

# Effects of Computer-Assisted Intervention on Mathematical Learning for Autistic Students

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**Abstract**—There has been vast research on the effectiveness of Computer-Assisted Intervention (CAI) in helping autistic students for learning various knowledge and skills. However, most of them are in the areas of literacy and only a small number of them are in numeracy. Hence, this research is aimed to examine a CAI in helping autistic students to learn a concept of addition in mathematics. Three male students diagnosed with autism and with prerequisite skills participated in this research. A pre-post-test design was implemented in the research. Findings of this research are promising in which all three participants demonstrated a positive outcome at the end of the treatment.

**Keywords**—Concept of Addition; Autism; Computer-Assisted Intervention.

## I. INTRODUCTION

Based on a report by BERNAMA cited in an article published by Time Money [1], one out of every 600 children born in Malaysia has been predicted to suffer from autism. Therefore, fundamental skills for independent living cannot be denied as extremely essential for those with special needs, including children with autism, to ascertain their ability to continue living independently without expecting help from others. Additionally, a special curriculum has been designed and used specifically for autistic students due to the limited ability to learn skills and shorter concentration span.

Besides using common interventions to teach autistic students, vast studies have been conducted to investigate a variety use of CAI to teach them various skills [2], [3]. The CAI is widely applied to enhance their social skills [4]–[9], communication skill [10], [11] and academic skills [12]–[16]. In fact, comparative studies have indicated that computer-based instruction typically results in advantages like increased motivation, decreased inappropriate behaviour, increased attention, and sometimes, increased learning, in comparison to other traditional methods [3]. In the past, CAI usually utilized as an assistive tool [2] or temporary instructional aid to treat children with autism [3]. However, most researches concentrated on the literacy skills [2], [12], [13] compared to mathematical skills, which focus on different practices and approaches without the use of CAI. Hence, the goal of this research was to investigate the effectiveness of the CAI in helping autistic students to study the concept of addition in mathematics.

## II. METHODOLOGY

### A. Participants

The participants of the research were three male students diagnosed with ASD attending a special education class in one of the primary school in Ayer Keroh, Melaka. The participants had been expected to possess certain prerequisite qualities, for example, (a) the ability to follow instructions orally or in written form like counting and adding, (b) know how to use the computer with a computer mouse, (c) the ability to recognise numbers between 1 and 10, as well as (d) the ability to focus on a certain activity for a minimum of 10 minutes.

During the selection process of the participants, pre-interviews were performed with the teachers to gather some basic information about the students. The participants, later, were observed separately to verify if they did possess the required skills. At the end of the observation period, three students out of six who met the required skills had been chosen for the experiment.

### B. Ethical Consideration

During the experiment, voluntary participation was imminent. Hence, students with autism were required to give consent to be involved in the research when they displayed sufficient competence to do so. The consent from these students with autism was sought in addition to the consent provided by their parents or guardians.

### C. Setting

The experiment took place in an individualised education classroom. A laptop with a computer mouse was used to present the MTS. Besides, during the experiment, no other person was allowed to be in the classroom other than the researcher and the students. Both the learning and assessment modules were presented using MTS during the experiment sessions. A prompt and assistance were given to the participants if they answered it wrongly.

**III. RESULTS**

Figure 1 and Figure 2 indicated that there was an improvement in the performance of participants throughout the experiment. Nevertheless, there were some sessions where the participants' performance showed slightly decreased, although these performances still within the predetermined performances. The findings of this research are encouraging in which all three participants showed a positive result at the end of the experiment.

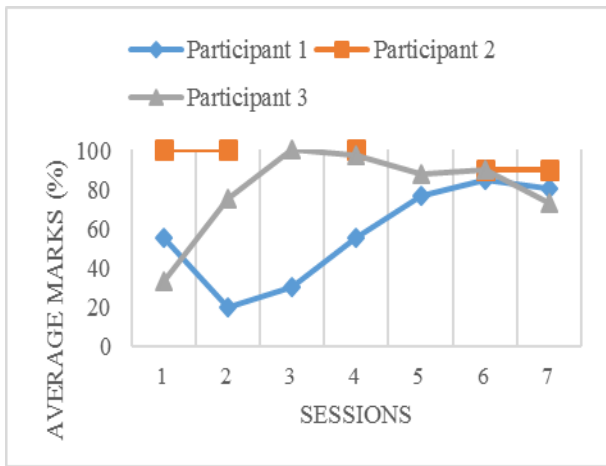


Fig. 1. Line plot of Participants' performance during experimental session

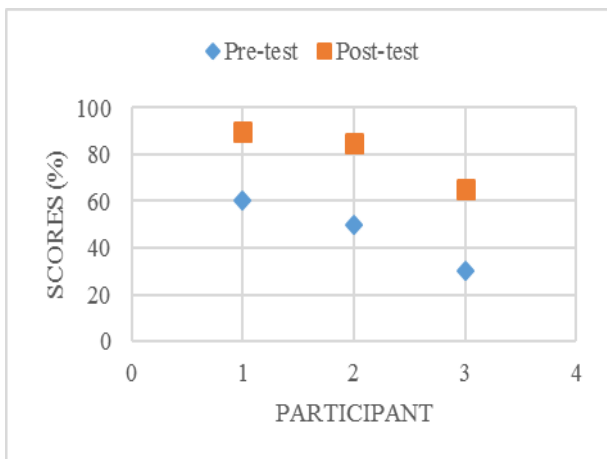


Fig. 2. Scatter plot of pre-test and post-test scores

*D. Participant 1*

During the pre-test, Participant 1 demonstrated that he already has the fundamental concept of addition with a score of 60%. Throughout the experiment, Participant 1 seemed playful and needed help to remain focused at the initial period of the session. However, in the third session, Participant 1 began to focus and show an increase in average scores throughout the session. During the experiment, Participant 1 reached target

performances following six sessions and the average scores increased to 85%. Participant 1 is said acquired the concept of basic addition skills with guidance and assistance from the teacher. During the post-test, the scores for Participant 1 increase 30%, from 60% to 90% in which suggest that the CAI was efficient for him. Additionally, during the intervention, Participant 1 showed an improvement in behaviour, where Participant 1 sustain decent behaviour throughout the remaining experiment session compared to the first two sessions.

*E. Participant 2*

During the pre-test, Participant 2 indicated that he already has the fundamental concept of addition with a score of 50%. During the entire experiment, Participant 2 had missed two sessions nevertheless it does not influence his performance on the subsequent sessions. These were mainly because throughout the experiment, Participant 2 demonstrated an excellent ability to recall the examples and instructions given in the previous session by which help him during the exercise. Participant 2 can be said acquired the concept of basic addition skills. During the post-test, Participant 2 has gained 85%, an increase of 35% compared to the pre-test scores. This suggests that the CAI was efficient for Participant 2. Furthermore, during the intervention, Participant 2 sustain decent behaviour throughout the remaining experiment session compared to the first session.

*F. Participant 3*

During the pre-test, Participant 3 indicated that he has the minimum fundamental concept of addition with a score of 30%. Throughout the experiment, Participant 3 demonstrated an excellent ability to recall the examples and instructions of the previous session by which help him during the exercise. During the experiment, Participant 3 reached target performances following three sessions. At the end of the experiment, Participant 3 average scores dropped due to the non-pictorial questions in which he seems confused and not able to solve the questions. Participant 3 can be said acquired the concept of addition skills with minimal guidance from the teacher. During the post-test, Participant 3 has obtained 65%, an increase of 35% compared to the pre-test scores. This suggests that the CAI was efficient for Participant 3. On top of that, during the intervention, Participant 3 also demonstrated an improvement in behaviour, where Participant 3 sustain decent behaviour throughout the remaining experiment session compared to the first session.

**IV. CONCLUSIONS**

In conclusion, the CAI can play an important role in autism education process and may improve the autistic students' academic skills as it represents a controlled environment to the students with autism which they can use it by themselves and makes them feel a certain level of control over the environment [17]. The use of CAI in the long term as learning tools can help to increase the student's interest towards academic and improving their academic performance. Since most of the autistic students are visual learners [18], the

methods used in the CAI such as animations, images and sounds can attract their attention and make them engage throughout the learning session. Besides, their interest and attention towards the CAI lesson can also help to reduce the autistic students' behaviour problems besides helping them to improve in academic skills.

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