International Journal of Advanced Trends in Computer Science and Engineering

Interactive Educational Animal Identification Game for Primary Schoolchildren with Intellectual Disability

Fatah Yasin Al Irsyadi[1], Supriyadi[2], Yogiek Indra Kurniawan[3]
[1,2]Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia
[3]Informatics, Faculty of Engineering, Universitas Jenderal Soedirman, Purwokerto, Indonesia
*[1]fatah.yasin@ums.ac.id, [2]supriyadi@ums.ac.id, *[3]yogiek@unsoed.ac.id

ABSTRACT

Sekolah Luar Biasa (SLB) Negeri Sukoharjo is a primary educational institution for children with special needs, including intellectually disabled children whose levels of intelligence are below average. Based on observations and interviews that have been conducted, there was difficulty in delivering the learning materials to children with intellectual disability (ID). Besides, learning media and supporting devices were minimum and manual. The learning process was one way, from teacher to students with books and whiteboard as supporting equipment. According to previous literatures, the implementation of educational games was limited only for normal children and there was no specific development for children with ID. In this research paper, interactive educational game apps specified for children with ID was developed. Animal identification was chosen as theme for this research. The methods were divided into several steps, which are analysis of needs, data collection, storyboard construction, game development and test. The developed app was consisted of a number of menus; Identifying Animals; Guessing Animals; Guessing Shapes; Arranging Letters, Quiz and Info. The Blackbox test showed valid results, indicating that the app was as expected. The application ran smoothly on smartphones with at least Kitkat operating system. The average result of expert validation test was 86% and classified in "Very Good" category. The User Acceptance Test presented average score of 81.73% and categorized as "Very Good". These results indicated that the animal identification game app for intellectually disabled primary schoolchildren is feasible to use.

Key words : Children with special needs, educational game, *Sekolah Luar Biasa*, Intellectual Disability

1. INTRODUCTION

Children with special needs are children whose processes of physical, mental, intellectual, social and emotional development experience abnormalities, hence need special treatment [1]. Some of them are blind, deaf, autistic, and mentally and physically disabled.

Sekolah Luar Biasa (SLB) Negeri Sukoharjo is a primary educational institution for children with special needs, including intellectually disabled children whose levels of intelligence are below average. Based on observation and interviews of teachers and head principle of *SLB N Sukoharjo* that were conducted on August 1st 2019, there was difficulty in delivering learning materials to children with intellectual disability (ID). In addition, learning media and supporting devices were minimum and manual. The learning process was one way, from teacher to students with books and whiteboard as supporting equipment.

Alongside with today's technological development, there are various learning media that can be utilized, such as mobile phone. One example of mobile phones' utility is game. The game development is not only for the purpose of entertainment as it has expanded onto diverse scopes, including education [2].

Technology is sophisticatedly developing and the world is evolving into industrial revolution 4.0, where it emphasizes on the process of technology-based effective and interactive learning [3][4]. Educational games become helping solutions for understanding learning materials [5][6], as they appear as visual technology that are interesting for children. According to [7], education with learning and motivational contents that are combined with games may increase interest on learning.

Literature [8] explained that educational game not only stimulate students engagement in learning, but can also be utilized to enhance lingual development, critical thinking, emotional development, intelligence and imagination. Therefore, educational games play a role in students' advancement.

Such use of educational games can also be applied on children with special need, particularly on children with ID [9][10][11][12]. Unfortunately, research and development for educational games are currently focused on normal children and yet existed for children with ID. Whereas, children with ID need special treatment on learning process due to their low understanding and engagement.

This research aims to develop interactive educational game for primary schoolchildren with ID. There are six grades of primary school for children with ID, and each has distinct learning materials. This research focused on the development interactive educational game with animal identification as the theme. This theme was selected as it was interesting and easy to understand for primary schoolchildren. This theme was a pilot project or a simulation which can be developed into various-themed interactive educational games, for the purpose of education of intellectually disabled primary schoolchildren.

Technology based applications can be utilized for children with special needs [13] and used in education [14]. Proper use of technology can help improving the lives of children with special needs, since learning media are chosen to support the process of learning activity. Thus, learning objectives can be achieved with good and maximal results.

One of the interesting and fun methods for learning activities is game. Game-based learning has been a booming trend in the 21st century. Not only have been computer games for entertainment, they also have been long adopted as valuable tool for learning. In his paper, Bouzid stated that computer games may offer numerous learning benefits for students as it is able to consume students' attention and increase their motivation and engagement which will help to boost their learning [16]. It [17] is also stated that environment affects and increases students' learning potentials, particularly game-based environment. Children' special skills showed positive effects after children played digital game. Educational games can be an alternative method for easier and more exciting learning.

Research paper [18] made an educational game for children with special needs. These children were able to understand lessons better using the educational game. Further development in research paper [19], educational game might shows significant improvement of learning for autistic children. These evidences showed that educational game may be an alternative solution in learning, particularly for children with intellectual disability.

Android is an open source operating system for smartphones, PDAs (Personal Digital Assistant), and other cellular devices. It is straightforwardly developed and flexible due to its agility in adapting with different structures [20]. In addition, Construct 2 is a tool for HTML 5-based 2D game construction. Basically, Construct 2 does not need any particular programming languages; hence it is easy to be understood and to utilize.

This paper aims to provide alternative solution in learning for primary schoolchildren with ID. With this app, teachers may have an alternative to teach children with ID when manual method does not work well. In future, the development of this game may be used by parents to provide independent learning for children with ID at home.

The result of this research is a product for education that is applied and benefited by *SLB Negeri Sukoharjo*. This interactive educational game is utilized by teachers in class and by parents to re-learn the lessons at home.

2. METHODS

This research was started by observations, data analysis, and direct data collecting of students of class V at *SLB-C Negeri Sukoharjo*, and interviews of their homeroom teacher. The author used SDLC (System Development Life Cycles) method. The flowchart of the research is shown in Figure 1.
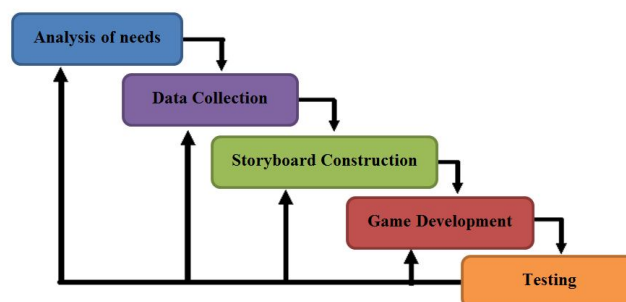

Figure 1 : Research System Flowchart

The stages conducted for this research based on Figure 1 are the following :

2.1. Analysis of needs

The authors conducted direct observations during the class to obtain information in order to select a model for educational game, to arrange learning materials based on the K 13 curriculum and to prepare game development software to build the game such as Construct 2, CorelDraw X7, and Adobe Photoshop.

2.2. Data Collection

The results of observations and interviews are:
  a. Students with ID got bored and had difficulties in concentrating. The lessons needed to be repeated multiple times; therefore interesting leaning media were needed.
  b. Students with ID needed assistance in learning.
  c. Students with ID needed interesting learning media to increase their concentration and to keep their interest.
  d. Pictures and colors were more interesting and easily understood by children with ID.
  e. Game as learning medium got higher interest of students compared to conventional learning medium.

2.3. Storyboard Constructions

Storyboard is a description of each scene as a means of illustration and explanation of every page of the game. There are six storyboards of educational animal identification game, and each is described as follows:

    a. Scene 1: contains the title of the game and six main menus: Identifying Animals; Guessing Animals; Guessing Shapes; Arranging Letters, Quiz and Info; and an exit button to quit the game.

    b. Scene 2: contains names and pictures of sea animals.

    c. Scene 3: contains animal-guessing game.

    d. Scene 4: contains animal-shape guessing game with drag-and-drop system.

    e. Scene 5: contains letter-arranging game with drag-and-drop system.

    f. Scene 6: contains exercises.

2.4. Game Development

General descriptions of this educational game are as follows:

    a. Educational game titled *"Mengenal Hewan"* (Identifying Animals)

    b. Software for assets improvement: CorelDraw, Construct 2, Adobe Photoshop.

    c. Desktop-to-android export used Adobe Phonegap.

    d. This game has 6 main menus: 'Identifying Animals'; 'Guessing Animals'; 'Guessing Shapes'; 'Arranging Letters', 'Quiz' and 'Info'.

    e. 'Identifying Animals' menu contains pictures, names and sounds of sea animals, meanwhile 'Guessing Animals'; 'Guessing Shapes'; 'Arranging Letters' are games.

    f. 'Quiz' menu contains of exercises.

    g. 'Info' menu contains of information of game's assets sources.

2.5. Testing

Testing or software evaluation can be conducted using two methods, which are functional and nonfunctional test [22][23]. The functional test, the Blackbox test, assesses software's features and functionality[24]. The nonfunctional test assesses software's compability, usability, and feasibility.

The testing section is divided into two major stages. The first one is running Blackbox test as functional test. In this stage, the application is tested to see whether the input and output is as expected. Blackbox test is one kind of assessments done by the app developer.

The second evaluation is nonfunctional test that is split into application compability test, expert validation, and User Acceptance Test. The compability test assesses application compability on various Android operating systems on smartphones.

In the expert validation test, the application's instructions, contents and quality are tested by several media and education experts. The objective of the test is to learn if the app has proper media and materials.

The last one is User Acceptance Test (UAT). It is a test done by the users in order to obtain a document proving the users' acceptance of the software. It forms as a questionnaire containing several questions that are distributed to the students and teachers of the school. Data gathered from the questionnaire can be used as accomplishment benchmark for the learning media app. A questionnaire can be used to measure subjective perceptions[25].

The game's questionnaire analysis is calculated by comparing obtained score with its determined maximum score of the questionnaire, as written in formula (1).

$$P = \frac{f}{N} x 100\% \qquad (1)$$

Where:
P = desired score percentage
f = score obtained by validator
N = maximum score

The scoring of the test is based on category degradation indicators on Table 1.

Table 1 : Scoring Category Indicators

P value	Category
0% - 20%	Very Poor
20.01% - 40%	Poor
40.01% - 60%	Fair
60.01% - 80%	Good
80.01% - 100%	Very Good

3. IMPLEMENTATION

Implementation is one step to prove design into real system. There are many choice to do implementation step, depend on system and method used. Most of them by built system itself.[26][27][28].

The implementation result is an android application of sea animals' identification for class V students of *Sekolah Luar Biasa (SLB-C) Negeri Sukoharjo* which can be utilized as learning media. The application can be used in class or at home to re-learn the lessons.

3.1. Main Menu

Main menu will appear at first when the game is run, as illustrated in Figure 2. The main menu consists of six buttons which are 'Identifying Animals' to show pictures and name of sea animals, 'Guessing Animals' to start animal-guessing

game, 'Guessing Shapes' to start animal-shape guessing game, 'Arranging Letters' to start letter-arranging game, 'Quiz' to start exercise quiz, 'Info' to show game's assets, and X button to quit the game.

Figure 2 : Main Menu

3.2. Menu 'Identifying Animals'

Animal identification game interface will appear if users click on 'Identifying Animals' button on Figure 2. 'Identifying Animals' interface consists of pictures, names, and sounds of animal as shown in Figure 3.

Figure 3 : Identifying Animals

3.3. Menu 'Guessing Animals'

Animal guessing game interface will appear when users click on 'Guessing Animals' button on Figure 2. The 'Guessing Animals' interface displays guessing game by clicking on the animal picture as shown in Figure 4.

Figure 4 : Guessing Animals

3.4. Menu 'Guessing Shapes'

Animal-shape guessing game interface will appear when users click on 'Guessing Shapes' button on Figure 2. The 'Guessing Shapes' interface displays drag & drop shape guessing game. It is illustrated in Figure 5.

Figure 5 : Guessing Shapes

3.5. Menu 'Arranging Letters'

Letter-arranging game interface will appear when users click on 'Arranging Letters' button on Figure 2. The 'Guessing Animals' interface shows drag &drop letter-arranging game as shown in Figure 6.
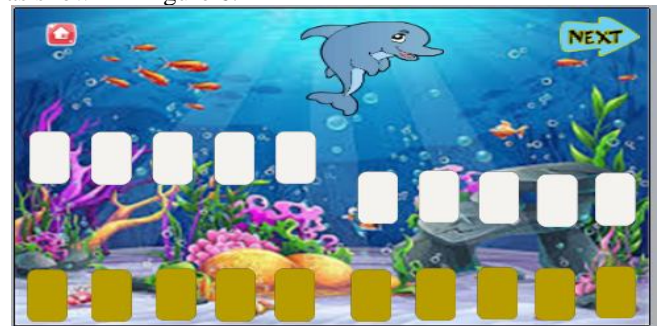

Figure 6 : Arranging Letters

3.6. Menu 'Quiz'

Quiz page will appear if users click on 'Quiz' button on Figure 2. The 'Quiz' interface contains problems as exercise for students as illustrated in Figure 7.
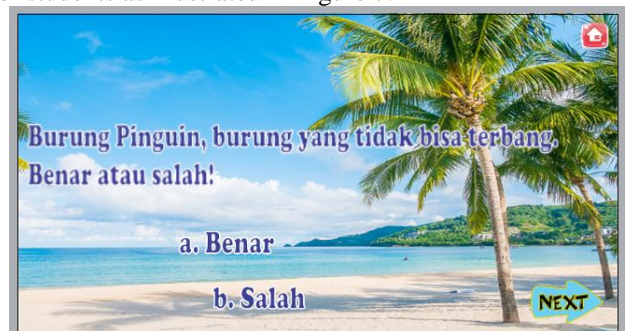

Figure 7 : Quiz

4. VALIDATION RESULTS AND DISCUSSIONS

Validation is a stage in application evaluation by app developer, media experts, and users.

4.1. Compability Test

Compability test is conducted to assess the minimal requirements needed to run the application. Testing on some

smartphones with various operating systems can be seen on Table 2

Based on the compability test on Table 2, the minimum requirement of operating system of the smartphones to run the application is Android OS 4.4.2 (Kitkat). All features and functionality of the app run smoothly without any trouble on Kitkat operating system. Meanwhile, there are some lags of the 3D animation when the app is run on Android OS 4.2.2 (JellyBean).

Table 2 : Compability Test Result

Operating System	Application Result
Android OS 7.0+ (Nougat)	Smooth
Android OS 6.0+ (Masrhmallow)	Smooth
Android OS 5.1.1 (Lollipop)	Smooth
Android OS 4.4.2 (Kitkat)	Smooth
Android OS 4.2.2 (JellyBean)	Animation Lag

4.2. Blackbox Test

Blackbox test assesses if the application run as expected by testing on some test cases. On each test case, input is given to see whether the application's output matches the app developer's expectation. This testing is also done to check for errors on the app hence it can be fix immediately. Blackbox test results are shown in Table 3.

Table 3 : Blackbox Test Results

No	Features	Input	Output	Status
1.	'Identifying Animals' button	Click on 'Identifying Animals' button	Object can be clicked	Valid
2.	'Guessing Animals' button	Click on 'Guessing Animals' button	Object can be clicked	Valid
3.	'Guessing Shapes' button	Click on 'Guessing Shapes' button	Object can be clicked	Valid
4.	'Arranging Letters' button	Click on 'Arranging Letters' button	Object can be clicked	Valid
5.	'Quiz' button	Click on 'Quiz' button	Object can be clicked	Valid
6.	'Info' button	Click on 'Info' button	Object can be clicked	Valid
7.	'Next' button	Click on 'Next' button	Object can be clicked	Valid
8.	X button	Click on X button	Object can be clicked	Valid
9.	'Home' button	Click on 'Home' button	Object can be clicked	Valid
10.	Drag and drop object	Drag and drop object	Object can be dragged and dropped	Valid

Blackbox test show valid results of menus that have been made, as expected by the application developer.

4.3. Expert Validation Test

This test is conducted to see application's validity according to the experts. The test is done by some competent media and education experts.

Experts Validation Test is run to be checked and validated by numerous media and education experts. In this stage, the instructions, contents, quality of the app is assessed by the experts. The test is recorded in a questionnaire to see the validity of the application. There are eight testers consisting of two lecturers of multimedia course in Informatics Studies of *Universitas Muhammadiyah Surakarta*, one lecturer of informatics course in *Universitas Jendral Soedirman*, and five teachers of the school (*SLB*).

The results of experts' interpretations on app's instruction, content, and quality, using formula (1) are shown in Figure 8.

The average of validations of the eight experts is 86%. Based on the category indicator on Table 1, the experts interpretations on the developed application AR is categorized as Very Good.
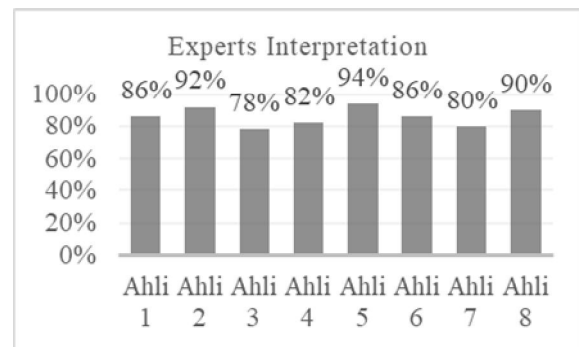
Figure 8 : Experts Validation Results

4.4. User Acceptance Test

User Acceptance Test (UAT) will obtain document as benchmark of feasibility and users' acceptance of the educational software. Likert scale is used in this research. Likert scale is a scale for measuring perception, attitude or opinion of a person or group on an event or social phenomenon that is based on operational definition of the researcher. After game is demonstrated to the teacher, the researcher then give a questionnaire containing assessment of the apps functionality. Respondents are 30 teachers and measured using equation (1).

The result of percentage calculation using the Likert scale to measure opinion or perception on game app is shown in Table 4.

Table 4 : Criteria Determination

Criterion	Scale
Strongly Agree (SA)	5
Agree (A)	4
Neutral (N)	3
Disagree (D)	2
Strongly Disagree (SD)	1

User Acceptance Test results of *SLB* teachers are explained in Table 5.

Table 5 : UAT Results

No	Problem Set Code	Sum of Answers					Total score	Percentage
		SA(5)	A(4)	N(3)	D(2)	SD(1)		
1	P1	13	14	3	0	0	130	86.67 %
2	P2	7	20	3	0	0	124	82.67 %
3	P3	11	15	4	0	0	127	84.67 %
4	P4	9	21	0	0	0	129	86%
5	P5	3	23	4	0	0	119	79.33 %
6	P6	5	21	4	0	0	121	80.67 %
7	P7	5	22	3	0	0	125	83.33 %
8	P8	8	19	3	0	0	125	83.33 %
9	P9	3	23	4	0	0	113	75.33 %
10	P10	2	27	1	0	0	113	75.33 %
Average Percentage								81.73 %

Based on Table 5, UAT results are converted to Table 1 to obtain assessment category indicator. List of questions coded as P1 to P10 and its answers is described in Table 6.

Table 6 : Assessment Results

Code	Questions	Results	Category Indicator
P1	Educational game interface	86.67 %	Very Good
P2	User-friendliness of game	82.67 %	Very Good
P3	Sounds media for material delivery	84.67 %	Very Good
P4	Educational game benefits	86%	Very Good
P5	Easy to understand the materials	79.33 %	Good
P6	Compatible with curriculum	80.63 %	Very Good
P7	Make learning more efficient	83.33 %	Very Good
P8	Make students more excited to learn	83.33 %	Very Good
P9	Train students' concentration	75.33 %	Good
P10	Help teachers in teaching process	75.33 %	Good

Based on Table 6, the average of score of the whole 10 questions is 81.73%. Compared to assessment category indicator in Table 1, the total score average of the application is classified as "Very Good". This shows that the animal identification game for schoolchildren with intellectual disability is feasible to use.

5. CONCLUSION

Referring to the discussions, the conclusions are as follows:
a. Animals Identification educational game helps increasing the learning interest of students of class V *SLB-C Negeri Sukoharjo*.

b. The developed app consists of some menus, such as 'Identifying Animals', 'Guessing Animals', 'Guessing Shapes', 'Arranging Letters', 'Quiz', and 'Info'.
c. Blackbox test showed valid results, meaning that the app is as expected.
d. The average of experts validations score is 86% which is classified in "Very Good" category.
e. The result of User Acceptance Test is on average 81.73% with "Very Good" indicator category.
f. Based on the testing results, it can be concluded that this app is feasible to be utilized as an alternative media for learning for primary schoolchildren with intellectual disability.

REFERENCES

1. Nida, F. L. K. **Komunikasi Bagi Anak Berkebutuhan Khusus**, Jurnal Komunikasi Penyiaran Islam, 2013, pp 163-189.
2. Khairy, M. S., Herumurti, D., & Kuswardayan, I. **Analisis Pengaruh Penggunaan *Game* Edukasi pada Penguasaan Kosakata Bahasa Asing dengan Studi Kasus *Game* Edukasi Bahasa Arab**, Khazanah Informatika: Jurnal Ilmu Komputer Dan Informatika, 2(2), 42, 2017. https://doi.org/10.23917/khif.v2i2.2137
3. Mourtzis, D. **Development of Skills and Competences in Manufacturing Towards Education 4.0: A Teaching Factory Approach,** In International Conference on the Industry 4.0 model for Advanced Manufacturing, 2018, June, pp. 194-210. Springer, Cham. https://doi.org/10.1007/978-3-319-89563-5_15
4. Hariharasudan, A., & Kot, S. **A scoping review on Digital English and Education 4.0 for Industry 4.0. Social Sciences**, 7(11), 227, 2018. https://doi.org/10.3390/socsci7110227
5. Yasin, A., Liu, L., Li, T., Wang, J., & Zowghi, D. **Design and preliminary evaluation of a cyber Security Requirements Education Game (SREG),** Information and Software Technology, 95, 2018, pp 179-200. https://doi.org/10.1016/j.infsof.2017.12.002
6. Grönlund, Å., Wiklund, M., & Böö, R. **No name, no game: Challenges to use of collaborative digital textbooks,** Education and Information Technologies, 23(3), 2018, pp 1359-1375. https://doi.org/10.1007/s10639-017-9669-z
7. Yong, S. T., Gates, P., & Harrison, I. **Digital *game*s and learning mathematics: Student, teacher and parent perspectives,** International Journal of Serious *Game*s, 3(4), 2016, pp 55–68 https://doi.org/10.17083/ijsg.v3i4.112

8. Ni, Q., & Yu, Y. **Research on educational mobile *game*s and the effect it has on the cognitive development of preschool children,** Zhejiang University of Technology, ISBN: 978-1-4799-6376-8, 2015, pp 165-169

9. Hardiyanti, F. P., & Azizah, N. **Multimedia of Educational Game for Disability Intellectual Learning Process: A Systematic Review,** In International Conference on Special and Inclusive Education (ICSIE 2018). Atlantis Press, 2019, April. https://doi.org/10.2991/icsie-18.2019.66

10. Lan, Y. J., Hsiao, I. Y., & Shih, M. F. **Effective learning design of game-based 3D virtual language learning environments for special education students,** Journal of Educational Technology & Society, 21(3), 2018.

11. Barak, S., Oz, M., Dagan, N., & Hutzler, Y. **The Game of Life soccer program: Effect on skills, physical fitness and mobility in persons with intellectual disability and autism spectrum disorder,** Journal of Applied Research in Intellectual Disabilities, 2019. https://doi.org/10.1111/jar.12620

12. Topaş Demirci, P., & Demirci, N. **The Effects Of Game And Physical Activity Lessons In Children With Learning Disabilities,** Kinesiologia Slovenica, 24(3), 2018.

13. Kurniawan, Y. I., & Dwiyatmika, W. **Aplikasi Diagnosa Retardasi Mental Pada Anak,** 2017.

14. Kurniawan, Y. I., Soviana, E., & Yuliana, I. **Merging Pearson Correlation and TAN-ELR algorithm in recommender system,** In AIP Conference Proceedings (Vol. 1977, No. 1, p. 040028), AIP Publishing, 2018, June. https://doi.org/10.1063/1.5042998

15. Ridwan, M., & Prasetyawan, P. **Rancang Bangun Aplikasi Permainan Adventure Of Frunimal Untuk Edukasi Bahasa Inggris Berbasis Android,** Simetris: Jurnal Teknik Mesin, Elektro dan Ilmu Komputer, 8(2), 2017, pp 763-772. https://doi.org/10.24176/simet.v8i2.1599

16. Bouzid, Y., Khenissi, M. A., Essalmi, F., & Jemni, M. **Using Educational *Game*s for Sign Language Learning - A SignWriting Learning *Game*: Case Study,** Journal of Educational Technology & Society, 2016, pp 129-141.

17. Ak, O., & Kutlu, B. **Comparing 2D and 3D *game*-based learning environments in terms of learning gains and student perceptions,** British Journal of Educational Technology, 48(1), 2017, pp 129-144. https://doi.org/10.1111/bjet.12346

18. Al Irsyadi, F. Y., & Nugroho, Y. S. ***Game* edukasi pengenalan anggota tubuh dan pengenalan angka untuk anak berkebutuhan khusus (ABK) tunagrahita berbasis Kinect,** Prosiding SNATIF, 2015, pp13-20.

19. Al Irsyadi, F. Y., & Rohmah, A. N. **Pemanfaatan Augmented Reality untuk *Game* Edukasi Bagi Anak Autis Tingkat Sekolah Dasar di Rumah Pintar Salatiga,** Simetris: Jurnal Teknik Mesin, Elektro dan Ilmu Komputer, 8(1), 2017, pp 91-98.

20. Hssina, B., Erritali, M., Bouikhalene, B., & Merbouha, A. **Edu*game* an Android *game* for teaching children,** International Journal of Innovation and Applied Studies, 9(4), 2014.

21. Nurrahim, D. I., & Sudarmilah, E. **Edu*Game* Sejarah Islam Masuk Indonesia,** PROtek, 3(2), 2016, Pp 57-62.

22. Kumar, M., Singh, S. K., & Dwivedi, R. K. **A Comparative Study of Black Box Testing and White Box Testing Techniques,** International Journal of Advance Research in Computer Science and Management Studies, 3(10), 2015, pp 32–44

23. Naik, K. & Tripathy, P. **Software Testing and Quality Assurance Theory and Practice,** Canada : Wiley, 2008. https://doi.org/10.1002/9780470382844

24. Kurniawan, Y. I., Rahmawati, A., Chasanah, N., & Hanifa, A. **Application for determining the modality preference of student learning,** In Journal of Physics: Conference Series (Vol. 1367, No. 1, p. 012011). IOP Publishing, 2019, November.

25. Haq, A. H. B., Kurniawan, Y. I., & Astuti, T. **Students' Interest in Vocational Schools as the Dimension of Being in a Wellbeing School Model**, International Journal of Vocational Education and Training Research, 5(2), 43, 2019.

26. Louis, Teng, Y.H., Kuok, K.K., Imteaz, M., Lai, W. Y., and Derrick, Ling, K.X. **Development of Whale Optimization Neural Network for Daily Water Level Forecasting**, International Journal of Advanced Trends in Computer Science and Engineering, 8(3), 2019, pp 354-362. https://doi.org/10.30534/ijatcse/2019/04832019

27. Rosario, J.R.B.D. **Development of a Face Recognition System Using Deep Convolutional Neural Network in a Multi-view Vision Environment**. International Journal of Advanced Trends in Computer Science and Engineering, 8(3), 2019, pp 369-374. https://doi.org/10.30534/ijatcse/2019/06832019

28. Fontes, D.B.M.M., Pereira, P.A., & Fontes, F.A.C.C. **A Decision Support System for TV self-promotion Scheduling**. International Journal of Advanced Trends in Computer Science and Engineering, 8(2), 2019, pp 134-139. https://doi.org/10.30534/ijatcse/2019/06822019