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THE IMPACT OF ICT AS ANOTHER ROUTE TO OVERCOME LEARNING BARRIERS FOR STUDENTS WITH SEN: A CASE STUDY IN AN EGYPTIAN CONTEXT

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ABSTRACT

The purpose of this case study was to measure the impact of using ICT in Individual Learning Programmes of students with learning disabilities. Twenty five students and thirteen teachers took part in the research which was based on classroom observations. The Kappa coefficient was employed as a measure to statistically quantify the students' acquisition and progress in learning computer and literacy skills through raters' observations. A high correlation between Keyboard, PowerPoint, and literacy skills (writing, reading, and maths) was revealed suggesting the significance and impact of keyboard training as an essential component towards achieving educational objectives. Moreover, thematic analysis of the teachers' interviews provided a further dimension for understanding factors influencing the ICT integration process. These results further confirmed the positive impact of computer skills training on the students' learning experience which also revealed a strong belief in the right of every child to all learning opportunities, particularly ICT regardless of his/her abilities.

KEYWORDS

ICT, Special Education Needs (SEN), measurement, observation, acquisition, skills

1. INTRODUCTION

The formula for the effective integration of any type of Information and Communication Technology (ICT) in education is not the technology in itself, but rather the perception of why, how and whether it can invigorate one's learning. Several researchers have recently presented new insights into the effect of ICT on education but mainly focusing on mainstream environment. Unfavorably, the area of ICT and learning difficulties is not yet extensively researched and necessitates more peer-reviewed body of literature in order to build in-depth knowledge of the optimum means of using ICT effectively with Special Education Needs (SEN)s (Abbot, 2007).

2. RESEARCH CONTEXT

The research was conducted in a center specialized in children with SEN education who were not mainstreamed due to the severity of their needs and will be referred to throughout the research as 'Center'. The Center operates in Cairo, Egypt and caters services to Egyptian and international students, 2 years to 21 years old, with autism and other disorders that impact on their communication, physical, mental or social development. Students are grouped according to both age and skill level in ten classes where instruction is conducted in Arabic except for two English instruction classes. Instruction is conducted in one-to-one and small group sessions, incorporating each student's Individualized Educational Plan (IEP) objectives through activities that promote cognitive development, language, motor skills as well as academic skills. A computer department was structured four years ago in order to integrate computer sessions into students' IEPs where computer skills are taught on a 1:1 basis at different levels to approximately 37 out of 60 students who qualified both physically and mentally for this task. Computers are equipped with regular screens, keyboards and mouses as well as external speakers.

3. METHODOLOGY

The nature of the impact of integrating ICTs with the IEPs of students with SEN was the main question that this research aimed to answer. In particular, the following questions were processed into the research on what type of ICT was employed, how to measure the ICT skills of students with SEN if achieved, and what were the factors behind the development of this practice.

3.1 Participants

An initial selection of 37 students at the Center identified upon an interview with the senior computer teacher who agreed to include all students currently enrolled for computer sessions. However, 25 students only were observed and rated for performance because of four parent refusals, and eight absences during the observation period. Due to the distinctive nature of the Center students' disabilities and broad age range, it was not possible to select a specific age range for the study and hence this sample was included as a unique heterogeneous group of students. At the sample selection phase of the research, a plausible grouping of the students was made according to their formal assessments and also, due to the severity of cases, ability took more precedence than age in the students' assignment to different classes. Therefore, Group A included autism diagnosed students with variable severity: N=16 mean age 12;5 (range 4;5- 24;10) 13 boys and 3 girls; Group B included Down Syndrome diagnosed students: N=4, mean age 10;9 (range 6;8-14;7) 2 boys and 2 girls; Group C included Cerebral Palsy diagnosed students with variable severity: N=3, mean age 12;5 (range 11;1-14;9) 2 boys and 1 girl; Group D included one 3rd chromosome deficiency diagnosed boy age 6;5, and finally Group E included one moderate developmental delay diagnosed boy age 21;8. Ten class teachers, three computer teachers, a Center coordinator, and four parents were invited respondents for the interviews.

3.2 Data Collection Methods

A pilot interview with the Center coordinator and senior computer teacher showed that computer skills were taught with the objective of setting up the Center students to be computer users. Hence, due to the unavailability of sufficient records containing information about students' performance in computer sessions, some were partially developed in response to the researchers' request. Students' background information, formal assessment of students' skills in relation to dealing with different types of ICT, reasons for approval or rejection to join specialized computer sessions, task dates and specific measurement of performance throughout the period of computer training, progress data, sessions' observations, and more were examples of required and requested data for establishing a clear history and also for comparative objectives over different time periods. On the other hand, the available data representations were a comprehensive checklist of sequential categorized computer skills used for an informal evaluation of each student's current computer skills before starting sessions in addition to a non-descriptive register of progress in yearly reports. A mixed design approach combining the application of both qualitative and quantitative research methods (Johnson & Onwuegbuze, 2004; Hanson et al., 2005) was adopted to explore the current practice of integrating computer sessions in students' IEPs and register progress whenever verified and thus demonstrate the impact of training students with SEN to be computer users as an ICT intervention.

3.3 Kappa Measure of Agreement on Learned Skills

Selection of the quantitative pole in the mixed design aimed at obtaining a quantified measurement of the practice investigated. One major preoccupation of quantitative method is measurement as classified by Bryman (2001) which generates consistent results and provides basis for comparative measurement over periods of time as well as among other researchers. To utilize this concept, the Fleiss (1981) Kappa Coefficient was selected to measure the agreement of more than two raters on the occurrence of progress in learning computer skills for the Center's students with SEN. This measurement corroborated the occurrence of progress as acknowledged by the teachers in the interviews and enhanced the internal validity of the findings. It also served as a baseline for prospective measurements over periods of time to capture anticipated developments and/or limitations to this practice.

3.4 Procedure

Based on a comprehensive list of the achieved computer skills per student, a rater sheet was developed for each student in the sample with the specific skills expected to be observed and rated by the judges. The rater sheet divided the skills on the y-axis into various categories: Mouse Control, Keyboard manipulation, Word, Paint, PowerPoint, Internet Explorer/email, and academic objectives. The academic objectives were selected by computer teachers from the annual multi-departmental IEPs based on their applicability for drilling using software programs. On the x-axis, each skill was evaluated upon various attributes: Independent without support, independent with verbal support, independent with physical support, not achieved, compliance, and motivation. A general performance scale of 1-2-3 was assigned for all attributes except for an 'X' for not achieved where 1=30%, 2=50%, and 3=100% to prevent binary evaluation and add more depth into the measurement analysis. Four raters were selected: the senior ICT teacher, the Center coordinator who is also a professional SEN tutor, and the researchers. A meeting for all raters to explain the attributes and scale was held before the five pilot observations. A cross validation meeting was held after the pilot observations and raters commented on the limitation and ambiguity of the performance scale, which was agreed to be changed to: 1= 0-30%, 2=30%-70%, and 3=70%-100%. The senior teacher also commented that his pre-knowledge of the students' performance interfered with his judgment and that he tended to be tougher, so, the objective of rating was re-explained emphasizing the need for fairness and practical accuracy. It was possible to re-observe the same students later, which yielded the same results for three raters but with variation towards higher rating in the teacher's sheet. In reflection, post-observation meetings proved to be valuable in maintaining the same perspective for all raters which were held consistently until closure of observations.

Calculating the kappa coefficient (**K**) developed into a complex matrix due to the addition of measurement layers of attributes and performance scales. For this reason, a complex excel worksheet was designed to calculate the final coefficient taking into consideration the multiple attributes and several measurement layers and also solve the kappa algorithm per skill. To further expand the dimension of interpretation and reveal more informative results, a specific software application was designed for two objectives: firstly, counter-calculate results as means of cross validation and secondly, explore further relations between attributes. The application aimed at: first, the creation of a database for the evaluation results of n raters to a number of students based on: a. students' data (could be grouped into various classes/categories)., b. raters/judges data, c. Skills classified into two levels (Main skill and subset of skills related to each main skill)An evaluation scheme to represent the grading marked by the rater. Grading entailed two levels: (Main level, A,B,C…) and Detailed level (A1, A2, A3…). Secondly the aim was to analyse the database content by student and per skill for all students, calculating Kappa coefficients and correlations between compliance and motivation during computer sessions.

The application was designed to retain specific features to ensure replication of evaluation at different periods of time for any number of students and raters to monitor pedagogy outcomes and inform practice.

3.5 Semi Structured Interviews

Semi-structured interviews were held and taped for re-examination of data and reduction of internal validity threats (Robson, 2002). Thirteen teachers, one coordinator, and four parents were interviewed where teachers' interviews consumed approximately forty minutes each and the parents an average of 25 minutes. All interviews were held in Arabic since it is the native language for all respondents. Thematic analysis was employed as a flexible analytic tool to decipher the flow of data in the semi-structured interviews Braun & Clarke (2006). Themes were recurrently reviewed and categorization was refined as deemed crucial Two independent readers were called for examining researcher's classification of two interviews and classification of themes upon which there was 80% agreement on the suggested main themes and 100% agreement on the assignment of utterances to the different themes as reported in the results and discussion.

3.6 Kappa Coefficient Values

The four raters rated independently the performance of these students during 1:1 computer sessions held in the Center. A total of 101 computer skills were observed among the 25 students, each according to his/her IEP. Selection of skills was initially grouped by program type: mouse control, keyboard manipulation, using CD drive, Paint Program, Word program, PowerPoint program, Internet/email and academic objectives. However, the type of data found during the rating phase and the outcome of results signified the need for a different categorization since not all students displayed achievement through common routes. Therefore, an alternate categorization of three major skill divisions was derived as follows:

1. <u>Basic computer skills</u>: incorporating mouse control and keyboard manipulation, and using CD drives. All 25 students were observed using basic skills since they are the fundamental keys for operating computers.
2. <u>Intermediate computer skills</u>: incorporating Paint, Word, PowerPoint Programs, and Internet/email which are considered interactive computer tools and require good basic skills.
3. <u>Digital Literacy skills</u>: where learning and/or consolidation of classroom academic objectives that take place via computer programs (reading/writing/math).

In the raters' sheet, five main variables comprising 'Independent without support', 'Independent with physical support', 'Independent with verbal support', 'motivation', 'compliance', employed the same rating scheme of 1/2/3 where 1= 0-30%, 2=30%-70%, and 3=70%-100% which constituted sub-variables for each of the main variables and a sixth variable of 'not achieved' attribute which required a binary rating of 'x' or 'no mark'. Raters used the same rating scheme for consistency. Tables 2 through 9 demonstrate the calculated **K** coefficient for all observed skills grouped according to the three new categories.

4. RESULTS

According to the senior computer teacher, all skills included for rating and observation were entirely new to these students before joining the program. In other words, the rated computer skills value before the intervention could be set up to nil at the beginning of training. Achieving a **K** value for a skill represented the students' ability to perform the task based upon raters' scores during observation, which in other words, signified progress in learning that skill. However, the variant **K** values represented the degree of agreement among raters regarding the level of mastery rather than the skill acquisition. For example, 1.00 indicated 'almost perfect agreement' by raters on one specific level of mastery versus 0.39 that indicated 'fair agreement' by raters on one specific level of mastery and accordingly -0.50 indicated 'poor agreement' by raters on one specific level of mastery rather than unsatisfactory knowledge.

4.1 Basic Computer Skills

Since basic skills represented a main threshold for operating a computer, all 25 students were observed and raters agreed that these students acquired these skills and could master it at different levels. None of the raters marked 'not achieved' for any of the basic skills but rather showed variable dependency rates where some students required either verbal or physical support to accomplish the task. Moreover, independent observation did not register a negative impact on the students' general performance as the students seemed to understand the task and act instantaneously upon instruction. However, some students displayed slower reaction due to behavioural or disability issues which was compensated by the instructor's verbal or physical support. The **K** values for both mouse and keyboard skills conveyed 90% and 63% mastery of skills respectively. Comparably, as stated in Olson et al.'s (1997) study, the researchers called attention to the importance of mouse control training as a basic skill for using the software program prior to starting a computer-based intervention which set the participants up for improved performance as computer users. Additionally, a high correlation was revealed between keyboard skills and higher skills learning as will be shown later in this section, that further corroborates the basic skills value suggested by Olson et al. (1997). Interestingly, a teacher during her interview supported this notion mentioning: '*...especially that their mouse skills is always better than their hand skills in moving flash cards in a task while working on a table …*' (interview no. 04, lines 12 & 13).

4.2 Intermediate Computer Skills

K values for Paint, CD drive, Word, and PowerPoint programs were calculated. The number of observed students for each skill varied according to each student's IEP.
Paint Program: There was perfect agreement for skills: Reduce and enlarge size of geometric figures, Create a group of fruits' images and Save working file but poor for Choosing a colour from tray.
Using CD Drive: There was perfect agreement for skills: Open CD ROM and Insert disc into drive but not for Close CD ROM.
Word Program: Almost Perfect to moderate agreement (1.0-0.49) for most skills (9) in this category and fair agreement for 3 skills (.3)
PowerPoint Program: K was from 1 to 0.32 for 12 out of 17 skills in this category showing high overall agreement.

The higher **K** agreement values on both Paint program and CD drive resulted from competent students' performance and small number of students observed (n=4). Students' performance on Word gained high agreement among raters with poor agreement on mastery level of only 3 skills out of 12.The PowerPoint **K** values showed total rater agreement on achievement of learning program functions with variant mastery levels. Of those, 12 out of 17 skills gained high **K** values which suggested high mastery of skills. However, it should be noted that the remaining 7 skills also obtained rater agreement for achievement but with dependant performance on verbal support. None were marked 'Not achieved' by raters. Internet and email **K** values also followed the same pattern of achieved performance as the preceding programs with variable mastery levels and no 'Not achieved' markings. Here, 5 out of 8 internet/email skills gained raters' agreement for independent performance yielding high **K** values while the rest of skills were acquired but required verbal support.

Abbot (2007) stressed the value of graphic symbols in software programs and its impact on facilitating the use of the various software functions. In this framework, the software programs employed in this research especially Word and PowerPoint highly utilized graphic symbols. It was observed that students trained on these programs mostly relied on these symbols, particularly non-readers, for choice/selection of tasks that markedly supported them in using the programs to a far extent. Considerably, interviews with all class teachers escalated the value of students' learning to use basic software functions to its possible impact on their future prospect. For example, teachers expressed their contentment of the students' progress in keyboard skills in conjunction with using the Word program for the objective of typing text. One computer teacher described the level of two students (Child07 and Child14) as '…faster than me in some tasks…'(interview no.01, line 90) and another class teachers upgraded this opinion to the level of actual employment opportunity in a clerical job mainly responsible for typing text in a factory for Child11 '…and I employed these computer skills in the factory…'(interview no.05, line 72). It is noteworthy that all class teachers concurred with this opinion and perceived this stage as a possibility given the right conditions to develop it which may be further researched in another context.

4.3 Literacy Skills

The observed students utilized their acquired computer skills as a tool for learning and drilling on their class academic objectives. The raters' agreements indirectly involved an evaluation of the students' academic performance regarding these specific tasks, nevertheless, none was marked 'Not achieved' which signified total agreement on the acquisition of skills but with variant mastery levels as per raters' agreement from 'almost perfect' to 'poor'. There was almost perfect agreement for the following skills: Re-arrange words to form correct sentence, Read passage and choose word opposites Size concept (small/big) choose correct image upon verbal prompt, Same/Different concept choose correct images upon a verbal prompt ,Select correct color from an array of 3 colors upon a verbal prompt and Categorize objects.; Moderate agreement (.49) for skill: Choose accurately currency upon verbal prompt and poor agreement for all other literacy skills observed. This category may be perceived as a further utilization of the previous acquired skills in the preceding two categories of basic and intermediate skills. It entailed the drill and practice aspect of technology discussed by Abbot (2007) as using technology to train or rehearse.

4.3.1 Correlations across Skills

At this point, the results pointed confidently at all students' successful acquisition of basic computer skills and the continued progress of some students throughout the following two phases of intermediate skills and using computer skills as a learning tool. Further investigation of these results yielded interesting correlation results. Various cross-relations among the above data components were examined and thus revealed two major correlations between the **K** values of academic objectives and other programs and another correlation between keyboard skills and PowerPoint skills.

Table 1. Correlation between agreement values of academic skills and other programs.

K *Values*	Correlation *Coefficient*	Correlation *Classification*
Academic Skills	**Dependent variable (reference skill for correlations)**	
PowerPoint	0.62	**High**
Keyboard	0.51	**Average**
Paint	0.32	Slight
Word	0.17	Low
Mouse	0.17	Low

As shown in table 1, correlations between each program skills and academic skills provided interesting results. The two highest correlations with acquiring academic skills were PowerPoint and Keyboard skills respectively. To further establish the relationship among the three highest correlation values presented in table 1, another investigation was calculated to determine the magnitude of basic skills category training, mouse control and keyboard manipulation, in relation to students' performance in other programs. Table 2 presented the results of a correlation matrix between keyboard skills and other programs as shown below:

Table 2. Correlation between keyboard skills and other programs

K *Values*	Correlation *Coefficient*	Correlation *Classification*
Keyboard Skills	**Dependent variable (reference skill for correlations)**	
PowerPoint	0.75	**Very high**
Academic skills	0.51	**High**
Paint	1	Almost perfect
Mouse	0.23	Slight
Word	0.15	Low

Table 2 shows the highest correlation relationship between a trio of keyboard skills, PowerPoint and Academic skills suggesting a strong relationship in the acquisition of skills among these programs. The preceding quantitative analysis and discussion of the students' performance corroborated by the teachers' judgments reasonably illustrated a positive impact on their learning as a result of integrating computer skills training into their IEPs, which provided an answer to the main research question. As demonstrated in the above tables, each of the 25 students was observed to master a set of skills according to his/her ability and training duration. The demonstrated progress was measured on a base of zero computer knowledge of the rated skills as formerly mentioned. In fact, it is important to note that other interesting correlations between motivation and compliance of students during computer sessions emerged in the course of data analysis which may be further researched and reported in another context.

5. CONCLUSIONS

The acquisition of computer skills was evidenced for the 25 participant students by the quantitative measure of Kappa in a mixed design methodology. The results further unfolded a range of acquired skills at mastery levels shown in the range of **K** values. Furthermore, data analysis revealed a possible categorization of skills where the population of students were distributed according to their level of achievement in learning computer skills. These categories began with a basic skills level, intermediate, and concluded with literacy skills learning category. Subsequently, correlations across learned skills were computed and revealed a high correlation relationship between Keyboard, PowerPoint, and academic skills, suggesting the significance and impact of keyboard training as an essential component for further learning of academic objectives. Results further demonstrated the impact of computer skills training on learning literacy skills. Learning and/or drilling of academic objectives such as basic reading, writing, and math was evidenced for students who were able to advance through the basic and intermediate skills categories. This finding further confirmed the significant impact of ICT as part of the students with SEN learning experience and a possible additional route for overcoming fundamental learning barriers. Additional correlations between other variables such as motivation and compliance were also captured during the observation and rating phases, which will be reported in another study.

To corroborate the above findings, teachers and parents opinions were obtained to capture their insiders' perspectives incorporating the researchers' observations. They further confirmed the positive impact of computer skills training on the students' learning experience. Findings highlighted the need for more research on the value of current and potential applications of ICT for students with SEN to position them among the major beneficiaries of the technology revolution. Within this framework, it may be suggested to replicate this study in the same context for comparative value of ICT impact issues and also in different contexts using the same as well as other types of ICT. Moreover, it may be beneficial to suggest the need for incorporating this report's findings with pedagogy aspects and parental perspectives in future research.

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