THE DEVELOPMENT OF ANDROID MOBILE APPLICATION AS INTERACTIVE MULTIMEDIA IN EARTH LAYER TOPICS FOR JUNIOR HIGH SCHOOL

RESEARCH PAPER

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DECLARATION

I do hereby declare that every aspect was written in this research paper entitled "The Development of Android Mobile Application as Interactive Multimedia In Earth Layer Topics for Junior High School" genuinely results of my original idea, effort, and works. The theories, findings of experts, opinions, and others contained in this paper have been quoted or referenced based on scientific code from UPI and in accordance with scientific ethics that applies in scholarly society. This declaration is created truthfully and consciously. When an infringement towards scientific ethics subsequently is found or if there is a claim of any others towards the authenticity of this research paper, hence I am willing to responsible and accept academicals sanctions correspond to the rules.

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ABSTRACT

Technological developments in this era are experiencing rapid progress. Especially in the field of science, everyone refers to education that will trend in the 21st century. Where education will become very modern with the help of many technologies to support student learning. The android-based application is nowdays used in order to engage students' understanding of science learning. In this work, we will propose a android learning application, named "E-Layer", as interactive multimedia for learning science. This application discusses physical material on the topic of the earth layer. This application is made using Unity software. Unity is software that can make applications for games or learning applications in two dimensions or three dimensions that are packaged in an interactive multimedia display. This application that has now been completed is the first version of the application that has undergone 7 changes and development during the creation process. Researchers have evaluated this device. The results showed that based on content expert evaluations, the average mobile learning score was 96%, language evaluation based on experts was 82.50%, and media design (IT) rated an average of 87.93% from the range 88 , 81%. As well as based reviews from science teachers and junior high school students the percentage of mobile learning applications is 90.55% and 92.50. Based on this, the Android mobile application is very suitable for use as a learning application. This application is dynamically designed and equipped with various supporting features, such as: images, videos, sounds, multi-language animation settings, and so on. The author suggests that this application can continue to be developed in future studies.

Keywords: E-Layer, Unity, Android Mobile Application, Interactive Multimedia.

PENGEMBANGAN APLIKASI MOBILE ANDROID SEBAGAI MULTIMEDIA INTERAKTIF PADA TOPIK LAPISAN BUMI UNTUK SISWA SEKOLAH MENENGAH PERTAMA

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ABSTRACT

Abstrak. Perkembangan teknologi di era ini sedang mengalami kemajuan pesat. Terutama di bidang sains, semua orang mengacu pada pendidikan yang akan tren di abad ke-21. Di mana pendidikan akan menjadi sangat modern dengan bantuan banyak teknologi untuk mendukung pembelajaran siswa. Aplikasi berbasis android saat ini digunakan untuk melibatkan pemahaman siswa tentang pembelajaran sains. Dalam karya ini, kami akan mengusulkan aplikasi pembelajaran android, bernama "E-Layer", sebagai multimedia interaktif untuk pembelajaran sains. Aplikasi ini membahas materi fisik tentang topik lapisan bumi. Aplikasi ini dibuat menggunakan perangkat lunak Unity. Unity adalah perangkat lunak yang dapat membuat aplikasi untuk game atau aplikasi pembelajaran dalam dua dimensi atau tiga dimensi yang dikemas dalam tampilan multimedia interaktif. Para peneliti telah mengevaluasi perangkat ini. Hasil penelitian menunjukkan bahwa berdasarkan evaluasi ahli konten, skor pembelajaran mobile rata-rata adalah 96%, evaluasi bahasa berdasarkan ahli adalah 82,50%, dan desain media (TI) dinilai rata-rata 87,93% dari kisaran 88, 81%. Selain berdasarkan ulasan dari guru sains dan siswa SMP, persentase aplikasi pembelajaran seluler adalah 90,55% dan 92,50. Berdasarkan hal ini, aplikasi seluler Android sangat cocok untuk digunakan sebagai aplikasi pembelajaran. Aplikasi ini dirancang secara dinamis dan dilengkapi dengan berbagai fitur pendukung, seperti: gambar, video, suara, pengaturan animasi multi-bahasa, dan sebagainya. Penulis menyarankan bahwa aplikasi ini dapat terus dikembangkan dalam studi masa depan.

Kata kunci: E-Layer, Unity, Aplikasi Android Mobile, Multimedia Interaktif.

PREFACE

All praise belongs to Allah SWT because of His Mercy and Grace, the author could finish the research paper entitled "The Development of Android Mobile Application as Interactive Multimedia in Earth Layer Topics for Junior High School". *Salawat* and *Salaam* might be sent upon the prophet Muhammad, the last of His Messengers and prophet, his family, companions, and all those who follow his steps till the end of the time.

The research had been conducted to develop the Android mobile learning application based on Arduino projects for Junior High School students. This research paper is the requirement to fulfill the Bachelor Degree of International Program on Science Education.

The perfection belongs to Allah. The author realizes that there are many weakness or limitation that need to be fixed and improved. Thus, suggestions, comments, and recommendations are openly welcomed for the better quality of mobile learning application in the future. Hopefully, this research might bring benefits for science education, technical aspect, and better learning and teaching implementation.

Bandung, August 2019

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Adams, S., & Lambert, D. (2006). Earth Science: An illustrated guide to science. New York NY,10001, 20.

Arikunto, S. (2010). Prosedur Penelitian Suatu Pendekatan Praktik. Jakarta:Rineka Cipta.

Alwan, A. A. (2011). Misconception of heat and temperature among physics students. Procedia-Social and Behavioral Sciences, 12, 600-614.

Alzahrani, A., Alalwan, N., & Sarrab, M. (2014, April). Mobile cloud computing: advantage,disadvantage and open challenge. In Proceedings of the 7th Euro American Conference on Telematics and Information Systems (p. 21). ACM

Bernard, H.R. 2002. Research Methods in Anthropology: Qualitative and quantitative methods.3rd edition. AltaMira Press ,Walnut Creek, California.

Bernard, H.R., P.J. Pelto, O. Werner, J. Boster, A.K. Rom¬ney, A. Johnson, C.R.Ember & A.Kasakoff. 1986. The construction of primary data in cultural anthropology. Cur¬rent Anthropology 27: 382-396.

Bloom, B. S. 1981. Foreword to Effective Instruction, by T. Levin. Alexandria,VA: Association for Supervision and Curriculum Development.

Boone, H. N., & Boone, D. A. (2012). Analyzing likert data. Journal of extension, 50(2), 1-5.

Cairncross, S., & Mannion, M. (2001). Interactive multimedia and learning:Realizing the benefits.Innovations in education and teaching international, 38(2), 156-164.

Calimag, J. N., Mugel, P. A., Conde, R. S., & Aquino, L. B. (2014). Ubquitous learning environment using android mobile application. International Journal of Research in Engineering & Technology, 2(2), 119-128.

Carrie, W. (2007). Research Methods. Journal of Business & Economic Research,65-72.

Chapman, P., S. Selvarajah, and J. Webster. 1999. Engagement in multimedia training systems. In Proceedings of HICSS, Maui, HI.

Dalmasso, I., Datta, S. K., Bonnet, C., & Nikaein, N. (2013, July). Survey,comparison and evaluation of cross platform mobile application development tools. In Wireless Communications and Mobile Computing Conference(IWCMC), 2013 9th International (pp. 323-328). IEEE.

Dyson, L., Andrew, T., Smyth, R., & Wallace, R. (2013). Towards a Framework for Ethical Mobile Learning, 405–406.

Forment, M., Guerrero, J. C., (2008).MOODLBILE: Extending Moodle to the Mobile On/Offline Scenario.Proceedings of the IADIS International Conference on Mobile Learning.

Gallegos, L., Jerezano, M.E., & Flores, F. (1994). Preconceptions and relations used by children in the construction of food chains. Journal of Research in Science Teaching, 31, 259-272.

Garcia, G.S.C. 2006. The mother – child nexus: knowl¬edge and valuation of wild food plants in Wayanad, West¬ West¬ern Ghats, India. Journal of Ethnobiology and Ethnomedi¬cine 2:39.

George, D., & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference.11.0 update (4th ed.). Boston: Allyn & Bacon.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education.

Gravemeijer, K. (1998). Developmental research as a research method.In Mathematics education as a research domain: A search for identity (pp.277-295). Springer, Dordrecht.

Gustad, G., S.S. Dhillion & D. Sidibe. 2004. Local use and cultural economic value of products from trees in the park¬lands of the municipality of Cinzana, Mali. Economic Bot¬any 58:578-587.

Hammond, N., J.McKendree,W. Reader, A. Trapp, and P. Scott. 1995.The PsyCLE project:Educational multimedia for conceptual understanding.In Proceedings ofACMMultimediaConference,447–456,SanFrancisco.New York: ACM Press.

Holla, S., & Katti, M. M. (2012). Android based mobile application development and its security.International Journal of Computer Trends and Technology, 3(3), 486-490.

Hoppe, H.U., Joiner R., Milrad M., & Sharples, M., (2003). Wireless and Mobile Technologies in Education, Journal of Computer Assisted Learning 19, 3, pp 255-261.

Islam, R., Islam, R., & Mazumder, T. (2010). Mobile application and its global impact. International Journal of Engineering & Technology (IJEST), 10(6), 72-78.

Jarvis, M.C., A.M. Miller, J. Sheahan, K. Ploetz, J. Ploetz, R.R. Watson, M.P.Ruiz,C.A.P.Villapan, J.G. Alvarado, A.L. Ramirez & B. Orr. 2004. EdibleWild mushrooms of the Cfrede Perote Region, Veracruz, Mexico: an ethno¬mycological study of common names and uses. Economic Botany 58:S111-S115.

Jones, S. (2002). The Internet goes to college: how students are living in the future with today_stechnology. Pew Internet and American Life Project, Sept.(accessed Oct, 2004). Available from http://www.pewinternet.org

Kang, H., & Cho, J. (2015). Case study on efficient Android programming education using multi Android development tools. Indian Journal of Science and Technology, 8(19).

Kaplan, R. M., & Saccuzzo, D. P. (2009). Psychological testing: Principles, applications, and issues (7th ed.). Belmont, CA: Thompson Wadsworth.

Khalid, T. (2001). Pre-service teachers' misconceptions regarding three environmental issues.Canadian Journal of Environmental Education (CJEE), 6(1), 102-120.

Kiger, D., Herro, D., & Prunty, D. (2012). Examining the Influence of a Mobile Learning Intervention on Third Grade Math Achievement. Journal of Research on Technology in Education, 61-82.

Kusky, T. M., & Cullen, K. E. (2010). Encyclopedia of earth and space science.Infobase Publishing.

Kucuk, S., Aydemir, M., Yildirim, G., Arpacik, O., & Goktas, Y. (2013).Educational technology research trends in Turkey from 1990 to 2011. Computers & Education, 68, 42-50.

Lan Y. (2009).Using RSS to Support Ubiquitous Learning Based on Media Richness Theory.Virtual Environments, Human-Computer Interfaces and Measurements Systems,VECIMS '09. IEEE International Conference, 287-291.

Liu, C. C. and Kao, L. C., (2007). Do handheld devices facilitate face-to-face collaboration?Handheld devices with large shared display groupware to facilitate group interactions. Journal of Computer Assisted Learning, 23 , 285–299.

Lo, J., Chan, Y., & Yeh, S. (2012). Designing and adaptive web-based learning system based on students' cognitive styles identified online. Computers and Education, 209-222.

Lyon, L.M. & L.H. Hardesty. 2005. Traditional healing in the contemporary life of the Antanosy people of Madagas¬car. Ethnobotany Research and Applications 3:287-294.

Mantell, C. (2013). Our fragile water planet: an introduction to the earth sciences. Springer.

McFarlane, Triggs, P. & Yee, W. (2008) Mobile learning: Research findings.Coventry:Becta.Available at http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/mobile_learning_july07.pdf.

Miangah T.M., Nezarat A. (2012.) Mobile-Assisted Language Learning Journal.International Journal of Distributed and Parallel Systems. Volume 3 Number 1,309-319.

Moore, M. G. 1989. Three types of interaction. The American Journal of Distance Education 3(2): 1–6.

Muthukumarasamy, S. (2013). Design and development of Mobile Assisted Language Learning(MALL) application for English language using Android push notification services.IJRCCT, 2(6), 329-338.

Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2004). Literature Review in Mobile Technologies and Learning. Futurelab Series. Report, 11.

Neo, T. K., & Neo, M. (2004). Classroom innovation: engaging students in interactive multimedia learning. Campus-Wide Information Systems, 21(3),118-124.

Nesbit, J. C., & Li, J. (2004, July). Web-based tools for learning object evaluation. In International conference on education and information systems: Technologies and Applications (pp. 21-
25).

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology:Developing a technology pedagogical content knowledge. Teaching and teacher education, 21(5), 509-523.

Parhizkar, B., Obeidy, W. K., Chowdhury, S. A., Gebril, Z. M., Ngan, M. N. A.,& Lashkari, A. H.(2012, May). Android mobile augmented reality application based on different learning theories for primary school children. In 2012

International Conference on Multimedia Computing and Systems (pp. 404-408). IEEE.

Phillips, R. (2014). The Developer's Handbook of Interactive Multimedia.Routledge.

Razek, M. A., & Bardesi, H. J. (2013). Adaptive Course for Mobile Learning.Fifth International Conference on Computational Intelligence, Communication Systems and Networks, 1-6.

Robinson, R., & Reinhart, J. (2014). Digital Thinking and Mobile Teaching:Communicating. *Collaborating and Constructing in an Access Age , bookboon. com*.

Rosenthal, I. G. (1999). New teachers and technology: Are they prepared?(Technology information). Technology and Learning, 19(8), 1–2.

Saß, S., Schütte, K., & Lindner, M. A. (2017). Test-takers' eye movements: Effects of integration aids and types of graphical representations. Computer & Education, 85-97.

Sarkar, S. (2012). The role of information and communication technology (ICT) in higher education for the 21st century. Science, 1(1), 30-41.

Sarrab, M., Elgamel, L., & Aldabbas, H. (2012). Mobile learning (m-learning) and educational environments. International journal of distributed and parallel systems, 3(4), 31.

Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the Mobile age. In R.Andrews & C. Haythornthwaite (Eds.), The Sage handbook of Elearning research (pp.221–247). London: Sage.

Sharples, M., Taylor, J., & Vavoula,G. (2013). A Theory of Learning for the Mobile Age: Learning through conversation and exploration across contexts, 2009.

Sims, R., G. Dobbs, and T. Hand. 2002. Enhancing quality in online learning: Scaffolding planning and design through proactive evaluation. Distance Education 23 (2): 135–148.

Zhang, D. (2005). Interactive multimedia-based e-learning: A study of effectiveness. The American Journal of Distance Education, 19(3), 149-162.

Zhang, D., and J. F. Nunamaker. 2004. A natural language approach to content-based video indexing and retrieval for interactive e-learning. IEEE Transactions on Multimedia 6 (3): 450–458.

Zhang, D., J. L. Zhao, L. Zhou, and J. F. Nunamaker. 2004. Can e-learning replace traditional classroom learning? Evidence and implication of the evolving e-learning technology.Communications of the ACM 47 (5): 75–79.

Zhao, N., Wu, M., & Chen, J. (2017). Android-based mobile educational platform for speech signal processing. International Journal of Electrical Engineering Education, 54(1), 3-16.