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RESEARCH REPORT

Studying the Impact of Using Multimedia Interactive Programs on Children's Ability to Learn Basic Math Skills

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ABSTRACT The continuous inventions and evolutions in all information technology fields open new channels and opportunities to enhance teaching and educational methods. On one side, these may improve the abilities of educators to present information in interactive and media-enhanced formats relative to traditional methods. This may help students or learners through offering them the information in channels and methods that can be easier to understand, deal with and retrieve. On the other hand, offering those alternative methods of teaching can be helpful particularly for children, people with special needs, or students in rural areas where they can have virtual or remote instructors, especially for majors who have shortages. The purpose of this study is to investigate the impact of utilising multimedia technologies on enhancing, or not, the effectiveness of teaching students at early stages in Jordanian primary schools. To achieve this objective, a program has been developed to test the students' ability to understand basic mathematical knowledge and skills. Two groups were selected from a local school based on their own class distribution, where one group was taught the subject in basic math using a program developed for this purpose and the second class was taught the same subject using traditional methods of teaching (i.e. direct student-to-child instruction, board, etc.). Results showed that in such math skills at this age, using programs or multimedia-enhanced methods of teaching can be effective in getting students' attention, especially when cartoon characters are used. Results also showed that there is no significant difference in learning and knowledge skills and information absorption based on gender distribution, as a comparison of the results between little boys and girls showed no significant difference in their learning skills.

Introduction

There are many parameters that can define and impact students' abilities in learning. Typically, papers focus on parameters or factors that are related to the school and the educational methods, as other methods such as self or family oriented factors can't be controlled by educators or educational systems. Students who have access in their home to new methods and tools of education through computers, interactive learning and so on may also have also different, and greater, potential to absorb those technologies while used in the school educational system.

Teaching methods is the subject of many research papers in this field in trying to evaluate methods to improve students' ability to be interactively involved in the class. This seems to be particularly necessary in the current environment of Internet and wireless (etc.) connectivity where students can be distracted through having or using those tools. Providing the means for students to use those tools in their education besides using them for entertainment or social activities may have a positive impact on education.

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The availability of Information and Communication Technology (ICT) tools and programs has spread all over the world. Those tools emerged to be part of the lives not only of high-class, well-educated people - rather, the Internet, cell phones, etc. are used to help people in their daily life activities, providing information about shopping and information about restaurants, maps, land, knowledge, science, etc. They are provided not only through personal computers, but also through wireless, GPS, PDA, etc.

The government of Jordan has been concerned about developing and reforming the education system. Similar to education systems around the world, the current education system in Jordan is facing many challenges. Probably one of the most important challenges concerns the quality of education.

Over the past four decades, Jordan has invested heavily in education and allocated an average of 5% of its gross domestic product to education. Furthermore, an impressive improvement has been made in terms of number of students enrolled in different levels of education. Unfortunately, recent reports indicate that there are several improvements to be done regarding the quality control and assurance of education. Such a problem is widely recognised in many circles. For instance, in a recent report by the World Bank (2008) it is made clear that the Jordanian educational system, like other educational systems in the Middle East and North Africa (MENA) region, depends heavily on memorisation, definition, knowledge of facts and concepts. It fails to concentrate on learning and the usage of new approaches or techniques that reinforce creative and critical thinking among students.

Another indicator about the poor quality of education is the results of the well-known international test of eighth-graders in mathematics. The average math score for 21 countries in MENA is 401. Although the mean score of math tests for students in Jordan is above the regional average, it is significantly below that of East Asia (466). It is also below the international average of 489. Over the past two decades or so, technology has a significant impact on the educational system. Drucker stressed the idea that new technologies will force us to shift from teaching to learning (Drucker, 1999). Research into teaching and learning with new technologies is currently a very dynamic, high-profile and relevant area of educational enquiry (Muller et al, 2006).

Multimedia technology is probably one of the most exciting innovations in the information age. The rapid growth of multimedia technologies over the last decade has brought about fundamental changes to computing, entertainment and education (Norhayati & Siew, 2004).

Multimedia technologies and applications are probably one of the most exciting innovations in the age of information evolution. They helped and got help from the Internet and other communication and computer inventions. Multimedia has the potential to create high-quality learning environments, with the capability of creating a more realistic learning context through its different media. It also allows learners to take better control of the classroom, especially when the class size is large. Interactive multimedia can thus provide an effective learning environment to different kinds of learners (Margie & Liu, 1996).

Many may argue against such studies that evaluate the impact of a technology on learning compared with traditional education, but in all cases, multimedia education offers an alternative to traditional education that can enhance the current methods and provide an alternative, especially in some cases where teaching by traditional educational methods is not applicable.

Definitions

Multimedia

Multimedia refers to computer-mediated information that is presented concurrently in more than one medium. It consists of some, but not necessarily all, of the following elements: text; still graphic images; motion graphics; animations; hypermedia; photographs; video; audio (i.e. sounds, music and narration). Multimedia can support multiple representations of the same piece of information in a variety of formats. This has several implications for learning (Ke, 2008).

Interactive Multimedia

By interactive multimedia, educators unusually refer to the use of multimedia and ICT equipment to offer an effective dialogue between the instructor and the students, in comparison with traditional methods of teaching which may lack such interactivity. However, supporters of traditional methods of teaching argue that the face-to-face communication can be more interactive.

Multimedia and Education

The advancement of technology has made a significant impact on the evolvement of teaching methods from traditional face-to-face teaching to computer-based learning (CBL) or e-learning systems at all levels of education. Modern education and communication environments can offer alternative ways in the learning process.

Multimedia has been widely used in educational technologies. It is also expected that the future will see more utilisation of such tools in education. Some argue that multimedia and e-learning tools should be used as a supplement to traditional classes (and not as a replacement). Using interactive multimedia in the teaching process is a growing phenomenon. It plays a very important role in assisting students in learning processes. Therefore, it can be concluded that multimedia enhances and enables students to learn in a more effective way.

More efforts are needed to create new programs using multimedia elements and multimedia authoring tools to provide content-rich learning software and courseware to different students. By multimedia, here we don't mean only animation, or image- and video-related products, although these maybe incorporated with programming and other methods to provide a portal or an application, etc., in which data, video and images are mixed.

Theoretical Background

The roles and effectiveness of interactive multimedia have been the subject of many studies. This section intends to shed light on the main works in this area.

User interactivity is a major feature of well-designed multimedia courseware. In fact, researchers have shown that an interactive learning environment can generate an effective instruction and learning system (Harper & Hedberg, 1997; Sims, 1998; Shinde, 2003).

In different research studies by Mayer, the results indicate that using multi-modal instruction is more effective than using any single mode (Mayer, 1997; Norhayati & Siew, 2004). In other words, this finding demonstrates that media do impact learning, through the instructional possibilities that they enable. For example, based on Mayer's research, one could state that when used appropriately, the video medium should be more effective than radio, since the latter cannot provide visual information. The presentation of ideas in visual form has proved to be particularly important as it critically helps the educational process.

A review by various researchers of studies that have investigated the effectiveness of multimedia in learning suggested that the people who used computer-based multimedia instruction performed better in terms of test scores compared with those who received instruction through traditional classroom lectures.

Bayhan et al explored the use of computers at home to develop mathematical ideas and reported that there was considerable potential for computer games to support such learning (Bayhan et al, 2002). Similar research papers showed that children who are exposed to the computer and Internet for educational purposes or who or have and use them at home in this way can have better chances to understand basic learning skills such as the basics of mathematics and alphabets. This early exposure to technology may offer new potential for both children and the pedagogy in early childhood settings. Special terms used to describe this new generation can be seen in different papers. For example: 'Generation Y' (Zabel, 1999; Charp, 2003); 'Digital natives' (Prensky, 2001); 'Millennials' (Howe & Strauss, 2000; Zemke, 2001). Children's homes often have computer technology in all facets, with gadgets such as TV remote controls, programmable microwaves, wireless phones, computers, digital games (such as PlayStation, Xbox, etc.). These offer significantly different ways of playing from those that had been possible in non-digital worlds (Zevenbergen, 2007). In trying to keep up and compete with those children, educators may have to

continuously update their knowledge and skills and should always include those methods in their education (at least in terms of preparation and presentation), no matter what their major is.

Stith's study (Stith, 2004) shows that the use of animation in teaching cell biology and all fields of biology is beneficial. It was found that scalable interactive animation with hot keys and rollover help to enhance learning in an effective way. Animated illustrations accompanied by audio, video and kinetics are much more effective for the cell biology learners than static illustrations (Stith, 2004).

Cronje and Fouche investigated the differences between various mental models of learners and designers. The study was based on six high school students (3 males and 3 females) attempting to learn principles of electricity (Cronje & Fouche, 2008). The students were selected in a way that reflects three levels (i.e. weak, middle and good) for each gender. The results revealed considerable differences between the mental models of learners and designers. The free navigation of the multimedia learning program helps good students to accelerate their learning, while weak students are lost (Clements, 2002).

Holzinger et al addressed the effects of using simulation to teach complex physiological models to 96 students at a college of medicine. They also found that the effectiveness of the designed simulator and that of the conventional text lessons are equivalent. Using additional guidance for the designed simulator helps to improve the learning process (Holzinger et al, 2009).

Kamat and Shinde's 2009 project was based on the results of a test on a number of interactive multimedia packages for Grades 1 to 4. These multimedia packages are usually used for subjects like science, mathematics, geography, history, etc. It was concluded that interactive multimedia is much better than traditional educational methods, which depends on classrooms and lecturers using chalk and talk (Kamat & Shinde, 2009).

Kay aimed at finding out whether gender affects the use of an interactive classroom communication system (ICCS). The study examined student involvement, assessment and perceived learning of a sample of 659 secondary school students, who were equally divided between males and females. The comparison revealed that male students are significantly more positive than their female counterparts (Kay, 2009).

Computer games can be used as a teaching and learning tool. Ke's study aimed to find out the effect of educational computer games on the 4th and 5th graders' ability to learn mathematics. To achieve this goal the study tested the effect of educational games on cognitive math achievement, meta-cognitive awareness, and positive attitudes toward math learning. Results revealed that educational computer games help to attract students towards learning math during the first five weeks, but have no effect on cognitive math achievement or meta-cognitive awareness (Ke, 2008).

Liu et al's 2009 study confirmed previous findings about the positive effect of media richness within e-learning educational systems on the user's intention to use such systems. E-learning systems that present their materials using text, audio and video stimulated a higher perceived usefulness (PU) and concentration than their counterparts which used text only, text and audio, text and video, or audio and video (Clements, 2002).

E-learning should not be a replacement for traditional learning, but an improvement to the efficiency of the learning process. Academic institutions adopt a number of learning strategies to enrich the learning process, and this is called blended learning. Experimental research shows a high retention rate of improvement for learning by reading and practising.

Many studies have found that the effectiveness of online teaching modules is equivalent to that of the traditional way of teaching. Moneta et al explored the effectiveness of interactive multimedia online courses versus the traditional lecture based on studying an introductory computing course. It was concluded that well-designed e-learning modules have their pros, but they could not prevent the cons found in traditional modules (Moneta et al, 2007).

Evans and Gibbons tried to discover the effects of adding interactivity to computer-based learning packages of business and management on a small sample of undergraduate students (22 males and 11 females). The sample was randomly divided into two groups in order to test the effect of interactivity versus that of the non-interactive modules. The results reassert the positive effects of using visualisation to improve the depth of learning and understanding. Also the results show that gender has no effect on learning (Evans & Gibbons, 2007). Kamil et al found that the dynamic nature of multimedia seemed to help children to create mental models more effectively and improved comprehension (Kamil et al, 2000).

Rochelle et al, 2000 have suggested that such research has indicated that learning is most effective when characterised by: active engagement; participation in groups; the provision of frequent interaction and feedback; and making connections to real-world contexts. Traditional teaching methods are quite poor at providing such contexts, and in fact the characteristics of innovative uses of computers that are conducive to learning include all of those listed.

Due to the lack of sufficient proficient English language teachers in public schools in the Philippines, alternative ways are used to bridge this need. Atienza and Tai (2009) and the Department of Education at the University of the Philippines created a handheld electronic reader that helps students to pronounce English words correctly, and to supplement English materials for third-grade students at the country's elementary schools. The electronic reader was used to monitor, test and evaluate the performance of 300 students. Results show that the electronic reader significantly improved the learning process (Kleen & Shell, 1994).

Recent studies attempted to evaluate the cognitive load (CL) necessary to learn and understand online multimedia curricula. These studies concluded that as the interactivity of the presented materials increases, the CL decreases. For instance, Chang and Yang evaluated CL during four weeks of learning web-based materials about global warming by 105 (24 males and 81 females) 11th-grade students from an academic senior high school in Taiwan (Chang & Yang, 2010). Gender differences were statistically significant, where males were overloaded with reading scientific articles, while females were engaged with chat rooms and search activities. Scientific articles, online notebooks, flash animations and online tests might require high mental effort, while chat rooms, videos and interactivity require low mental effort.

Most of the e-learning materials designed linearly forcing their users into sequential learning, so that all users are forced into the same pedagogical path regardless of their experience and their needs. Because of that, Robberecht asserts that there is a need for designing interactive non-linear e-learning educational systems that are intelligent enough to dialogue with the learners according to their actions and responses. Also the e-learning educational systems should attract different learners regardless of their experience (Robberecht, 2007). Educators should incorporate entertainment through education and should get students involved actively in classes. This can be achieved through showing them that the things they use and appreciate, such as games, social websites, etc, can be used and utilised in the class as well, for educational purposes.

Well-designed interactive multimedia e-learning systems can attract the learners to possess more information. Active engagement is an important factor in improving the learning process. Said attempts to lay down the foundation for a design model of an interactive multimedia e-learning system which offers active engagement (Said, 2007).

Design and Development

Designing an interactive educational multimedia system involves presenting the learning material in an adequate form and providing the facilities to enable and process learner activities. In designing new technologies for children, researchers of human-computer interfaces (HCI) have discovered that children have unique likes, dislikes and needs that are often different from those of adults. In addition to that, it is important to know how interactive multimedia elements are used in teaching and learning mathematics.

One of the most important issues in designing course material concerns how to transfer the course contents to students via a combination of text, graphics, sound and animation. The use of multi-sensing communication can lead to better learning results, increasing the motivation for students to learn, achieving larger volumes of knowledge transfer and more attractive ways of presenting educational content.

Stemler mentioned that 'educators should have access to appropriate ways to design software packages that will take advantage of multimedia capabilities without losing the focus on the user's needs or the content being presented' (Stemler, 1997).

A multi-billion-dollar industry exists all around the world producing children's video games (Herz, 1997; Jones, 2003). From an early age children spend a significant amount of their daily time on those video games. Providing education through those games can then be very effective and useful. Educators and possibly game developers need to find smart ways of mixing entertainment

with education where students at early ages usually see education methods as 'boring' in comparison with those video games that they like. Researchers who worked in this area tried to see the factors that make video games important and interesting to kids. Of course, features, tools and gadgets are important elements. However, children also pointed to the social factors that make those games popular, whether through playing those games together or sharing their experience with those games in their social activities at school or outside. Similar to the recognition that researchers can get for significant publications and that players can get for good scores, children are looking to be recognised by their friends on their exceptional games achievements. They use this to trigger most of their dialogues at meetings.

In other reports, children seem to be 'hiding' or 'running' away by spending time on those games in the absence of family activities or in order to avoid their families.

Some researchers summarise the 'skills' that some rich video games may provide for children. They include: possible complex learning; thinking; social practice; achievement; communication; collaboration; and fantasy. Of course, this is not to say that those games provide only benefits. Most agree that many games promote violence and addiction and consume a considerable amount of children's time, as well as causing them possible health problems related to their sight and their bodies.

Many research papers also had a different definition of the word 'game' given the rich and wide spectrum they can currently include. They also argue about whether entertainment and fun are core elements in this definition, and if so, how this can be applied to educational games. According to Salen and Zimmerman (2004), 'a game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome'. This definition gave four major features that comprise a game: system, rules, artificial conflict, and quantifiable outcome. Several research papers discussed the benefits of using 'academic games' in education. Learning should occur as a part of participation in rich contexts through which the science information and content takes on meaning. As such, it is this sort of engaged participation that also makes learning through games an attractive pedagogical shift. Barab et al proposed an ontology for the core tensions to consider in the academic play space (Barab et al, 2009). The percentage of each core participant may vary from one game to another, based on the type of audience, the goals of the game and its people's target age, level of knowledge, etc.

Figure 1. Core tensions in an academic play space (Barab et al, 2009).

Purpose of the Study

This study aims at:

1. Finding the differences (if any) in achievements of first-grade children in arithmetic, between those students who use the traditional learning approach and those who use the interactive multimedia approach.

2. Finding the association (if any) between the gender of first-grade children and their levels of achievement in arithmetic by using the traditional learning approach and the interactive multimedia approach.
3. Identifying the strengths and weaknesses in both the traditional and the newly proposed systems.

Problems with the Traditional Education System

This section discusses some problems with the current traditional educational system in Jordan. Those problems may not always be true. They are also related to the proposed enhancements and do not focus on other issues, such as the international quality standards for educational systems.

Enhanced methods of learning extend the learning experience beyond the traditional physical boundaries of the school. Teachers and students can securely access the system from any Internet-enabled location. This can be achieved using a range of different devices, such as desktops, laptops, handhelds, wireless phones, etc. Elimination of physical boundaries has many benefits. For example, the student learning experience can be achieved from home and is no longer limited by physical or actual presence in the school. This means that parents can be actively involved in the educational process through online visibility of student accomplishment and greater involvement in the support of specific educational needs. External educators or experts can be invited to deliver talks and presentations using web-conferencing technologies; and teachers can share learning resources and build upon other external resources to enrich the process of creating educational content.

A major problem with the current educational system in Jordan and many other countries in the region is the large number of students per classes. This problem arises as a large percentage of the population in these countries is usually young or at the age of attending school or university. Most people in this age category prefer to join higher education institutions, which is likely to increase the pressure on class size and instructors. Large classes may cause several problems for the instructors. They are usually harder to control. It is not easy for the instructor to ensure that all students are concentrating on the course material. It is not easy also for students of large classes to focus, especially where teaching traditional using the board or through directly listening to the instructor. It will take more time from instructors to monitor attendance. Instructors will also have a hard time dealing with students on an individual basis and interacting with them, answering their queries or evaluating their understanding.

Large classes imposed a further headache on the instructor in terms of managing his/her exams. Another problem with the large size concerns the instructor's ability to write and correct exams. Large classes may decrease chances to give quizzes, assignments and any extra work – instructors will hardly even have time to grade the main exams.

Current traditional educational systems are also incapable of dealing with students with special needs and disabilities. Students who have visual or hearing problems may not be able to see or hear the class material well, especially when the class size is large.

In the age of information evolution, students are equipped with cell phones, laptops with wireless Internet and probably some other high-tech gadgets. It is sometimes boring and uninteresting to present the course material to them on a board or through direct rehearsal (i.e. where the instructor reads from a book or slides). The educational system may need to utilise and compete with the new information and communication technologies and benefit from them. There are lots of possibilities for such utilisation, such as using simulation and animation to present some of the complex boring problems in a more appealing format. Such techniques are particularly useful for teaching children in primary schools at a young age.

Rural areas usually face the problem of shortages in the number of teachers in their schools. Usually teachers may not be willing to teach in rural areas. Traditional educational systems may not provide a solution to this problem, but new technologies can be helpful by recording different teacher courses or by using an e-learning system.

Acknowledging and dealing with those new technologies can help educators develop skills in children for a future that is different from the present. Educators, especially for children at young ages, should be proactive in their teaching methods and should help prepare those youngsters for a

different future. In Australia, for example, the Department of Education focused on such elements in its periodical publications. In one of those in 2003, it mentioned that educators should prepare children to 'think flexibly and creatively and to manage their learning throughout life'. It continued: 'the ability to apply knowledge to new situations and make informed choices and decisions will be of paramount importance'.

Methodology and Case Study

The population of the study consists of all first-grade children enrolled at Yarmouk University Model School. The first-grade students were divided randomly into two sections (e.g. groups). The researchers designed and developed a multimedia program that covered two topics from the class mathematics curriculum (according to the Ministry of Education's curriculum and guidelines). Table I shows the research procedures adopted in this experiment.

Study sample and activities		Traditional	Multimedia	No. of students/group
Day 1	Topic 1	Group 1	Group 2	122
	(Half)	60 students	62 students	
Day 2	Topic 2	Group 2	Group 1	123
	(Quarter)	62 students	61 students	
		122	123	

Table I. Experiment implementation procedure.

As can be noticed from Table I, the research consists of two steps. In the first step, the first group was taught by using a traditional approach, whereas the second group was taught the same materials as the first group by using the newly developed multimedia program. Each group was given a test. The first was subjected to a traditional text-based quiz, while the second group was given a computer-based quiz. In the second step of the research procedure the two approaches were reversed.

Methods and Procedures

In designing the tool used in the present research the following procedure were utilised:

1. An interactive multimedia program was built to cover one of the main topics (fractions principles) in mathematics for Grade 1 students that are usually covered in the textbook adopted by the Ministry of Education. This program was developed by using Adobe Flash CS3 as an authoring tool.
2. Different multimedia elements were used to deliver the needed information (text, images, sound and animation) with interactive and retroactive (feedback) features implemented within a user-friendly interface.
3. The students were allowed to interact with the interactive multimedia lesson for a maximum of 30 minutes, followed by a computerised short test. A traditional test was executed before using the multimedia program. Before both tests, students learn the basic math skills through traditional methods of teaching.

Screen Design Feature

The interactive multimedia program was designed and implemented by integrating different multimedia elements. Special attention was given to the interactivity 'user control', vivid colours, animation and using a common cartoon characters usually kids like to make it more attractive and different from the traditional way.

- *Main Screen*: it can be seen in Figure 2 that the main screen contains buttons that are linked to the basic components of the selected material. These buttons were designed by using a combination of different elements. Figure 2 shows the main user interface for the program developed.

- *Text*: a clear and easy-to-read font size and style was utilised. Bailey and Milheim (1991) suggested that no more than two or three types and sizes of fonts be used per screen. Garner adds that one font per screen be used unless certain material needs to be emphasised. In this case, varying the size and font of text can be used to attract attention (Gamer, 1991).
- *Graphics*: As shown in Figure 2, two of the most popular cartoon characters that children know and admire (i.e. Tom & Jerry) are associated with simple drawings to represent the topic.
- *Sound*: A child's voice was attached to the main buttons. When the child rolls over any of these buttons, he/she will hear the title of the button.
- *Animation*: in addition to the sound attached to each button, the button became a little bit larger when the child rolled over it.

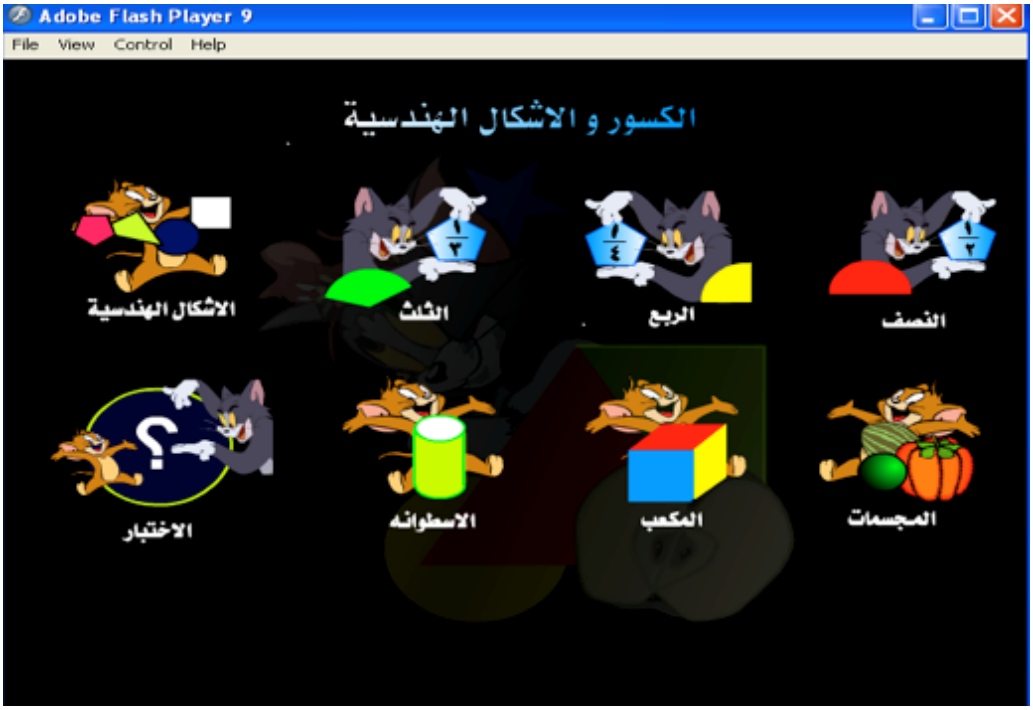

Figure 2. The main user interface for the developed program.

Results and Analysis

In order to evaluate the impact of using multimedia interactive educational tools for education, a case study was designed and executed on two classes from Yarmouk University model school. Each group was further divided into two groups. The same educational material, which was about teaching basic math skills, was taught through a traditional educational method along with the multimedia interactive method. In order to reduce possible biases in the study, classes were selected without any rearrangement or reordering of the students in the four classes selected for the studies (two classes for each method). At the end of the educational session, a simple math exam was conducted on the two teams. Table II shows the summary of the results for the average student grade (out of 10), comparing the multimedia and traditional results. The correlation between the results of the two tests was calculated and came out to be +0.29.

As shown in Table II, the computer-based group using interactive multimedia significantly outperformed the traditional group as measured by the test scores. The results show a positive impact of using multimedia interactive tool for teaching elementary education. This is shown in both averages of multimedia teaching relative to traditional teaching. Table III shows the gender-based distribution of results, which indicates an insignificant difference of results based on gender. Tables III and IV show that there are no significant differences between the means of males and females in the two approaches.

	Multimedia	Traditional
No. of Students	123	122
Mean	8.47	8.05
Std. Deviation	2.06	1.41

Table II. Comparison of average scores between multimedia and traditional.

Traditional approach			
Gender	*n*	Mean	Sig.
Male	68	8.132	0.512
Female	54	7.963	

Table III. Gender-based results distribution using traditional approach.

Interactive multimedia approach			
Gender	*n*	Mean	Sig.
Male	72	8.375	0.557
Female	51	8.600	

Table IV. Gender-based results distribution using multimedia approach.

Several papers have tried to evaluate the effect of using multimedia interactive tools on enhancing children's learning, particularly in math skills. Rauscher has done a review of meta analyses showing that studying music has positive effects on math and reading skills (Rauscher, 2003). These students were also compared with students who studied English on the computer and who did the math puzzles. The results showed that students who actually studied the piano scored better than the students who merely listened to music or did not have music training.

Van Luit and Naglieri (1999) showed that the use of the self-instruction programs usually produces better results than use of the general instruction program. Furthermore, the results of children with learning disabilities showed that they were more significantly improved in the experimental group when they used effective problem-solving strategies on non-trained tasks.

Whizz Education (2009) evaluated the effect of a program designed to improve math skills in students in the fourth grade. The results showed improvement on some math skills, such as multiplication and division, over other math skills, such as learning fractions.

This is a clear indication is that interactive learning is not a silver-bullet solution for all possible education weaknesses. The results of a study involving use of Math-Whizz software in the UK on a class of 26 children showed improvement in math skills after using this interactive program (Math-Whizz, 2009). The study was applied over a period of one and a half school terms.

Ainley and Pratt (2005) evaluated students of different grades in terms of their ability to solve proportional word problems. The results showed that they only acquired skills to calculate proportions and solve proportional problems. The proportionality scheme became so prominent in students' minds that they also began to transfer it to settings where it was neither relevant nor valid. Adamo-Villani and Wilbur (2008) proposed a methodology to help students with disabilities in learning math skills. The results showed that deaf children generally took longer to accomplish various tasks in comparison to hearing children. Results showed that, on average, girls took more time in performing tasks relative to boys.

Table V shows a summary evaluation of a similar research project from Joenathan et al (2005). The results showed somewhat similar improvements to those demonstrated in this article. Joenathan et al (2005) provided a unified geometrical and mathematical presentation of spectrometers that facilitate the learning process and the retention of the physics behind spectrometry.

Score above this percentile	Pre-class questionnaire Number of students (total = 8)	Post-class questionnaire Number of students (total = 7)
90%	0	0
80%	0	0
70%	1	2
60%	0	3
< 60%	7	2
	Pre-class	Post-class
Average	40.6%	60.7%
Standard deviation	18%	10.4%

Table V. Results summary from article (Joenathan et al, 2005).

Study Risks and Assumptions

In traditional methods of teaching, the computer, games, programs and multimedia have little or no role to play. These days, those are elements that exist in the environment around us everywhere. Those elements enable students to experience a new range of skills and ideas that it was not possible to experience using traditional methods of teaching. They can also facilitate project-based working, enabling students to collaborate in the exploration of related learning content to complete assignments whilst communicating with teachers or other students.

While the intention in this research is not to produce propaganda against traditional methods of teaching, of course new techniques and applications in ICT should be used as enhancers and facilitators for improving traditional methods of teaching. Many may also argue that the evaluation process may not be fair and that in introducing this different method of teaching we may focus intentionally or unintentionally on the group that was taught using this enhanced method relative to students who were taught the subject using the traditional method. The general approach adopted in this study, similar to many research projects and papers that promote enhance methods of education, is that the use of those enhanced methods needed to occur within the context of the continued use of traditional early childhood educational methods.

In addition, several educators appear to have major concerns regarding the amount of time that children spend using computers, with the fear that once children start to use them they will not want to experience traditional play materials, and will only want to play computer games, acquiring some sort of addiction. In reality, without introducing educational games, many children are already spending a significant amount of their time playing games on computers or other ICT equipment such as PlayStation, Xbox, Wii, etc.

Many opponents of enhanced methods of teaching argue that using those interactive methods of teaching may transiently improve children's knowledge or skills and that such skills may not be mature or stable in comparison with those acquired through traditional methods of teaching. Opponents also argue that supporters of new methods ignore the serious drawbacks of those methods, particularly citing games that promote violence or that are addictive and time consuming. Further, if the Internet is involved in those methods, the risks that those children may be accidently exposed to pornography or improper websites can be serious and catastrophic.

Opponents of new methods may also argue that comparison and competition is not fair and balanced, especially when it comes to young children, to whom graphics and animation can be overwhelmingly attractive relative to black and white colours in traditional boards (even coloured markers may not be as impressive compared with flashy pictures and animation). This may come at the risk that anything below 'mind-blowing' on a graphical scale has the chance of being ignored or written off by some students. As such, it may be helpful to use those methods as supplements to traditional methods rather than as alternatives.

Educators will be concerned with the time and difficulty that might be involved in integrating games into their curricula. However, we believe that it is possible to use interactive and enhanced methods such as gaming technology in the classroom and that they will have a positive impact on students' ability to acquire knowledge.

Experiment and Study Implications

In this experiment, we started with an assumption that video games, multimedia and animation pedagogies and technologies produce a considerable potential for science education. In particular, they can help in introducing or simplifying some of the complex concepts, and this can facilitate understanding of such systems. The work described here suggests that it is possible to develop games or programs that are both entertaining and educationally useful. In general, schools and the educational system have had difficulty engaging children in the process of learning for reasons that go beyond the need to educate them to score highly on tests, with research revealing a significant decline in academic motivation, especially for children at young ages. Despite the fact that some of the reasons that cause such lack of motivation in children in their middle years at school are external and may not be controlled by the educational system, a failure in the educational system to inject motivators for these young children may expand if educators insist that traditional methods of education should never be replaced or enhanced by new methods and techniques. It is important to find methods and programs that can provide a significant percentage of information to students using programs, games, media flash, etc. In this simple demonstration, we tried to prove that it is possible to mix education with entertainment.

As educators, we have a core responsibility to support students in understanding particular facts, concepts and principles. However, balancing gaming or entertainment elements with educational or pedagogical goals is a challenging task where those program or game designers need to compromise between those two elements - a process that is not always simple and straightforward. While games in education are not introduced for pure entertainment, however, 'swallowing' information without those motivators being present may not be always possible. Therefore, we need to make sure that any structure we give them allows the students to learn and reflect without being too prearranged an experience. We should try to accomplish this fragile balance by using some recent developments in ICT and e-learning technology, as well as referencing more traditional learning techniques and theory.

Conclusion and Future Work

The usage of games and enhanced methods of education has been the focus of many recent education-related research papers and studies. In this study, a small math program was developed for young students to evaluate the impact of interactive learning on students' abilities to improve their learning skills. In synchronisation with several similar studies, the results showed that those methods can be especially effective for youngsters, where they can be motivated by graphics and animation, particularly when known cartoon characters are used in those educational games.

As explained in the article, however, and despite the fact that the results showed improvements in students' learning skills, this is not a proposal for the replacement of traditional education. Rather, interactive enhanced learning can provide a very useful alternative to traditional education, especially in cases where it is not applicable to teach through traditional methods.

In future, a field study will be conducted on students of schools in Jordan to assess the effectiveness of using multimedia interactive systems with larger study or experimental groups. In order to be able to generalise the outcome results, different game applications will be used and applied to different subjects or fields of knowledge. In order also to reduce possible bias in the results, groups of both students and educators will be selected randomly. Future studies should also include studying some other factors, particularly possible drawbacks of using those educational games on students.

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