# A Prototype of Augmented Reality Animation (ARA) E-Courseware: An Assistive Technology To Assist Autism Spectrum Disorders (Asd) Students Master In Basic Living Skills

**Kung-Teck, Wong; Hafizul Fahri Hanafi; Norazilawati Abdullah; Noraini Mohamed Noh; Mahizer Hamzah**

***Abstract*: *The purpose of this study is to identify the e-courseware effectiveness and Special Education (SpeEdu.) Teacher perception in using Basic Living Skills (BLS) E-courseware prototypes, namely BLS (Augmented Reality Animation) & BLS (Static graphic). The study employed survey research design and experimental approaches. The survey design approach was conducted in identifying the usability of the prototype of Basic Living Skills e-courseware among Special education (SpeEdu) Teachers and for the experimental design approach was carried out to identify the ASD's achievements between Basic Living Skills E-courseware (Augmented Reality Animation) & Basic Living Skills (Static graphic) for Autism Spectrum Disorders (ASD) students master in basic living skills. A total of five (5) practising SpeEdu teachers had participated in this study, and there was 4 total number of children involved in the study. The study used a pre-post experimental research design. The participating in-service teachers and ASD students were selected based on the criteria required. Pre-test and Post-test instruments were employed to gather ASD students' achievement scores. Analysis descriptive was carried out to understand and compare the differences between control and treatment group. The result indicated that BLS (Augmented Reality Animation) is more effective to be used rather than BSL (Static graphic) and respondents are more dominant and satisfied with the BLS (Augmented Reality Animation) presentation. The implications of this study are significant contributions to the Ministry of Education Malaysia (MOE), teachers, parents and caregivers.***

***Keywords*: *Augmented Reality, Autism Spectrum Disorder, Educational Technology, Achievement.***

## I. INTRODUCTION

The developments of ICT have radically changed the way in which humans communicate with one another and how they gain access to diverse information. The major impact of ICT is that it has now become an integral part of the peoples' lives. For example, in education, ICT is now one of the vital elements in the process of delivering knowledge that can help improve student learning [1-2]. Apparently, the integration of ICT in learning has become an indispensable need, as evidenced by the pervasive adoptions of ICT applications or systems in blended learning in many schools and institutions of higher learning (IHLs). As anticipated, these learning institutions have begun adopting e-courseware learning approach as one of the learning methods to meet the educational needs in producing knowledgeable and skilled students, who would be able to face new challenges in the 21st century Indeed, multimedia is particularly powerful in education for allowing students in visualizing various kinds of things in their teaching and makes the learning become more fun towards the learning. Nowadays, using e-courseware is one of the multimedia technologies that can encourage fun learning and create multi animation within the classroom settings [2]. Students are able to use various gadgets such as mobile, personal computer and tablet wherever they want and anytime they wish to learn, without any constraint or instruction from others. Most of the apps and e-e-courseware, students can follow the lessons and enquiry the new knowledge easily to engage if compare before. On the other hand, compared with traditional teaching, e-courseware of media of teaching and learning provides the various opportunity for students to learn new things at any time and anywhere.

## II. RESEARCH BACKGROUND

In Malaysia, the numbers of children with Autism Spectrum Disorder (ASD) or neurological differences have increased dramatically. According to the autism statistics, 1.6 out of 1000 Malaysian children have been identified as on the spectrum (Ministry of Health, Malaysia, 2017), and the figures keep increasing with an established prevailing rate of 1-2% globally. Alongside, the biggest challenge for individuals with ASD is to be independent and getting jobs after schooling. Hence, beginning 2017, Secondary School Standard Curriculum – Special Education (KSSM –PK) has introduced the Basic Vocational Skills subject which must be mastered by students during their schooling years.

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**Kung-Teck, Wong** Prof. Department of Education and Human Develop-ment, Sultan Idris Education University (UPSI), Malaysia.

**Hafizul Fahri bin Hanafi** senior lecturer department of Art, Computing and Creative Industry (FSKIK), Sultan Idris Education University (UPSI), He completed his PhD from UPSI, Malaysia.

**Norazilawati Abdullah**, Associate Professor, a senior lecturer in Educational Studies Department, Universiti Pendidikan Sultan Idris, Malaysia.

**Noraini Mohamed Noh,** Associate Professor, a senior lecturer in Educational Studies Department, Universiti Pendidikan Sultan Idris, Malaysia.

**Mahizer bin Hamzah,** Assoc. Prof Department, of Human Development in Sultan Idris Education University (UPSI), Malaysia.

However, pre-research has identified various problems attached to the teaching of Basic Vocational Skill subject in KSSM-PK. Among the problems are age-graded classrooms with spectrum disorder characterized by diverse learning styles are a common scenario in our special education classrooms. Furthermore, ASD students are facing serious insufficient practice/enhancement materials after school hours and guidebook for parents or caregivers to enhance their living or vocational skills at home. In response to the issues highlighted above and the myriad of potential uses of Augmented Reality (AR) as assistive educational technology, the current study aimed to design and develop a differentiated instructional pedagogical kit (Kit-MASAK) with AR to assist the ASD students to master in basic vocational skills.

To date, there is no evidence found in the literature indicating any studies on the to identify the e-courseware effectiveness and SpeEdu teachers' perceptions in using to Basic Living Skills (BLS) e-courseware prototypes namely BLS (Augmented Reality Animation) & BLS (Static graphic) in Malaysia settings. As such, the findings of this research would serve as guidelines to which all the stakeholders could refer, such as the Ministry of Education (MOE) officials, policymakers, members of the academia, contractors of ICT Project, school administrators, and teachers, among others. Using such guidelines would certainly help those concerned in a number of ways.

In accordance to that, this study carried out to design and develop Basic Living Skills e-courseware and is especially evaluated the effectiveness between Augmented Reality Animation prototypes namely BLS (Augmented Reality Animation) & BLS (Static graphic) in mastering basic living skills among ASD children.

The impression of constructing the prototype of Basic Living Skills e-courseware was raised on own experience having difficulties on mastering basic living skills among ASD learners. Besides, it is because there are lacking e-courseware or multimedia teaching tools or aids in accordance to help Special Education teachers who deal with low functioning students and for users who learn interested in mastering basic living skills in their daily life.

## III. CONCEPTUAL MODEL AND OBJECTIVES OF THE SIMULATION WORK

The purpose of this study is to identify the e-courseware effectiveness and Special Education Teachers' perception in using to Basic Living Skills (BLS) e-courseware prototypes, namely BLS (Augmented Reality Animation) & BLS (Static graphic). Figure 1 shows the research framework for this study.

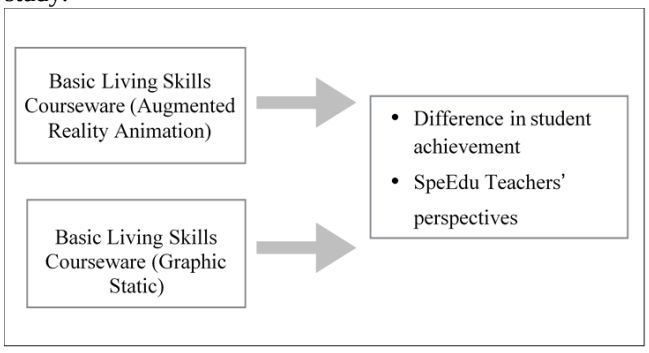



**Figure 1. Conceptual Framework of the Study**

The following are the objectives discussed in this study:

1. To identify the differences in students' achievement in between learning basic living skills using Basic Living Skills (BLS) e-courseware prototypes (Augmented Reality Animation) and Basic Living Skills (Static graphic).

2. To understand the usability of Basic Living Skills (BLS) e-courseware prototypes (Augmented Reality Animation) based on the perception of Special Education Teachers.

### A. *Augmented Reality Animation (ARA) As Assistive Technology for ASD Children*

The significant contributions of assistive technologies for teaching and learning have produced the most support and recognized in many studies. Assistive technologies provide exciting possibilities for among ASD students, as most of them have intrinsic attitudes and preferences toward or aptitude for technology [3-6]. Indeed, empirical studies on the importance of related technology-assisted learning via Augmentative and Alternative Communication (AAC) has proven its benefit individuals with a means to communicate with peers and family [7-9].

Augmented Reality Animation e-courseware as an assistive technology learning tool that promotes learning is compatibility with multimedia materials and multi-sensory capability. The multimedia presentation enhances ASD students' memory via visual images. Technologies as an assistive tool have been proven that can ASD students in many ways [6, 9]. In addition, amenities augmented reality animation has presented the images in vivid colours, and to annotate, hide, move and zoom in on or focus on the image, including text, that encourages fun and interesting teaching and learning among students [2-3].

The physical and tactile nature of ARA is also stimulating students' eagerness to touch the tablets or mobile screen [6]. Since ARA allows students to point, write, and draw and interact with mobile gadgets with either a finger or stylus, hence it also promoting kinaesthetic learning that helps to reinforce students' learning effectiveness. ARA also able to presents various multimedia materials efficiently and spontaneously. This is because ARA allows special education teachers and ASD students to retrieve information and resource instantly right on the mobile gadgets during the lessons, this helps students easier to understand the ideas and concepts on the spot. Furthermore, ARA is also claimed it could accommodate a variety of 'learning styles' as a teacher can present any type of resource that suits a student needs.

The ARA also appears to bring together a variety of resources to help ASD students understand complex ideas related to basic living skills. The needs of ASD students with different learning styles can all be handled. In other words, potential students have more opportunities to participate, collaborate, and develop their personal and social skills [3].

## IV. METHODOLOGY OF THE SIMULATION WORK

This research investigation used a quasi-experimental methodology for data collection and analysis. This is because true randomness was not possible to be achieved within a school system [10-11]. The independent variable in the research is the use of Basic Living Skills (BLS) e-courseware prototypes (Augmented Reality Animation) and Basic Living Skills (Static graphic). Through the research, the researcher collected and analysed the variables: 1) ASD students' test result before and after the use of BLS e-courseware, 2) The usability of BLS e-courseware based on perception from Special Education Teachers via questionnaires.

The score obtained from the post-test was the measurement of the level of students' basic living skills achievement, the bigger the difference between pre-test and post-test scores they obtained, the more significant and higher the level of student characters' achievement.

During the research, two classes had randomly chosen to be the participants and Special Education Teacher of each of the chosen classes conducted at least eight lessons using the BLS e-courseware prototype. To figure out the effectiveness of the aspect of student characters learning achievement, the quasi-experimental study was undertaken to measures the post-test on two non-equivalent groups. Two classes with a similar background were involved in this study while the first group, Group A, was a treatment group and second group, Group B was a control group. The treatment group was the group where participants were using Basic Living Skills (BLS) e-courseware prototypes (Augmented Reality Animation) to teach and learn among ASD students, and the participants in the control group have Basic Living Skills (Static graphic). The flow of procedure is summarised in Figure 2.

Besides that, the study also employed the following components of the Augmented Reality Animation application, as shown in Figure 3. In the initialization stage of ARA application, the users will install and run the application. Thereafter, overlay mobile gadget on the flashcards to produce 3D images. The application followed by frame calibration via images tracker and at the end, the images will be converted and send to converter frame. Lastly, the render camera will preview the 3D images.

There was 9 total number of samples involved in the study where 2 participants were grouped into the experimental group Basic Living Skills Prototype e-courseware (Augmented Reality Animation) while 2 of the samples were in the control group Basic Living Skills Prototype e-courseware (Static Graphic). For this study, samples in the treatment group used Basic Living Skills Prototype e-courseware (Augmented Reality Animation). However, the samples in control groups were used Basic Living Skills Prototype e-courseware (Static Graphic) (Fig. 4). Besides that, the study has interviewed five (5) Special Education Teachers with the intention to understand their perception on the usability of Basic Living Skills Prototype e-courseware (Augmented Reality Animation) in the aspect of:

a) Ease of Use
b) Introduce to Friends
c) User Orientated
d) Help in Teaching
e) Easy to Upload
f) Use as Revision Material

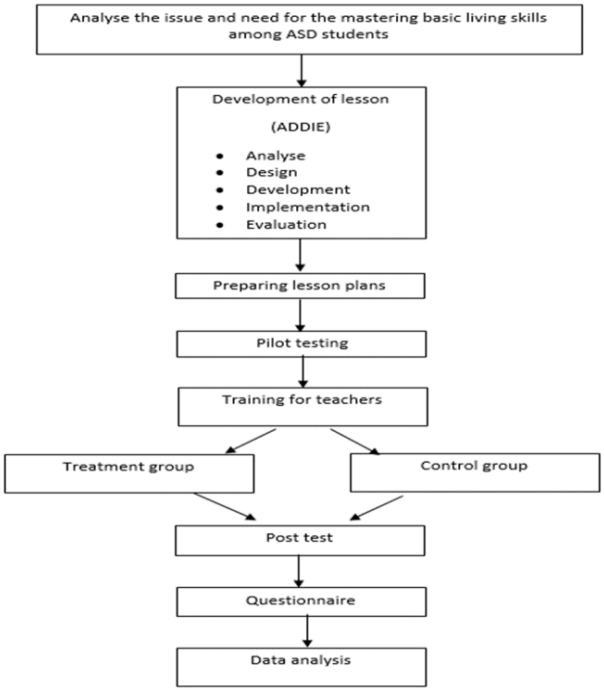



**Figure 2. The flow of the proposed experimental work.**

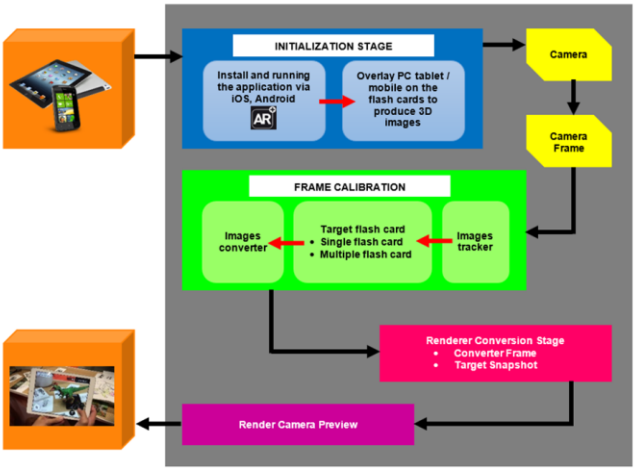



**Figure 3. The Core Components of Augmented Reality Animation Application**.

Figure 4 shows the algorithm of the implementation of this study. The study divided into two groups. Group 1 was intervention, and group 2 was the control group.

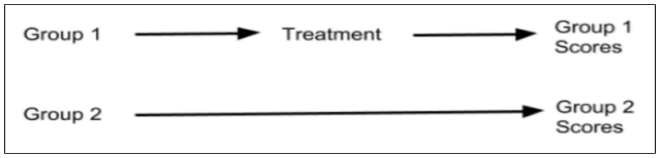



**Figure 4. Algorithm of Implementation of the work**

## V. THE SIMULATION RESULTS AND DISCUSSION

### A. *Academic Performance*

Three (3) tests have been carried and the analysis as the post-test score results. By comparing the mean difference in post-test scores between the treatment group and control, Table 1 shows the results of the academic performance according to pre-test and post-test for the treatment group (Repeated Measure-Testing). Based on the results, Student A has improved from 34% to 56% (increase 22%) and for the Student B also indicated the huge improvement after using Basic Living Skills e-courseware (Augmented Reality Animation). Student B has improved from 22% to 43% (increase 21%).

On the other side, the difference between the pre-test and post-test mean score result of the control group did not show improvement. Student C and D also improvement but with low percentage if compared to Student A and B. Based on the results shown in Table 2, Student C has improved from 31% to 41% (increase 10% only) and for the Student D also indicated the huge improvement after using Basic Living Skills E-courseware(Static Graphic). Student B has improved from 22% to 30% (Increase 8% only).

**Table 1. Academic Performance According to Pre-Test and Post-Test for Treatment Group (Repeated Measure-Testing)**

| Students | Pre Treatment Result 1 | Post Treatment Result 1 | Post Treatment Result 2 | Post Treatment Result 3 |
|---|---|---|---|---|
| Student A | 34% | 44% | 47% | 56% |
| Student B | 22% | 32% | 40% | 43% |

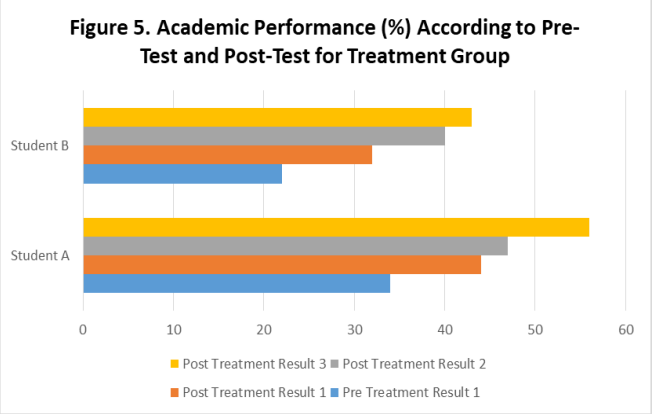
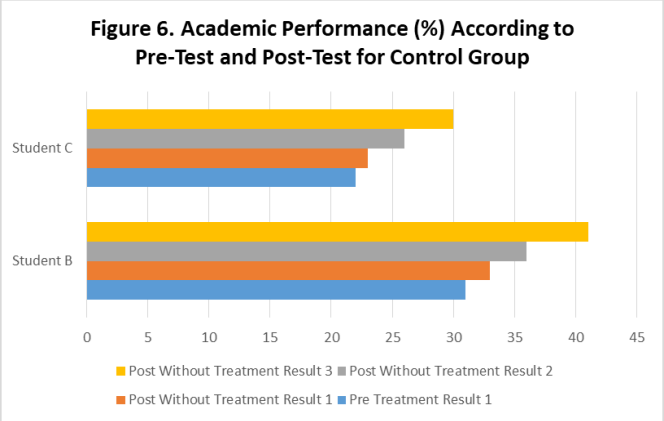


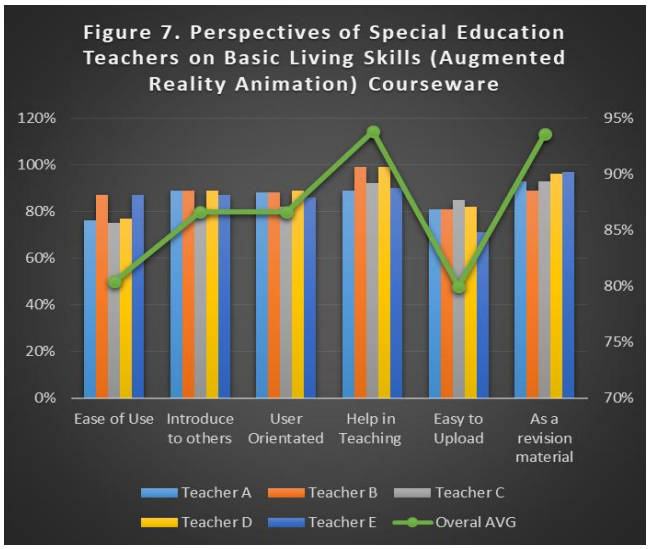

**Table 2. Academic Performance According to Pre-Test and Post-Test for Control Group (Repeated Measure-Testing)**

| Students | Pre without Treatment Result 1 | Post without Treatment Result 1 | Post without Treatment Result 2 | Post without Treatment Result 3 |
|---|---|---|---|---|
| Student A | 31% | 33% | 36% | 541% |
| Student B | 22% | 23% | 26% | 30% |

### B. *Perspectives of Special Education Teacher on BLS (ARA)*

From Figure 7, shows the six (6) different score of the usability of Basic Living Skills (Augmented Reality Animation) e-courseware based on a) Ease of Use, b) Introduce to Others, c) User Orientated, d) Helping in Teaching, e) Easy to Upload, f) As a revision material. Based on the results, all categories have scored above 75% and above. This reflected that most of the interviewed Special Education Teachers have positive feedbacks of the usability of the Basic Living Skills (Augmented Reality Animation) e-courseware. The score achieved from 0-30 % indicated Poor result; 31%-70% indicated Average result, and score 71-100% indicated Good result. Figure 7 explicitly shows the comparison of the result gained from Special Education Teachers according to overall scores for each category. The x-axis in the bar graph indicates the category of usability of BLS (ARA) and the y-axis indicates the percentage (%) score from the result. The line chart illustrated the overall mean of scores for each category. Most of the interviewed SpeEdu Teachers indicated that the Basic Living Skills (Augmented Reality Animation) e-courseware can help in their teaching (94%) and the e-courseware can be used as revision material (94%).



## VI. CONCLUSIONS

The purpose of the study is to identify the e-courseware effectiveness on animated transition and user satisfaction in using Basic Living Skills (BLS) e-courseware prototypes, namely BLS (Augmented Reality Animation) & BLS (Static graphic). The study employed survey research design and experimental approaches. The findings of this study provided greater insight into the understanding of the effectiveness and proven that Augmented Reality Animation e-courseware as assistive technology to assist Autism Spectrum Disorders (ASD) students master in basic living skills. Some of the findings from this study were in line with the previous study on augmented reality [12–16]. Besides that, most of the interviewed participating SpeEdu Teachers also revealed the usability of the e-courseware in helping them to deliver the lessons more effectively compare to transitional pedagogical practices.

Thus, particularly the MOE would be able to gain from this study, such as to precisely determine the actual effectiveness of augmented reality in help ASD students. Naturally, with better information, the ministry would be able to fine-tune its management and monitor processes of the implementation of ICT related tools for special education and ASD students as a whole. This is very important to ensure the long-term success of such e-learning especially related to the e-courseware project, which has thus far incurred huge implementation and maintenance cost. Hence, the MOE needs to put in place better strategies and directives that would encourage teachers and students to use e-courseware related to Augmented Reality Animation (ARA) among ASD children.

Alongside, this study has proven the advantages of Augmented Reality Animation (ARA) in teaching and learning for ASD children. ARA provided many great features and functionality that help SpeEdu teachers to teach, and ASD children are able to learn faster. Having that, the effective and interesting lesson can occur with the help of advanced educational tools related to augmented reality. However, not many schools in Malaysia are able to pay for costly Augmented Reality Animation for all ASD children due to limited funding by the government. Hence, it is difficult and almost impossible to provide ARA e-courseware in all classes. Therefore, the solutions with better implementation are urgent need to solve this issue.

Another pedagogical implication is the SpeEdu teachers should be trained in using Augmented Reality Animation e-courseware in their classrooms. SpeEdu teachers need to be explicitly trained to adopt the e-courseware in teaching and learning especially regards to master living skills among ASD children in the classroom. Teachers ought to be provided professional development courses with the focus on the use of the e-courseware as a teaching and learning strategy that can be effectively adopted and introduced into classes to motivate learners in their learning.

## VII. ACKNOWLEDGEMENT

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## AUTHORS PROFILE

**Kung-Teck, Wong** is a Prof. at Faculty of Education and Human Develop-ment, Sultan Idris Education University (UPSI), Malaysia. Prior to joining UPSI, he was a senior teacher in government schools. He completed his Ph.D. from University Malaysia Sabah and Post-Doctoral at University of South Australia, Australia (UniSA). He has published extensively in local and international journals. He also serves as reviewer of several local and ISI and SCOPUS indexed journals. In the past five years he has secured many public and private research funding.

**Hafizul Fahri bin Hanafi** is a senior lecturer at Faculty of Art, Computing and Creative Industry (FSKIK), Sultan Idris Education University (UPSI), He completed his PhD from UPSI, Malaysia. He has published many high impact articles in international and local journals. Hafizul specialized in software engineering and artificial intelligent. He has received many research grants from private and national institutions and external agencies.

**Norazilawati Abdullah**, Associate Professor, a presentable, self-motivated and confident lecturer with extensive knowledge on education. Possessing excellent counselling, listening and general communication skills, along with the ability to communicate to students in simple ways on matters regarding teaching and learning. Having exceptional multi-tasking and organisational skills, all of which are imperative when working closely with colleagues.

**Noraini Mohamed Noh,** Associate Professor, a senior lecturer in Educational Studies Department, Universiti Pendidikan Sultan Idris, Malaysia. Her interest research consist of School Library Media Center 2. Technology Adoption 3. Learning Environment.

**Mahizer bin Hamzah** is an Assoc. Prof at Faculty of Human Development in Sultan Idris Education University (UPSI), Malaysia.