The Effects of ICT Use in Teaching and Learning on Students' Achievement in Science Subject in a Primary School in Malaysia

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Abstract

This study is aimed to identify the relationship between the Information and Communication Technology (ICT) use in teaching and learning towards the achievement of primary school students in Science subject. A total of 100 respondents were selected amongst Year 4 students at a primary school in Butterworth, Penang, Malaysia. Quantitative approach has been used in this study. Students were classified into two groups namely the Treatment Group (teaching using ICT) and the Control Group (teaching without using ICT). The t-test showed higher value for the Treatment Group as compared to the Control Group. The result indicated that ICT use in teaching and learning increased the students' achievement in Science subject in the primary school. This study also attempted to determine the differences of achievement between the female and male students in Science subject. Both male and female students showed improvement in their learning outcomes. However, the male students revealed higher level of achievement compared to the female students. The findings showed positive relationship between ICT use in Science lessons and the students' achievements. The usage of ICT during lessons conducted in classes has improved the learning outcomes of students and therefore the contribution should be recognised by all teachers in order to enhance students' achievement in academic. Based on the findings, several recommendations have been made to provide some insights into the application of ICT in Science subject.

Keywords: Information and Communication Technology, teaching and learning, Science subject, education, achievement, primary school

Abstrak

Kajian ini bertujuan untuk mengenal pasti perkaitan antara penggunaan Teknologi Maklumat dan Komunikasi (ICT) dalam pengajaran dan pembelajaran terhadap pencapaian pelajar sekolah rendah dalam mata pelajaran Sains. Sejumlah 100 orang responden dipilih dalam kalangan pelajar tahun 4 di sebuah sekolah rendah di Butterworth, Pulau Pinang, Malaysia. Pendekatan kuantitatif telah digunakan dalam kajian ini. Pelajar diklasifikasikan kepada dua kumpulan iaitu Kumpulan Rawatan (mengajar menggunakan ICT) dan Kumpulan Kawalan (mengajar tanpa menggunakan ICT). Ujian-t menunjukkan nilai yang lebih tinggi untuk Kumpulan Rawatan berbanding Kumpulan Kawalan. Hasil kajian menunjukkan penggunaan ICT dalam pengajaran dan pembelajaran meningkatkan pencapaian pelajar dalam mata pelajaran Sains di sekolah rendah. Kajian ini juga cuba untuk menentukan perbezaan pencapaian antara pelajar wanita dan lelaki dalam mata pelajaran Sains. Pelajar lelaki dan juga wanita menunjukkan peningkatan dalam hasil pembelajaran mereka. Walau bagaimanapun, pelajar lelaki menunjukkan pencapaian yang lebih tinggi berbanding pelajar wanita. Penemuan menunjukkan hubungan positif antara penggunaan ICT dalam mata pelajaran Sains dan pencapaian pelajar. Penggunaan ICT ketika mata pelajaran dijalankan dalam kelas telah dapat meningkat hasil pembelajaran pelajar dan dengan itu, sumbangan ini patut diiktiraf oleh semua guru supaya pencapaian pelajar dalam bidang akademik dapat dipertingkatkan. Berdasarkan hasil yang ditemui, beberapa cadangan telah dibuat bagi membuahkan beberapa pandangan tentang penerapan ICT dalam mata pelajaran Sains.

Kata kunci: Teknologi Maklumat dan Komunikasi, pengajaran dan pembelajaran, mata pelajaran Sains, pendidikan, pencapaian, sekolah rendah.

Introduction

In order to fully participate in the global economic activities, Malaysia needs to sustain productivity driven growth through critical thinking workforce and technology literate workers (Chan, 2002). To achieve and support that vision, the educational system has to be changed. Hence, various initiatives have been introduced by the government to facilitate the use of Information and Communication Technology (ICT) and enhance the capacity and capability in all fields, including education. ICT to be used in education system as a teaching aid was one of the transformations that Malaysian government has introduced.

The main contribution of ICT is that it offers access to a lot of data and information which the teachers can utilise for teaching and learning in class. ICT is a tool and a way to improve the pedagogy of teaching, building a more effective organisational structure in schools, stronger links between schools and the community, and empower students (Chan, 2002). The Ministry of Education Malaysia believes that ICT has the potential to revolutionise education and improve learning as it has changed the medical, financial, manufacturing, and other sectors in society.

According to Chan (2002), the Ministry has formulated three main policies for ICT in education. The first policy insists on ICT being used by all students to reduce the digital gap amongst schools. The second policy emphasises the role and function of ICT in education as a teaching and learning tool. Apart from radio and television as a teaching and learning tool, this policy stresses the use of the computer for accessing information, communication, and as a productivity tool.

Moore (2005) summarised about the positive impact of ICT on pupils' learning such as increased students' motivation to stay on-task and drive them to behave better and produce high quality work. Besides, through ICT, students learnt more independently and did more works at a fast pace. Since the importance of ICT and its contributions to all fields including education had been proved in previous studies, this study will demonstrate the impact of ICT use in teaching and learning on the achievement of primary students in Science subject.

ICT in Education

ICT refers to the use of computer-based communications technology that serves as a network to find information. This includes computer hardware and software that can be used for teaching and learning and information resources (Goay and Wong, 2003). In 2006, the Department of Science and Mathematics, Faculty of Education, University of Malaya has conducted research on the use of ICT in schools that applied the policy of teaching and learning of science and mathematics in English (PPSMI). This programme also encourages teachers to use ICT in class lessons. In order to implement the PPSMI, the Ministry of Education Malaysia has sent 67% of the 300,000 teachers across the country for ICT training. In addition, the Ministry has distributed a total of 97,000 laptops, 70,000

LCDs, 67,439 screens and 2,000 software courses to schools. The Malaysian Government also introduced a model of "Futuristic School" that integrated ICT in all aspects (Yusof, 2006).

The new millennium witnesses a great transformation of society through global competition and the power of information and communication technology. This development poses a lot of implications on education system, school management and also for the formation of Smart Schools. Same study revealed that awareness of ICT amongst teachers and principals was generally low and needs improvement. Previous study by Universiti Kebangsaan Malaysia (UKM), Computer Centre (2003) reported that the acceptance and the rejection of ICT were depending on community perceptions. The same study also revealed that 13% of Malaysian have negative perceptions towards ICT, while 18.6% gave positive perceptions towards ICT and 67.7% of Malaysian have neutral feelings towards ICT. These results pictured that Malaysian society does not realise the effect and impact of ICT in their lives.

Teachers' Skills and Willingness of ICT Use in Teaching

Skills and the willingness of teachers refer to skilled teachers who are ready to use ICT in learning and teaching. According to Osman and Ahmed (2003), to achieve a comprehensive teaching by using ICT, teachers need to be convinced of the importance and benefit of ICT use in teaching and learning. Indeed, teachers should be given adequate training to use ICT tool effectively and efficiently. Findings also showed that teachers who have attended training courses in English and ICT were more efficient, capable at using computers and willing to implement the teaching of Science in English compared to teachers who have no training. (Saamad, 2003)

Cook and Finlayson (1999) indicated that the increased use of ICT in the community provided opportunities for students to gain experience that will encourage them in learning. They added, if the use of ICT in learning and teaching produced favourable effects, teachers will be more confident of the education system in the future. Norzita (2004) revealed that the minimum level of the skill of using computers and ICT amongst teachers in teaching and learning of Science was high. However Sutherland et al. (2004) stated that ICT will enhance learning if teachers plan to incorporate

into learning activities carefully in lessons but it will, in turn, becomes useless without good plans. Students must be encouraged to understand the process involved. Becker (2001) suggested that teachers' expertise in ICT was an important factor in its successful use in lessons. Government has provided materials and facilities such as laptops, LCDs, CDs, guide books, textbooks, reference books, activity books to help teachers in teaching. Therefore, teachers were encouraged to take advantages of ICT in teaching and learning in order to produce a big impact in education field (Romai Nor, 2003).

Lim (2005) found that the use of ICT in teaching and learning allowed students to be active in finding information and build knowledge from information obtained by the chance to cross-link between knowledge of subjects without restricted by time and distance. Fun (1990) conducted a study on the attitudes of the Form Six students during computer-aided activities in Geography classes. It showed that students have positive attitudes towards the use of computer which was considered as an effective technique of teaching and learning pedagogy by students. According to Kubiatko (2010), the results of students' attitudes toward ICT use in teaching and learning Science subject among high school students were based on statistical evaluation. Students seemed interested in using ICT in the Science subjects. The same study also concluded that ICT can enhance students' learning in Science from early age. Ong, Foo and Lee (2010) in their study revealed that the initiative of Malaysia Smart Schools promotes the use of ICT has created significant positive attitude towards Science among students.

Method

Sampling

Stratified Random Sampling was used to ensure the generalisation and the accuracy of the data. Population of this study is 200 students of a primary school in Butterworth, Penang. Respondents were randomly selected amongst the Year 4 students. Fifty students (25 male and 25 female) were selected for the Control Group and another 50 (25 male and 25 female) students for the Treatment Group. The selection of sample also was based on the final examination grade of Science subject.

For this experimental study, a set of pre-test questions were given out to the Control and Treatment groups at the beginning of the study. A set of post-test questions (that same as the pre-test questions) were given out to both groups after the experiment is conducted.

The pre-post test questions were divided into two parts: Part A (30 questions) and Part B (12 questions), whereby all the 42 questions were related to the topics of Year 4 Science subject. Part A consists of 30 objectives questions worth 60 marks that cover the topics on *Basic Needs Life Processes, Protection* and *Measurement*. Part B consists of 12 subjective questions worth 40 marks based on the topics on *Materials, The Earth and The Universe,* and *Technology around Us*. The total mark is 100%.

The pre-test was conducted for both groups and data was collected for analysis using SPSS version 13.0. Then, an experiment was carried out for both groups. For the Treatment Group, they have to use ICT during their Science lessons for 10 weeks. Whereas, for the Control Group, their Science lessons were carried out without use of ICT. Following the experiments, a post-test session has been conducted for both groups for data collecting.

Data collected from this survey were then presented by using descriptive and inferential statistics. Descriptive analysis was used to study the effect of ICT use in Science lessons on the achievement of Year 4 students as well as to find percentage, mean and standard deviation of the item. The t-test and correlation were used to investigate the relationship between the effects of ICT use in teaching and learning on the achievement, and to determine the direction and strength of the relationship between achievement in Science subject by ICT use, and without ICT use. The t-test and correlation were also used to determine whether there was a significant difference in students' achievement across gender.

Findings and Analysis

Table 1   The comparison of students' achievements in pre-test session between the Treatment Group and the Control Group

Test	Group	N	Mean	Standard Deviation	Standard Error	t	Sig
Pre-test	Treatment	50	13.53	3.08	.51	−1.367	.176
Pre-test	Control	50	14.64	3.65	.64		

The mean score for the Treatment Group was 13.53 and the mean score for the Control Group, was 14.64. The t-test analysis showed that the t value was −1.367. These results showed that there was no significant difference in students' achievement in Science subject between both groups in pre-test session.

Table 2   Students' achievements in post-test session between the Treatment Group and the Control Group

Test	Group	N	Min	Standard Deviation	Standard Error	t	Sig
Post-test	Treatment (ICT)	50	17.58	4.15	.69	2.841	.006
Post-test	Control (without ICT)	50	14.85	3.82	.66		

As seen in Table 2, the Treatment Group attained mean scores of 17:58, while the Control Group attained 14.85. The significant value was .006 and these results showed that there were significant differences in the achievement of both groups in the post-test. Results indicated that performance of students from the Treatment Group increased in post-test. This concluded that ICT use in Science teaching affected students' achievement.

Table 3   The comparison of students' achievements in pre- and post-test session between the Treatment Group and the Control Group

Test	Group	N	Mean	Standard Deviation	Standard Error	t	Sig
Pre-post	Treatment	50	4.00	5.36	.89	4.477	.000
Pre-post	Control	50	0.21	3.55	.62	0.343	.734

The t-test was also conducted to analyse the achievement of student for both groups. The aim was to prove that there was a significant improvement for both groups of Year 4 students in Science subject. The mean and standard deviation values (min = 4.00n; SD = 5.36) proved that there was a high improvement for the Treatment Group. Hence, these indicated that there were significant differences in student achievement between pre-test and post-test sessions. The t value (t = 0.343) for the Control Group showed that there was no difference on students achievement in pre-test and post-test. The value of standard deviation (SD = 3.55) showed that there was only a slight achievement in the Control Group. The significant value of 0.734 clearly proved that no difference existed on students' achievement in Science subject between pre- and post-test sessions. These results indicated that teaching without using ICT did not improve the achievements of students in the Control Group.

Table 4   Correlation between ICT use and students' achievements

		Use of ICT	Students' achievement
Use of ICT	Pearson	1.000	.899**
	sig. (2-tailed)	50	.000
	N		50
Students' achievement	Pearson	.899**	
	sig.(2-tailed)	.000	
	N	50	

Data gathered showed that correlation between the ICT use and students' achievement was very high which indicated that there was a positive relationship between ICT use and students' achievements.

Table 5   The difference of female students' achievements with teaching ICT use and without ICT use

	Group	N	Mean	Standard Deviation	df	t	Sig
Female	Treatment	25	8.00	3.20	.48	3.243	.000
	Control	25	7.43	2.57			

Table 5 showed that the mean value for female students' achievements with teaching using ICT was 8.00 and for teaching without using ICT was 7.43. This study has found out that the female students' achievements increased when ICT was used in Science lessons compared to the achievement without using ICT.

Table 6   The difference in male students' achievements by teaching using ICT and without using ICT

	Group	N	Min	Standard Deviation	df	t	Sig
Male	Treatment	25	9.58	5.15	.48	3.503	.000
	Control	25	7.42	2.58			

Table 6 showed that the mean value of male students' achievements in Science subject by teaching using ICT was significantly different from the mean value of students' achievements by teaching without using ICT (t = 3.503, p = 0.001). The data also found that the achievement of male students which have been taught by using ICT was better than the achievement of male students that have been taught without using ICT.

Table 7 showed that the male mean value was higher than female students (male = 9.58, female = 8.00). These indicated that ICT use in Science lessons provided more positive impact to males compared than female students.

Table 7   The difference of ICT use in Science lessons on students'
achievements based on gender

Group		N	Min	Mean	SD	df	t-value	*P* value
Treatment Group (use ICT)	Male	25	25	9.58	5.15	.48	3.841	0.000
	Female	25	25	8.00	3.20			

**The Effect of ICT Use in Teaching and Learning on Year 4 Students'
Achievements in Science Subject**

The main purpose of this study was to investigate the effect of ICT use in
teaching and learning towards students' achievement in Science subject at
primary level. As a result of this study, it was found that the use of ICT in
teaching and learning has improved the achievement in Science for the
Year 4 students.

The comparison of students' achievements showed that the Treatment
Group had higher achievement than the Control Group. It was concluded
that there was a significant difference in achievement of Science subject
between both groups. This indicated that the achievement of students was
increased when teacher used ICT in their teaching and learning. According
to Pittard, Phil and Jessica (2003), ICT provided significant contribution to
teaching and learning in all subjects and to all ages. ICT can motivate
children and engage them in learning, besides meeting individual learning
needs. According to the Bruner (1966) theory, to achieve better results,
children need motivation to learn. It has been proven in this study where
ICT has been used in teaching for 10 weeks in the Science classes. As a
result, the students were more interested to study and this helps to improve
students' performances. Deaney, Ruthven and Hennessy (2003) also found
that ICT has increased the interest and motivation for pupils in schools.
Similar study proved that teaching and learning using ICT improved the
achievement of moderate learners (Norzita, 2004).

Correlation between the Use of ICT in Teaching and Learning with the Students Achievement in the Science Subject

Findings showed that there was a positive correlation between the use of ICT in teaching and learning with students' achievements. According to the findings of this study, students' achievements increased when ICT is used in a lesson. Students' achievements were found decreasing in a non-ICT based lesson. According to Cox (1999), using ICT in lessons can enhance self-esteem leading to expectations of achieving goals. Becker (2001) also suggested that using ICT in lessons may help students in mastering subject skills. ICT used in lessons especially in the Science subject produced higher quality output of students. Comber et al. (2002) suggested that ICT can be used effectively in the Science subject to show video sequences of things that are hard to explain or visualise. Students would be able to construct knowledge easier with the support of ICT (Hull 1995; Gayeski, 1993).

The Effects of ICT on Students' Achievement Based on Gender

Findings indicated that there were differences in students' achievement by gender. Data found that 80% of male students and 70% of female students have passed in the post-test. It can be described that male students showed higher achievement than female students. This finding is supported by Shaw (1999) who revealed that male students felt more at ease with new ICT than females. In addition, study by Hakkarainen et al. (2000) revealed that male students' scores were higher than female in ICT skills. Similarly, according to Papastergiou and Solomonidou (2005), male students were more involved in working with computers than female students. Males are suggested to have better ICT and computer skills compared to the females. They spent more time on computers and accessed the internet at home more than females. Instead, their attitudes towards computers are more positive than the attitudes of females (Hakkarainen et al., 2000). The same study also examined that male students believe in ICT facilitation of learning is more strongly than did the female students. Sixty percent of male students stated that they will put more effort into studying if they were allowed to use information technology; however only 30% of female students fully or partially have the same opinion. These findings concluded that male students have better learning outcomes when ICT was used in Science lesson. However, both male and female students showed

improvement in Science, determining that both gender have the interest to learn Science using ICT.

Conclusion

The use of ICT in teaching and learning helps students to expand knowledge, experience and increase understanding, especially in the Science subjects that require visual, audio, flow chart, video presentation and so on. The findings concluded that using ICT in Science lesson has positive impact on students' achievements. Schools must strive to increase usage of ICT amongst teachers. On the other hand, teachers should put more effort to use ICT in their Science lesson in order to increase students' achievements. Teachers who are weak in the use of ICT need to participate in ICT training courses. ICT facilities provided by the government in schools must be fully utilised by the teachers.

Using ICT in Science lesson can also help students to understand Science concepts through a relationship with a real life situation. The use of ICT in Science lessons can improve students' achievements compared to using traditional approaches. Moreover, it can make teaching and learning process become more interesting, encouraging and effective. Using ICT in study encourages students to process information better and thus enhances the understanding and improves students' memory (Hull 1995; Gayeski, 1993).

Both gender showed improvement in Science subject. However, male students had greater achievement than female students. Differences in cognitive style, interest and motivation between boys and girls might be the causes of the difference in their achievements. Following Kogan (1971), boys were more cognitive than girls. Hence, when ICT was used in the Science lesson, we can see the differences in both genders' achievements. It is concluded that ICT promotes better learning outcomes on male students' achievement in Science. The overall conclusion from this study reveals that ICT has a significant and positive impact on teaching and learning specifically for Science subject. ICT contributes greater performance or achievement of students. Teachers should replace traditional teaching approach with attractive learning style by involving ICT in their lesson. Science field that needs investigation and practical works needs ICT to assist in teaching.

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The integration of ICT in teaching and learning is not a method; rather it is a medium in which a variety of methods, approaches and pedagogical philosophies may be implemented [5]. This statement shows that the effectiveness of ICT depends on how and why it is applied and integrated. In 1980, Taylor stated that ICT usage is classified to tutor, tool and tutee [6]. Tutorial programmes lead learners step-by-step through a programme such as drill and practice. Using technology as a tool can help other types of problems, for example, technology as a tool is frequently seen in tutorial or explanat As Stephen reports the use of ICT reasserts the productivity of teaching and learning foreign languages. Therefore, some scientists mention about positive effects of using it and its impact is highly dependent on the way it is used (the teachers' motivation and their savoir-faire). Teaching foreign languages in blended classes requires enormous effort on teachers' shoulders. As educators play the great role in this process. For this reason, teachers always need to be in a move forward looking for new and interesting methods for teaching in order to motivate and increase students' knowledge and Use of ICTs in educational process to achieve the goals of education has revolutionary impact in instruction and education using various instructional tools. Narasaiah point out that "Technology related skills among the staff concerned, n particularly teachers and trainers, need to be improved" [10,6]. It is fact that integration of information and communication technology has transformed way of instruction which has great potential for learning. According to Heyneman and Haynes Educational technology may be altering schooling in developing areas, including both the teaching and learning processes€.[11,60]. ICT offers opportunities for intensive one-to-one learning in a multimedia computer lab. In this digital era, ICT use in the classroom is important for giving students opportunities to learn and apply the required 21st century skills. Hence studying the issues and challenges related to ICT use in teaching and learning can assist teachers in overcoming the obstacles and become successful technology users. Therefore, the main purpose of this study is to analyze teachers' perceptions of the challenges faced in using ICT tools in classrooms. A quantitative research design was used to collect the data randomly from a sample of 100 secondary school teachers in the state of Melaka, Malay... You have to learn ICT details to built up your career. A man builds his life from the school level. So it is our duty to teach the best use of the internet and other tools to them. The importance of ICT in the education sector is much higher. Students know about the outside part of the world because of the addition of ICT in education. Everything is becoming computerized nowadays. So it is important to teach our students about the computer. Importance of ICT in education. And adding the ICT book into the curriculum will help the students to know and learn about technologies. Everything has both sides, right and wrong. We have to get the right one. People are misusing technologies. So it is important to save our young generation from misusing the ICT.

For most European countries, the use of ICT in education and training has become a priority during the last decade. However, very few have achieved progress. Indeed, a small percentage of schools in some countries achieved high levels of effective... The findings are interesting: ICT has positive impact on students' performances in primary schools particularly in English language and less in science. Schools with higher level of e-maturity show a rapid increase in performances in scores compared to those with lower level. There's primary school and university which is also mostly classroom-based learning. There's a part of the industry focusing on adult eLearning and those develop software like e.g. LMS. Students using ICTs for learning purposes become immersed in the process of learning. As more students use computers as an information source and cognitive tool (Reeves & Janassen, 1996), the influence of the technology in supporting how students learn will continue to increase. In the past, the conventional process of teaching has revolved around teachers planning and leasing students through series of instructional sequences to achieve a desired learning outcome. Constructivism emphasises an integrated curriculum where students learn a subject in various ways or through different activities. ICT offers many strategies for a constructivist-learning environment. Does teaching and learning with the use of ICT improve students' knowledge of business education? Can implementation of computer based teaching in secondary schools across the country improve Nigeria's educational system? Can the use of ICT in secondary schools in Oshimili LGA enhance the academic development of Delta state? Research Hypothesis. There are no challenges that can hamper the use of ICT in teaching and learning business education in secondary schools in Oshimili LGA of Delta state. There are challenges that can hamper the use of ICT in teaching and learning business education in secondary schools in Oshimili LGA of Delta state. Significance of the study/ Justification of the study. Experts say that using technology in teaching and learning can increase children's engagement in class, more than an old school textbook can as devices and apps are where today's students live their lives. This is a benefit for all learners as apps cater to all levels of ability and use various teaching methods to support learning. Apps also help to give teachers new ways of teaching the same thing, from games to virtual field trips. As you engage more students through classroom apps and by using EdTech in teaching and learning, the more data you will collect. Thus you will be able to achieve a better work-life balance. Primarily this data can be used to gauge the learning difficulties faced by the student and modify the instructions to then customise the learning for a better outcome. use of ICT and the students' performance in Physics. Integrating ICT in teaching and learning process at present remains a challenging task on the part of teachers due to some reasons like: the ratio of student-computer and teacher-computer, lack of trainings in integrating ICT, lack of confidence and competence in ICT, lack of technical support and lack of accessibility to ICT resources. The achievement test in Physics that is based on the learning competencies for Physics-8 indicated in the K-12 Science Curriculum Guide provided by the DepEd was used as the research instrument in gathering of data from the students. The test was composed of fifty items.