

Development of Learning Application for College Students with Special Needs using Universal Design for Learning

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ABSTRACT

This study aims to analyse the learning needs of college students with special needs, develop a Universal Design for Learning based learning application named AJAR MBK, and assess the efficiency of the AJAR MBK application. It used a research and development model adapted from the ADDIE (analysis, design, development, implementation, and evaluation) development model. Our analysis results showed the learning needs of college students with special needs, which were used in the AJAR MBK learning application development. Further, the AJAR MBK's feasibility test results showed 4.56 and 4.67 scores from the experts in learning materials and media, respectively. Both feasibility scores were classified as very feasible. Meanwhile, the average feasibility score from the students with special needs was 4.6, categorized as very feasible. Our last analysis results showed that the developed learning media was effective to be used as presented by students' average final score in the education for children with spectrum autism course that increased by 15.4% from their pre-test score. The higher post-test score than the pre-test score confirmed that the AJAR MBK is effective to be used by students with special needs in the education for children with spectrum autism course

Keywords: learning application, college students with special needs, universal design for learning.

INTRODUCTION

Every individual, including people with disabilities, acquires the right to develop their skills through the education process. As articulated in Law Number 8, the Year 2016, article 10, a person with disabilities is entitled to access excellent, qualified, inclusive, and special education in every type, track, and level. The data from the Directorate of Students and Learning Affairs of the Ministry of Education of Indonesia (in Junaidi, 2020) show that more than 70 state and private universities in Indonesia have welcomed students with disabilities. Besides, more than 400 college students with special needs have been reported to be attending courses in diploma, undergraduate, and graduate programs. These students have different disabilities (quadriplegic, vision impairment, hearing impairment, and so forth). The students are dispersed in various disciplines, such as special education, language, law, history, music, sociology, social and political science, computer, graphic design, physical exercise, religion, non-formal education, guidance and counselling, fashion, cosmetology, psychology, early education, and other disciplines.

However, in its implementation, students with special needs face greater difficulty than regular students (Kartini, & Aprilia, 2022). Their most typical issue is the inability of lecturers to recognize their special needs. The lecturers are expected to know students with special needs, acknowledge their characteristics and special needs, as well as to develop learning innovation and creativity, ensuring that all students can follow and successfully obtain the previously determined learning target.

Similar to other Indonesian universities, based on data from universities in 2021, Universitas Lambung Mangkurat has also arranged a quota for students with special needs. In general, there are 32 special needs students in Universitas Lambung Mangkurat, in which most of them are taking the special education program. In this program, there are nine students from 2021 admission, in which one of them has a visual impairment, two of them have a hearing impairment, and the remaining students are slow learners. Their various impairment results in a number of special learning challenges that require proper solvency to ensure a minimum learning distraction. The same learning challenge is also reported in special education for children with autism spectrum courses.

The learning problems faced by students with special needs are propagated in the three learning stages of planning,

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implementation, and evaluation. During the planning, there are two issues commonly encountered by the students, namely the non-comprehensive assessment for students with special needs and an unmodified semester learning plan. Meanwhile, in the implementation stage, their problem is mostly related to the implementation of the semester learning plan, as it is frequently implemented in different ways. The other problems are the non-optimum ability of special needs students' assistants, non-inclusive setting learning, and non-complete learning media (Azimi, Rachman, and Mirnawati, 2020).

Those issues are induced by the non-linear implementation of Regulation of Minister of Research, Technology and Higher Education No 46 the Year 2017 on the special education and special service education in the universities article 8 paragraph 1. That regulation emphasizes the universities' obligation to facilitate the learning and assessment of students with special needs without lowering the quality of the learning results. Paragraph 2 of that same article defines the learning in paragraph 1 as the learning with adjustments, such as modification in the learning materials, media or instruments, process, and assessment.

This study offers a solution for those aforementioned issues, namely universal design for learning (UDL) based learning using e-learning-based universal design (DUE). DUE learning transforms learning to be fun and accessible anywhere at any time as it uses innovative technology that accommodates the students' different needs, which are incapable of being accommodated in traditional learning. This DUE learning applies three UDL principles. The first principle is providing a number of representations means by presenting materials and information in the form of visual, audio, or audio-visual multimedia. The second principle provides different actions and expressions, facilitating students to explain their knowledge using digital software, such as a virtual keyboard that allows students to type without pushing the keyboard buttons. The third principle proposes various means that facilitate students' involvement through the freedom to establish a comfortable learning environment using e-learning, enabling students to learn from anywhere (Windy et al., 2020). This study developed an e-learning-based universal design in the form of a learning application using a universal design for learning. This study represents our commitment to establishing inclusive services for students with special needs at Universitas Lambung Mangkurat.

RESEARCH METHODS

This study involved the second-semester special needs students in the 2021/2022 academic year in the Special Education Program of Universitas Lambung Mangkurat. We used the research and development method. Sugiyono (2016) defines research and development as a research method used to develop a particular product while also investigating the

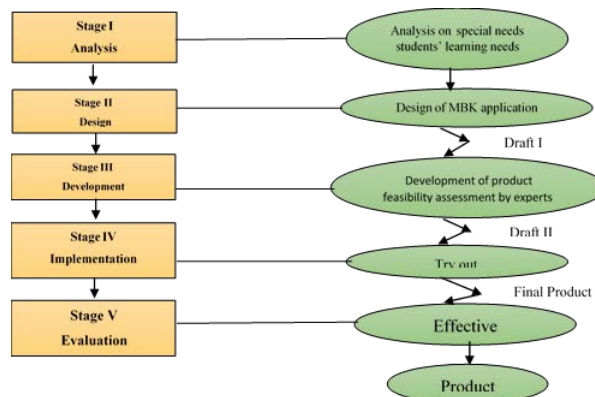


Fig. 1: Design of ADDIE Model

product's efficiency. In this study, we adapted the ADDIE development model developed by Dick and Carry. This ADDIE model consisted of five stages comprised of analysis, design, development, implementation, and evaluation (Setiadi, Yuliatmojo, and Nurhidayat, 2018), as illustrated in Figure 1. At the tryout stage, the media was tested on eighth special needs students at Lambung Mangkurat University. Validity test by expert results from learning material through learning design, linguistics, and content feasibility aspects. Besides, media experts judge through visual communication, software engineering, and practicality. Apart from that, trials were carried out on students through media, content, and accessible aspects. Finally, after revision, student learning progress is assessed through the pre-test and post-test contained in the application.

RESULTS

Prior to this study, we conducted preliminary research on Universal Design for Learning implementation involving students with special needs in Universitas Lambung Mangkurat. Our preliminary investigation revealed the learning needs of students with special needs. Further, we constructed and developed an application to be used as an accessible learning medium for special needs students. In this study, we used the ADDIE development model, consisting of five stages, namely analysis, design, development, implementation, and evaluation.

Analysis Phase

The stage of analysis was carried out as the first stage. It was carried out to understand the learning needs of second-semester special needs students from the Special Education Program of Universitas Lambung Mangkurat. Further, we developed a learning application based on those students' needs to help them better understand the materials of education for children with autism spectrum courses. This analysis stage was carried out by conducting two stages of

assessment. The first assessment for students with special needs consisted of an initial writing test, a test of writing for understanding, an initial reading test, and a test of reading for understanding. The second test was a voluntary interview with the special needs students.

According to the test results, the students with visual impairment categorized as low vision are not capable of crossing outline from right to left and from top to bottom, face difficulties in connecting the dotted lines, face difficulties in imitating the rectangular shape as they cannot differentiate between the rectangle and square shape, can only write the description of special need students by two sentences with the help from the volunteer, tired eyes affecting their bad writing, and require a long reading time. Additionally, these students can significantly understand the terms used during the course.

In addition, students with hearing impairment face no problems in initial writing and reading activities, but they face an obstacle in understanding the terms used within the course material and their meaning. Meanwhile, in writing for understanding, the participants write essays with order less Indonesian grammar. In contrast, in the reading for understanding, they face problems comprehending the implicit question using the “why” and “how” question marks. The participants’ answers tended not to be in line with the question.

In contrast, the slow learners encounter no issues in the initial writing activities, but they face problems in the initial reading activities as the reading consists of consonant clusters and affixed words, as well as in comprehending the vocabularies and their meaning. Besides, in the reading for understanding activity, the participants are not capable of answering the implicit questions using the ‘why’ and ‘how’ question marks properly. Further, in relation to the writing for understanding activity, the participants write essays with very simple wordings.

The interview results with special needs student volunteers showed that they also experienced problems in understanding the learning video presented by the lecturer. If the video is played too fast, the students cannot hear the audio clearly, with no supporting pictures, no sign language interpreter, and a not-interesting explanation that is hard to be understood. Besides, the students with special needs also face issues in comprehending the materials presented in PowerPoint (ppt) and textbooks since they consist of incomprehensible scientific languages that require complicated explanations. Sometimes, the fonts in the PowerPoint and textbook are too small and exaggerated, worsening their problems. In working on the essay questions, the students with special needs also face issues in arranging the words, so they need a longer time to answer the questions. Contrastingly, in answering the multiple-choice questions, these students need a little help and a faster time, with more than 50% correct answers. For the true-false question, the students consider it harder than

the multiple-choice question since the true-false questions involve an analysis process.

As a result, the students with low vision necessitate bigger font and bright presentation within the application, with a dark background, to aid them in seeing clearly. Besides, they also need adjustable video volume during the lecturer’s explanation and exercise. In contrast, the students with hearing impairment need a sign language interpreter and subtitles, with simpler word usage in the lecturer’s material explanation. The slow learner students demand visualized learning materials into figures and direct explanations of the essential points that do not transform their original meaning. Besides, the proper exercise question for these students is multiple choice and true-false questions which are completed with illustrations. Additionally, the application display should be made simple and with few menus to enhance its efficiency.

Design Phase

From the results of our preliminary studies, the second-semester students with special needs from Universitas Lambung Mangkurat encounter a number of learning obstacles during the courses. These results were considered during the development of a learning application that facilitates special needs students to learn in the course of education for children with spectrum autism. Our developed application was named AJAR MBK. This application consists of an asynchronous course map that can be accessed offline. This application enables students with special needs to attend courses using Universal Design for Learning. The menus of the AJAR MBK application developed in this study are illustrated in Figure 2.

This AJAR MBK application has colorful and black-white modes. The black-white mode is specially designed for students with low vision. This mode induces the text to appear bigger with bright font and dark background. Meanwhile,

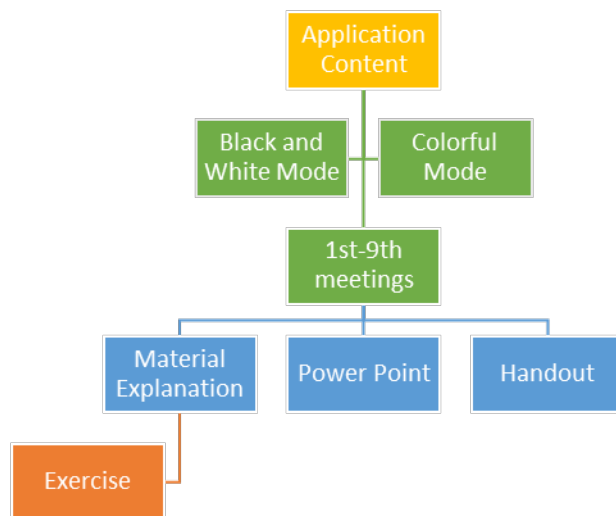


Fig. 2: Maps of Menu Design in AJAR MBK Application

the colorful mode is designed for special needs students with other impairments and great visual senses. The content of the AJAR MBK application subsists of materials explanation video with subtitles and a sign language interpreter that is provided separately in different menus, modified PowerPoint, modified handout, and multiple-choice exercise with figures and audios. The displays of the AJAR MBK application are presented in Figures 3 to 14.

a. Logo of AJAR MBK Application



Figure 3. Logo of AJAR MBK Application

b. Introductory Display of AJAR MBK Application



Fig. 4: Introductory Display of AJAR MBK Application

The introductory display of the application presents a short description of the application. Besides, it also shows the menus of colorful and black-white modes. The students with low vision can use the black-shite mode, while the students with other impairments can choose the colorful mode.

c. Display of Main Menu of AJAR MBK Application



Fig. 5: Display of the Central Menu

The main menu displays the menus of 'start' (*mulai*) and 'exit' (*keluar*). If the students want to begin the learning process, they should click the 'start' button. Besides, this main menu also shows the (i) symbol that will display the names of AJAR MBK's developer team members. Also, this main menu consists of the instruction of use, completed with audio from Google, that can be accessed by clicking the button

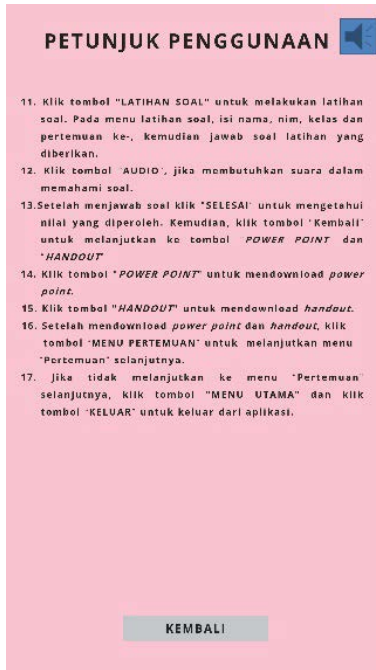


Fig. 6. The Developer Team Members of AJAR MBK

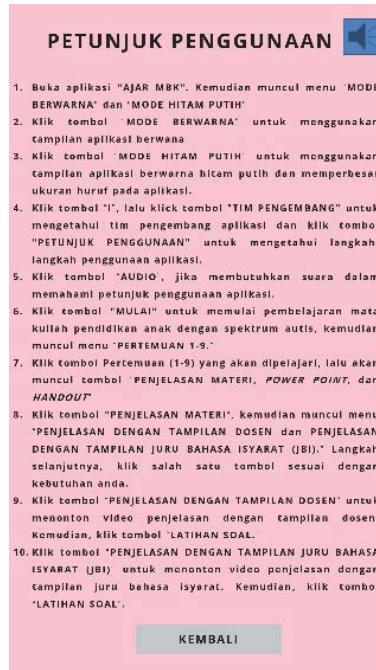


Fig.7.1: Application's Instruction of Use (First Page)



Fig. 7.2: Application's Instruction of Use (Second Page)

d. Display of Meetings Menu



Fig. 8: Display of Meetings Menu

In the menu of meetings, students can select one of the meetings, from the first to the ninth meetings. Once they choose a particular meeting, the materials explanation, PowerPoint presentation, and handout will be presented, as illustrated in Figure 9.



Fig. 9: Display of Contents for Every Meetings

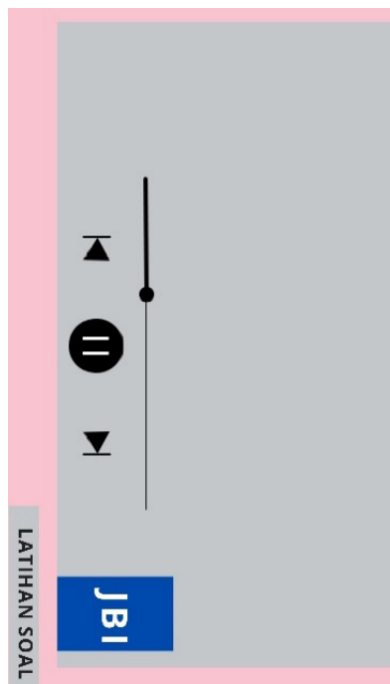


Fig. 10. Display of Materials Explanation Menu

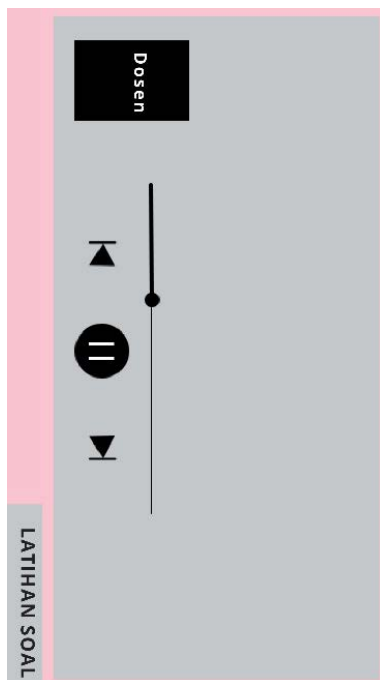


Fig.11: Display of Material Explanation Video with Lecturer



Fig. 12: Display of Material Explanation Video with Sign Language Interpreter

In accessing the learning materials from the lecturer, students can click the 'material explanation' (*penjelasan materi*) menu, which later leads them to another two menus, namely 'explanation with lecturer' (*penjelasan dengan tampilan dosen*) and 'explanation with sign language interpreter' (*penjelasan dengan tampilan juru bahasa isyarat*). The menu explanation with a sign language interpreter was designed for students with hearing impairments, while another menu was designed for students with other impairments. The content display for those menus are shown in Figures 10 to 12.

After the students listen to the material explanation video, they have to complete the exercises by clicking the exercise menu and fill the self-identity. The students with low vision are provided with practices in the form of audio that is accessible through the button.

Once the students complete the exercise, they can directly see their score, as illustrated in figure 14.

As a follow-up of the attained score, students can click the 'exit' (*kembali*) button to get back to the meeting menus. For material enrichment, the students can download the learning materials in the form of PowerPoint presentations and handouts.

1. Development Phase

The development phases were completed by submitting the AJAR MBK application design to the developer partner. After the application was developed, it was validated by experts in learning materials and media. The results of the learning



Fig. 13: Display of Exercises

material and media experts' validity test are illustrated in Figures 15 and 16.

a. Validity Test Results from Learning Material Experts

Figure 15 presents that the AJAR MBK application attains an average score of 4.56, categorized as very feasible to facilitate the learning of students with special needs.

b. Validity Test Results from the Learning Media Experts

Figure 16 illustrates that the AJAR MBK application attains an average score of 4.67, classified as very feasible to facilitate the special needs students learning. After being validated by the experts, the application was revised by our developer partner following the validation results. According to the learning material experts, the revision covered the learning design, language, and content feasibility. Besides, the revision on the aspects of visual communication, software engineering, and practicality was carried out following the inputs from the learning media expert.

2. Implementation Phase

The stage of implementation was carried out by conducting a tryout involving the second-semester special needs students from the special education program 2021 admission of Universitas Lambung Mangkurat. In the first stage, the application was introduced to the participants. In this introductory phase, we explained the aim of AJAR MBK

application development and its instruction of use. Then, the participants, accompanied by a volunteer assistant, were asked to assess the application. The results of the participants' evaluation of the AJAR MBK application are presented in Figure 17.

Figure 17 indicates that the average score obtained from the participants is 4.6, classified as very feasible to facilitate the learning process of students with special needs.

1. Evaluation Phase

The evaluation in the AJAR MBK application development consisted of a feasibility test involving the learning materials and media experts, along with an evaluation from the students with special needs during the product tryout. The effectiveness evaluation was carried out through the material tests in the education for students with autism spectrum. The effectiveness



Fig. 14: Display of Obtained Score

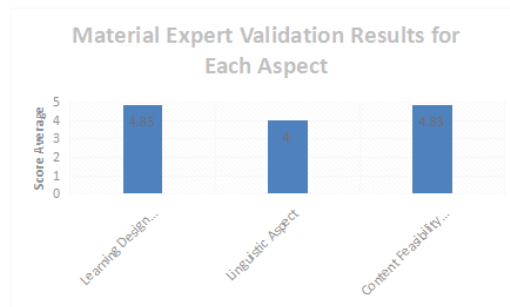


Fig. 15: Validity Results from Learning Material Experts

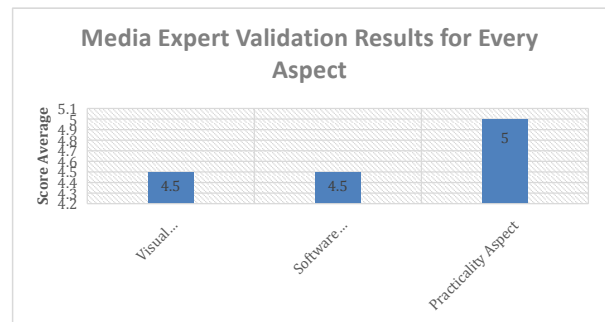


Fig. 16: Validity Test Results from Learning Media Expert

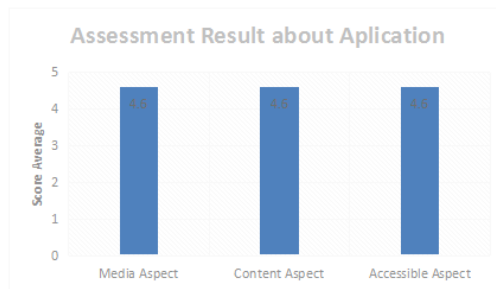


Fig. 17: Evaluation Results from Students with Special Needs

Table 1: Recapitulation of Pretest and Posttest Results from Students with Special Needs

| No. | name | Pretest | | Posttest | | Increase | |
|---------|------|---------|-------|----------|------|----------|-------|
| | | Score | % | Score | % | Score | % |
| 1. | DK | 25 | 56% | 33 | 73% | 8 | 18% |
| 2. | HS | 27 | 60% | 34 | 76% | 7 | 16% |
| 3. | NH | 30 | 67% | 36 | 80% | 6 | 13% |
| 4. | IHQ | 33 | 73% | 38 | 84% | 5 | 11% |
| 5. | RAA | 24 | 53% | 32 | 71% | 8 | 18% |
| 6. | AR | 32 | 71% | 37 | 82% | 5 | 11% |
| 7. | CAS | 31 | 69% | 38 | 84% | 7 | 16% |
| 8. | RI | 28 | 62% | 37 | 82% | 9 | 20% |
| Total | | 230 | 511% | 285 | 632% | 55 | 123% |
| Average | | 28.75 | 63.9% | 35.6% | 79% | 6.9% | 15.4% |

test was completed by measuring the student's ability before (pretest) and after (posttest) the learning using the AJAR MBK application. The test consisted of 45 multiple-choice items. This test aimed to identify the efficiency of the AJAR MBK application. The results of special needs students' pretest and posttest are presented in Table 1.

DISCUSSIONS

The results of the effectiveness test of AJAR MBK application involving the students with special needs showed increasing scores representing their improved understanding of the education for children with spectrum autism course, as presented in Table 1. This effectiveness test involved eight students with special needs. These students have higher posttest scores than the pretest score. The highest increasing score was observed in subject RI, by 20%, while the lowest increase was observed in subjects IHQ and AR, by 11%. The average increasing posttest score of the participants was 15.4%. In general, all eight participants had higher posttest scores than their pretest scores. These results indicate that the developed AJAR MBK application is effective in facilitating the learning of students with special needs in the education for children with spectrum autism course.

The UDL implementation in the classroom can reduce possible learning obstacles and challenges for students with special needs, as it is reported to offer flexible access to knowledge by providing proper and relevant accommodation (Lowrey et al., 2017). However, the minimum awareness, resources, time, and technology also become an obstacle to universal design for learning (UDL) implementation in schools and universities (Kilpatrick, 2021).

Rose & Strangman (Parker, 2012) government-mandated learning supports for students with documented disabilities vary significantly from K-12 education to higher education. Universal Design for Learning (UDL) state that UDL

implementation relies on new technology. Through UDL, the newest technology can be used to bolster the learning process in every class environment (Almumen, 2020; Siu & Lam, 2012), providing greater flexibility and accommodations that positively affect the learning setting (Flagg-Williams and Bokhorst-Heng, 2016). Meanwhile, Evmenova (2018) describes that the UDL implementation does not always require advanced technology, as UDL-based instruction can be realized through low technology and even without technology (Shin et al., 2021). However, the involvement of technology in UDL learning will improve its ease and efficiency in enhancing students' involvement, representation, and action or expression. Therefore, this study developed an AJAR MBK application that consists of visual, auditory, and textual learning materials that are correctly accessible and organized (Black, Weinberg, & Brodwin, 2014; Davies, Schelly & Spooner, 2013). It consists of learning materials in the form of PowerPoint that is designed to aid every stakeholder with special font, background color, and more detailed learning videos (Fenrich, Carson & Overgaard, 2018).

In addition, the AJAR MBK application was developed through the process of analysis, design, development, implementation, and evaluation. Therefore, this application has fulfilled the criteria of Universal Design for Learning, consisting of purpose, method, material, and flexible assessment, as well as acknowledging the variability of students' skills, needs, and preferences (Robinson and Wizer, 2016). This result was represented by the results of the AJAR MBK application feasibility test, which obtained scores of 4.56 and 4.67 from experts in learning materials and media, respectively. Those scores were classified as very feasible. Besides, the average obtained posttest from the application implementation in the course of education for children with spectrum autism is higher than the pretest score, by 15.4%.

CONCLUSION

Our research results conclude that the developed AJAR MBK application can aid the students with special needs in comprehending the materials in the education for students with spectrum autism course. This conclusion was formulated following the assessment results, which suggested that the AJAR MBK application has been revised and adjusted for students with special needs. Besides, the results of validity tests involving the experts of learning material and media, as well as the evaluation from students with special needs, showed that this AJAR MBK application is categorized as highly feasible. Further, the obtained post-test score in the course of education for children with spectrum autism is also higher than the pre-test score.

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