Educational Robotics in Teaching Learning Process

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Abstract

ICT is perceived as a significant component of the teaching and learning process in classrooms. The utilisation of multimedia tools in education has become familiar with the fast development of technology in the 21st century. We can see a high potential particularly in technical tools which will develop thinking, imagination and creativity of pupils. There is a need of implementing selected activities through specific technological tool. In the light of this view, our interest focuses on the use of educational robotics in teaching learning process. This is one of the ways to attract future generations towards technology and higher levels of education and thinking. Despite their applications in engineering, robots are being used by teachers in schools. Several colleges today have a long lasting belief of involving students in robotic experiments and competitions - events where robots have to accomplish a given task. This paper deals with the possibilities of introducing educational robotics into teaching learning process that would lead to an understanding of how teachers engage in, learn about, and use robotics for teaching.

KEYWORDS: ICT, Educational robotics, Teaching, Learning

Introduction

In the past, educational goals reflected the emphasis of society on the need for basic skills such as reading, writing and arithmetic and an agreed on the body of information considered necessary for everyone. Many educators now accept that the world is changing too quickly to define education regarding specific knowledge or skills; they believe it should focus instead on more general capabilities such as learning to learn skills, which will help citizens cope with inevitable technological change. Everyone seems to agree that changes in our educational methods are needed to respond to new challenges. Though technology has used in education and training for decades, it has mostly been used as an aid to supplement traditional classroom learning or to support distance learning programs. With the growing acceptance of ICT, it is possible to evolve innovative ways of teaching and learning that complement face to face teaching. Globally, Information and Communication Technology (ICT) options are being explored to improve the quality of education and training initiatives and to enhance their reach. ICT offers an unusual choice of tools and evolving digital technologies. Its use has stimulated discussion and debate on the policy, planning and implementation of education and training programs.

Acquiring information has always been a prefacing factor towards gaining knowledge. However, supporting the transformation of information to knowledge are teaching-learning frameworks guiding educators that enable them to lead students towards academic success. Depending upon the physical or virtual space used to accommodate teaching and learning, consideration of the attributes and affordances these areas offer narrows the framework options from which to build and execute learning processes. Nowadays educators tend to think of educational or instructional technology as devices or equipment particularly the more modern digital devices such as computers, cell phones, and i-Pads. But, as educational technology historian Saettler (1990) quoted, educational technology is not unfamiliar at all, and it is by no means limited to the use of devices. Modern tools and techniques are simply the latest developments in a field that some believe as old as education itself.

Educators may not be able to predict the future of educational technology, but they know that it will be different from the present; that is, they must anticipate and accept the inevitability of change and the need for a continual investment of their time. Educational practice tends to move in cycles and new methods often are old ways in a new guise. The advancement of digital technologies and supporting infrastructure could portend the beginning of a ‘digital age.'

Digital technologies permeated in our routine activities; whether we are at school, at work, and during our personal engagement. Innovative technologies may have conceded powerful, transformative tools which are inquiring on our quality of lives (Fullan 2013). In a knowledge construction setting, technology becomes a means that supports students access information, communicate information and cooperate with others (Warren et al., 2008; Fullan and Smith 1999). Technology-rich environments have not only positive effects on achievement of students in all areas (Butler 2008; Sivin-Kachala 1998) but also create new ways for developing student's social interaction skills, creativity, social and cognitive development (Gee 2008; Kazakoff, Sullivan and Bers 2013). Technologies also encourage teamwork and collaboration among students and create more democratic, collective and participatory spaces (Davis, Sumara and Luce-Kapler 2008). Although access to technologies and electronic resources has improved dramatically in these last few decades, students from tender age are attaining digital skills and expertise in media and information communication technologies (ICT). As a matter of fact, ICT has enhanced the ways of accessing knowledge, researching, communicating, socializing and succeeding at all levels of education. (Hoskins and Crick 2010; Smith et al.,2005). It may be prudent for NCTE to make certain that ICT training is constantly being presented as a necessary component in all initial teacher education programs. Possibly, having high access as well as positive attitudes among educators in schools and colleges does not essentially promise the successful engagement of technologies in education. The use of digital learning resources needs on-going support not only technical but also pedagogical (Fullan 2013). The experienced teachers are proficient in making the best practice of poor ICT learning environments (Burns 2013).

A recent innovation in technology that can be used for educational purposes are the Educational robotics, byproviding learning environment in which people involve in the design and construction of robot creations. It includes educational activities that upkeep and strengthen specific areas of knowledge and skills developed in students through the design, creation, assembly and operations of robots. The objective of teaching robotics is to familiarize students with current production processes, with the Automation Technology which is related to the use of mechanical, electronic and computer-based, in the operation and control of the production plays a very significant role. However, robotics system is well-thought-out beyond a working application. In robotics, robot hardware and software need to have a seamless connection as robotic movements are a link between the physical and logical. Use of Educational Robotics can improve one's practical, cognitive and didactic motor skills.

This approach is proposed to motivate students towards the hard science and inspire healthy activity. Educational robotics have a positive effect on the development of student's critical thinking, problem-solving and metacognition skills and also on the learning of a programming language. It stimulates a joyful mode of learning while advancing student's motivation, collaboration, self-confidence, and creativity. However, certain researchers point out that even though robotics seems to be an excellent device for teaching and learning and a captivating topic for students of all ages, the pedagogy of teaching with robotics is still in its early stages. More research is needed to point out how to work with educational robotics to support student's scientific skills.One could also point out that robotics in education advances and supports both in curricular and in extra-curricular activities values such as creativity, innovation, support, cooperation, and teamwork. Apparently, these values must be encouraged in our society.

Educational robotics is a powerful, flexible, teaching and learning tool, inspiring students to construct and control robots using specific programming languages. The origins of educational robotics are to be found in work of Papert, an originator of Logo programming language. Papert advocates that learning is more active when students come into contact with and seeing the things for themselves. He also says that robotics activities have the remarkable potential to develop classroom teaching. Drawing on the theoretical foundations of constructionism of Papert and socio-cognitive approaches of Vygotsky, educational robotics activities support students to change themselves from passive to active learners, creating knowledge by cooperating with their peers and developing critical mental skills. Robotics has been useful in the world of the education system for over 15 years. The practice of class organization on robotics for students is represented in published works of teachers and educators of additional education. Teaching should emphasize on creating the knowledge, skills, and proficiencies and preparing the younger generation to be adequately included in the modern socio-technical systems, to proficiently sustain and advance the scientific and technological perspective of the society.

Robotics in classrooms

Using robots as an educational tool to teach children was initiated in the early 1980's where learning is achieved most effectively by constructing robotic artifacts. Children can study through the process of designing, building and programming their robots. In the foundational work at MIT media lab, Resnick and Ocko (1991) started the progress of LEGO/Logo. They integrated LEGO Technic products with the Logo programming language that enabled children to build and program robots. This learning by doing method has attained much attention in recent years.

A new robotic infrastructure is shaped resulting in global socio-cultural transformation. In the realm of education, robots are currently being used to teach math (Janssen et al.,2011), history (Park, Kim and Pobil, 2011), new languages (Saerbeck et al., 2010), and even new tasks (Looije et al., 2008). Some studies vary the type of feedback (positive, negative, neutral) (Park, Kim and Pobil, 2011) and behavioural techniques (Szafir and Utlu, 2012) given from the robot, while others vary the type of learning adaptation (Janssen et al.,2011) provided from the system. Generally speaking, students are more attracted to the robot when it exhibits positive feedback (Saerbeck et al., 2010 ; Park, Kim and Pobil, 2011), are more motivated to learn from the robot when there is personalized learning (Janssen et al., 2011), and have increased recall abilities when the robot uses appropriate behavioural techniques to re-engage (Szafir and Utlu, 2012).

Widespread interest in robotics has increased astonishingly in the last few years. Robotics is seen by many as contributing significant new benefits in education at all levels (Johnson, 2003). Educational theorists Papert (1993) believe that robotics activities have an enormous possibility to enhance classroom teaching. Although, Williams, Ma, Prejean, Lai, and Ford (2007) affirm that there is limited empirical evidence to prove the impact of robotics on the k-12 curriculum. Educators have started to generate ideas and develop activities to incorporate robotics into the teaching of various subjects including math, science, and engineering. Researchers emphasize that most of the literature on the use of robotics in education is illustrative in nature, based on reports of teachers obtaining positive outcomes with individual actions (Caci et al., 2003; Petre and Price, 2004).

Different perspective observed in the literature is that most of the applications of robotic technology in education have mainly emphasized on supporting the teaching of subjects that are closely related to the robotics field, such as robot programming, robot construction, or mechatronics. Moreover, most of the applications have been utilized the robot as an end or a passive device in the learning activity, where the robot has been built or programmed (Mitnik, Nussubaum, and Soto, 2008). Rusk et al., (2008) agree that the way robotics is currently presented in educational settings is undesirably narrow. Exploring a broader range of possible applications has the potential to engage young people with the wider area of interests. Young people who are not interested in conventional approaches to robotics become motivated when robotics activities are presented as a way to tell a story, or in connection with other disciplines and interest areas, such as music and art (Resnick, 1991; Rusk et al., 2008). Different students are attracted to different types of robotics (Resnick, 1991). Students interested in cars are expected to be driven to create motorized vehicles, while students with interests in art or music are supposed to be excited to build interactive sculptures. Rusk et al., (2008) examined the strategies for introducing students to robotics technologies and concepts and argue for the significance of implementing multiple pathways into robotics, to assure that there are entry points to engage young people with different interests and learning styles. It seems that an educational robot is a relevant tool for improving learning. However, this assertion needs to be further supported by the application of experiences and above all, through empirical evidence.

Robotics creates learning experiences for children about sensors, motors, and the digital domain. Playing with motors, gears, sensors, levers and programming loops will lead children to become engineers and as well as storytellers by designing their projects that move in response to their surroundings. Robotics can help children to learn about related mathematical concepts, the scientific method of inquiry and problem solving.

Froebel developed kindergarten in the 1800s and introduced a series of gifts to teach children about size, number and shape. Robotics also involve young children in using their hands and developing abilities. Robotics also invite children to participate in social communications and conversations while playing to learn, and learning to play (Resnick 2003). Learning how to work in the social world is an essential developmental task that young children need to achieve. Despite all of the potential advantages of robotics in education, research has shown the challenges of introducing new technologies in schools (Cuban 2001). The challenges of incorporating technology in education are higher. On the one hand, teachers are not well- prepared to understand the possibilities of new technologies. On the other hand, teachers have issues regarding the developmental suitability of introducing technology and engineering in the start of grades. Most teachers were directed to a Piagetian idea of developmental stages that advises that children enter the concrete operational stage at age six or seven. Therefore, according to Piaget, only at this age, a child obtains the capability to perform mental processes and also to modify those operations. As a result, a concrete operational child has a more complicated understanding of number, can imagine the world from views other than his or her own, can systematically analyse, sort, and classify objects, and can explain notions of time and causality (Piaget 1971).

Robotics helps students to improve skills which are difficult to learn through traditional classes but are critical scientific and engineering practices (Gura 2012). The author stated that asking questions and defining problems, planning and carrying out investigations and engaging in argument from evidence are some of the skills that are encouraged in robotics classes. He also reported that robotics not only helps students to learn and understand mathematics subjects but also contributes to promoting problem-solving and teamwork skills, thinking skills, developing and reflecting on their learning. Robotics can be applied as a tool that gives opportunities for students to engage and develop computational thinking skills. ER is being introduced as innovative learning environments, enhancing and building higher order thinking skills and abilities and helping students solve complex problems (Blauchard, Freiman and Lirrete-Pitre 2010). Furthermore, a guide instruction approach using robots facilitates teamwork, develops conceptual understanding, enhances critical thinking and promotes higher order learning (Chambers, Carbonaro and Grove 2007).

In education, the use of robots has the potential to help children develop various academic skills like science process understanding, scientific concept development and improvement of achievement scores (Barker & Ansorge, 2007; Williams et al., 2007; Highfield, 2010). Also, the introduction of robotics in the curriculum also increases children's interest in engineering. As reported in Chang et al., 2010, the use of robots in education allows children to engage in interactive and engaging learning experiences. Robots seem appropriate to use in language skill development because it allows for a richer interaction (Sugimoto, 2011; Chambers et al., 2008; Bers, 2010; Chang et al., 2010; Young et al., 2010).

The effectiveness of robots in education programme could be analyzed from different aspects: Study design in order to report meaningful and statistically significant results, robot's effects on child's behaviour and development, relevance of stakeholders' perception on using robots in and outside of classroom setting, and users' reaction (especially the children) to the robot's design.

Conclusion

As robot technologies develop, the use of robots to support teaching and learning has gained popularity. Over the past decade, researchers have provided substantial evidence that the robot is a great teaching aid for mathematics and science. Furthermore, educational robots are helpful to students in developing collaboration and problem-solving abilities. This paper discussed the potential for using robots as an instructional tool for teaching by analysing the characteristics of robots. To conclude, the roles of educational robots can be described regarding two categories: learning materials, and teaching companions. We also believe that there will be additional robot educational functions in the future, for example, using robots as communication mediators to support group learning. By interacting with the robot, the children can respond with high motivational levels. The robot can also exhibit gestures and body movements so it could be the partner with the teacher to tell stories. Robots can create an interactive and engaging learning experience. Instructors will have more time to guide weaker students when the robot is the primary focus of attention. The important factors that influence whether the robot is likely to be useful in teaching include usability and the availability of appropriate learning activities and content. Compared to other instructional tools for teaching, robots have the advantages of being able to demonstrate highly mobile behaviours and extensive repetition. However, based on current technologies, there are many challenges and limitations to the expanded use of instructional robots. Problems include lack of adequate teacher training, complicated techniques, and the inability of robots to adequately portray emotions.

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