekatan saintifik berbantukan LKS terhadap hasil belajar fisika peserta didik kelas XI SMA Perintis 1 Bandar Lampung,” *J. IIm. Pendidik. Fis. Al-Biruni*, vol. 5, no. 1, pp. 231–248, 2016.

[47] F. Khaddage and W. Zhou, “A Mobile Learning model for Universities-Re-blending the current learning environment,” *Int. J. Interact. Mob. Technol.*, vol. 3, pp. 18–23, 2009.

[48] K. T. Martono and O. D. Nurhayati, “Implementation of android based mobile Learning application as a flexible learning Media,” *Int. J. Comput. Sci. Issues*, vol. 11, no. 3, p. 168, 2014.

[49] B. R. Simanjuntak, D. Desnita, and E. Budi, “The Development of Web-based Instructional Media for Teaching Wave Physics on Android Mobile,” *J. Penelit. Pembemb. Pendidik. Fis.*, vol. 4, no. 1, pp. 1–10, 2018.

[50] M. Syazali, “Pengaruh Model Pembelajaran Creative Problem Solving Berbantuan Media Maple 11 Terhadap Kemampuan Pemecahan Masalah Matematis,” *Al-Jabar J. Pendidik. Mat.*, vol. 6, no. 1, pp. 91–98, 2015.

[51] J. Alden, “Accommodating mobile learning in college programs,” *J. Asynchronous Learn. Networks*, vol. 17, no. 1, pp. 109–122, 2013.

[52] I. Han and W. S. Shin, “The use of a mobile learning management system and academic achievement of online students,” *Comput. Educ.*, vol. 102, pp. 79–89, 2016.

[53] J. Martín-Gutiérrez, P. Fabiani, W. Benesova, M. D. Meneses, and C. E. Mora, “Augmented reality to promote collaborative and autonomous learning in higher education,” *Comput. Human Behav.*, vol. 51, pp. 752–761, 2015.

[54] L. Ariyanto, D. Aditya, and I. Dwijayanti, “Pengembangan Android Apps Berbasis Discovery Learning Untuk Meningkatkan Pemahaman Konsep Matematis Siswa Kelas VII,” *Edumatika J. Ris. Pendidik. Mat.*, vol. 2, no. 1, pp. 40–51, 2019.

[55] K. Ciampa, “Learning in a mobile age: an investigation of student motivation,” *J. Comput. Assist. Learn.*, vol. 30, no. 1, pp. 82–96, 2014.

[56] I. Gunawan, “Pengembangan Aplikasi Mobile Learning Fisika sebagai Media Pembelajaran Pendukung,” *J. Ilm. Pendidik. Fis. Al-Biruni*, vol. 3, no. 1, pp. 20–26, 2014.

[57] M. Lu, “Effectiveness of vocabulary learning via mobile phone,” *J. Comput. Assist. Learn.*, vol. 24, no. 6, pp. 515–525, 2008.

[58] E. G. de Ravé, F. J. Jiménez-Hornero, A. B. Ariza-Villaverde, and J. Taguas-Ruíz, “DiedricAR: a mobile augmented reality system designed for the ubiquitous descriptive geometry learning,” *Multimed. Tools Appl.*, vol. 75, no. 16, pp. 9641–9663, 2016.

[59] S. Andriani, H. Suyitno, and I. Junaidi, “The Application of Differential Equation of Verhulst Population Model on Estimation of Bandar Lampung Population,” in *Journal of Physics: Conference Series*, 2019, vol. 1155, p. 12017.

[60] S. Hartinah et al., “Teacher’s performance management: The role of principal’s leadership, work environment and motivation in Tegal City, Indonesia,” *Manag. Sci. Lett.*, vol. 9, no. 14, pp. 1–12, 2019.

[61] I. Yusnita, R. Masykur, and S. Suherman, “Modifikasi Model Pembelajaran Gerlach dan Ely Melalui Integrasi Nilai-Nilai Keislaman Sebagai Upaya Meningkatkan Kemampuan Representasi Matematis,” *Al-Jabar J. Pendidik. Mat.*, vol. 7, no. 1, pp. 29–38, 2016.

[62] R. R. A. Akbar and K. Komarudin, “Pengembangan Video Pembelajaran Matematika...
Berbantuan Media Sosial Instagram sebagai Alternatif Pembelajaran,” *Desimal J. Mat.*, vol. 1, no. 2, pp. 209–215, 2018.

[63] A. O. Kyriakides, M. Meletiou-Mavrotheris, and T. Prodromou, “Mobile technologies in the service of students’ learning of mathematics: the example of game application ALEX in the context of a primary school in Cyprus,” *Math. Educ. Res. J.*, vol. 28, no. 1, pp. 53–78, 2016.

[64] C.-K. Looi, P. Seow, B. Zhang, H.-J. So, W. Chen, and L.-H. Wong, “Leveraging mobile technology for sustainable seamless learning: a research agenda,” *Br. J. Educ. Technol.*, vol. 41, no. 2, pp. 154–169, 2010.

[65] V. Albe, “When scientific knowledge, daily life experience, epistemological and social considerations intersect: Students’ argumentation in group discussions on a socio-scientific issue,” *Res. Sci. Educ.*, vol. 38, no. 1, pp. 67–90, 2008.

[66] A. Roychoudhury, “Connecting science to everyday experiences in preschool settings,” *Cult. Stud. Sci. Educ.*, vol. 9, no. 2, pp. 305–315, 2014.

[67] Ál. Fernández-López, M. J. Rodríguez-Fortiz, M. L. Rodríguez-Almendros, and M. J. Martínez-Segura, “Mobile learning technology based on iOS devices to support students with special education needs,” *Comput. Educ.*, vol. 61, pp. 77–90, 2013.

[68] J. Sandberg, M. Maris, and K. de Geus, “Mobile English learning: An evidence-based study with fifth graders,” *Comput. Educ.*, vol. 57, no. 1, pp. 1334–1347, 2011.

[69] G. Schwabe and C. Göth, “Mobile learning with a mobile game: design and motivational effects,” *J. Comput. Assist. Learn.*, vol. 21, no. 3, pp. 204–216, 2005.

[70] L. F. Motiwalla, “Mobile learning: A framework and evaluation,” *Comput. Educ.*, vol. 49, no. 3, pp. 581–596, 2007.

[71] P. Nesser et al., “Welcome from the Editors,” 2016.

[72] L. E. Holmquist, F. Mattern, B. Schiele, P. Alahuhta, M. Beigl, and H.-W. Gellersen, “Smart-its friends: A technique for users to easily establish connections between smart artefacts,” in *international conference on Ubiquitous Computing*, 2001, pp. 116–122.