InternationalJournalofMultidisciplinaryResearch EducationAnalysisandDevelopment–IJMREAD
Peer-Reviewed:OpenAccess

Computer Science and Education

Dr.Ruchi Tiwari, Dr. B. R. Ambedker University Agra

Abstract

Many regions around the world are experiencing a gradual paradigm shift away from computer science (CS)use that complements traditional teaching and towards embedded CS use in E-learning that is ubiquitous and pervasive. We suggest that a promising way to maximize the knowledge and impact of researching CS in education is to establish longitudinal programmatic research sustained through the establishment of E-learning. A major challenge in forming a clear and coherent strategy for researching CS in education lies in the fact that there are multiple stakeholders with differing aims, goals and objectives.

Keyword:Computer Science, Phenomenon, Complex etc.

Introduction-

This article is the outcome from (a) an earlier position paper on the current development and penetration of E-learning and the implications for research (Cox & Sakamoto, 2011); (b) development of ideas presented therein by working group members . The purpose of the article is to consider how effective pre- vious educational research results have been on influ- encing policy and practice at national and international levels, and to propose ways in which educational research into information technology CS can be con- solidated and made more accessible, thereby increasing influence on policy.Research on CS in Education has been the focus of JCAL since its establishment in the 1980s and the diverse nature of CS in different educational settings has been reflected in studies which include: specific,approaches to teaching (e.g., Passey, 2010; Voogt,2010); CS integration within the curriculum (e.g., Tondeur, Cooper, & Newhouse 2010); effects of infor- mal uses of CS on students' learning informal and informal settings (e.g., Clough, Jones, McAndrew, & Scanlon, 2008; Cox, 2013); and the digital divide (e.g., Cooper, 2006; Jones & Czerniewicz, 2010). However, rapidly changing technologies within a vast and complex field make it difficult for an established and accepted body of research evidence to become dis- persed across research communities. This also hampers practitioners and policymakers, who do not have ready access to an easily comprehensible and agreed-upon body of evidence, from developing effective imple- mentation strategies.To establish a conceptual framework for E-learning based on CS trends in society at national and interna- tional levels.To consider past and current trends in researching CS in education, building on established evidence and how best research practices can be shared across research communities.To identify ways that research can be consolidated and thereby affect policy and practice and vice versa.To articulate methods that can be used to inform policymakers and influence change in education.To provide recommendations to guide future research and to identify some of the current gaps in research that need to be addressed. Conceptual framework for E-learning.In order to identify significant trends in CS in education, and implications for research and government policies, the working group considered a conceptual framework for CS learning, which would depict the different stages of the uptake and integration of E-learning achieved by different nations, and the extent to which these were likely to affect policy and practice (Moonen, 2008).

Learning resources include the instructional leader, who is involved in the design and utilization of media and real-world activity, who creates a productive learn- ing environment that supports the learner in goal achievement. In the E-learning environment, leaders are typically designers, teachers and facilitators (see Harms, Niederhauser, Davis, Roblyer, & Gilbert, 2010). who design, develop and/or select media that, coupled with real-world experience, enhance learning activities and help learners engage in deeper, more robust learning. Learning activity provides the link between the learner and learning resources. Learners engage in activity that involves collecting and accepting knowl- edge that is grounded in the learning resources; this knowledge is transformed and reflected back to the instructional leader in the form of answers or responses that demonstrate both intellectual and affective knowl- edge gains.
The second primary component, shown in Figure 2, the learning support mechanism, includes two ele- ments: supporting activity and supporting body. These two elements show the interplay among supporting activities (high-quality training, educational services and quality assurance) and a group of supporting bodies (academic organizations, government entities and industry partners). With collaborative support- ing bodies, support mechanisms can contribute to E-learning through:Training and education that draws on best practices in leadership, instruction, instructional design, CS use, class management, and so on;Leadership and guidance from national and interna- tional agencies and professional organizations;Funding, coordination and quality monitoring;Developing and providing resources.
Through these collaborative interactions, the sup- porting bodies provide the means of support for the supporting activities, and the supporting activities propose and demand support from the supporting bodies, creating an integrated system that constitutes the learning support mechanism. Further, learning support mechanisms interact with the learning process when needs identified in the learning process serve as a request to the learning support mechanisms, and the learning support mechanisms provide support for the learning process.
Finally, R&D and educational development provide a mediating function between and among components and elements in the model. R&D and educational development include functions like accreditation of educational entities and evaluation of learning out- comes relative to both teacher training (producing effective leaders), and to the ultimate target in the system, the student learner. There is also a reciprocal relationship between R&D and educational develop- ment and learning support mechanisms. That is, R&D and educational development are inherent in manyof the learning support mechanisms described previously, and also mediate the relationships between learning support mechanisms and learning processes.This framework shows how agencies involved in research, and in policy and practice, interact in the contribution and influence of educational provision and those engaged in learning.

Researching the impact of CS in education requires us to have a clear understanding of the rela- tionships among learners and resources and studying these relationships has become increasingly challeng- ing in more informal E-learning contexts when com- pared with researching more traditional formal learning contexts. Academic and government agencies should there- fore be able to work collaboratively to identify and promote best practices through funding and conducting high-quality educational research, and by providing pre-service and in-service training for leaders, who are integral to the learning process. Furthermore, peda- gogical and curricular reform and establishment of rig- orous standards can be best accomplished when professional organizations (typically grounded in the learning process.Large-scale international studies (Voogt & Knezek, 2008) have shown

That the educational services sup- porting the learning resources shown in Figure 2 will vary across regions and countries and need active par- ticipation by supporting bodies. These, in turn, may be supported by a variety of stakeholders including: indi- viduals, teachers, academics, governments, govern- ment agencies and industry. However, such educational support/services are influenced by specific national/ regional budgets, which often also determine the level of R&D (Pelgrum & Plomp, 2008) and consequent evaluation of the effectiveness of policies and educa- tional services. Finally, quality assurance in an educational system, which involves evaluation and accreditation, is often conducted by the government agencies who deliver the educational services. This may happen directly through boards of educational examiners, or indirectly through academic researchers who are funded to investigate the impact of support services on specific competencies, competency analysis and learning technologies in their broadest sense. In order to understand how researching IT in education needs to develop and change to take account of this evolving conceptual framework, we present here a brief synthesis of trends with regard to research focus and methods, and the consequent poten- tial for influencing policy and practice.

The paradigm proposed here is that E-Learning rep- resents the true nature of future education and tradi- tional face-to-face instructional norms in universities and schools are, so to speak, exceptional practices. Put simply, the spread of E-Learning is causing a major, if somewhat, belated shift in educational philosophy. However, adopting this new paradigm will take consid- erable time, as there is a great deal of inertia in educa- tional communities that have always practiced traditional face-to-face education. Concerning the balance between formal (traditional face-to-face) and informal learning (which can be more in line with E-learning practices), these two forms are not contra- dictory concepts; rather, as seen in Figure 1, formal learning experiences should be included in informal learning opportunities as essential components of all learning activities. Various and flexible combina- tions of formal and informal learning options are necessary and required (Cox, 2013). understand- ings which can be applied effectively to education that reflects an E-Learning perspective. Although a few scholars have made direct connections between research-based traditional instructional practices and E-Learning contexts (e.g., Hacker & Niederhauser, 2000), previous research on CS in education has often overlooked the contributions which traditional instruc- tional techniques can make to students' learning within an IT environment (Cox & Marshall, 2007).

Past and Current Trends in Researching CS and Education

Past evidence from research into CS in education has shown that the effectiveness of national and interna- tional policies and strategies for integrating CS in schools and colleges has been dependent upon knowing what has influenced the uptake, impact and sustainability of CS in education, sible to policymakers. As was discussed in the previous section, in order to take account of the integration of CS across society and networked communities, policy- makers, researchers and practitioners need to recon- struct the conceptual framework of CS in education and E-learning, rethinking the potential for CS in education and the interaction between formal and informal uses. Although formal educational settings (e.g., class- rooms) are still the main priority for national policy- makers regarding policies and funding, actual IT use by many learners in developed and developing coun- tries also permeates their wider informal learning expe- riences (Cox, 2013). Across different countries and regions.

E-learning educational settings range from hi-tech classrooms with extensive resources to schools in developing countries with no CS access (Resta, 2011). Future shifts in these diverse settings will there- fore entirely change the role and contribution of CS in education and profoundly affect research agendas and methods.If we consider the types of E-learning resources available to learners, then earlier research into the impact of CS resources such as simulations and mod- eling on students' learning (Johnson, Cox, & Watson, 1994) has now been replaced by similar research inves- tigations but addressing more powerful recent tech- nologies now available in formal educational settings. For example, eight recent large-scale national Teaching and Learning Research-Technology Enhanced Learn- ing Programme (TLRP-TEL) projects in the UK (TLRP-TEL; 2007–2012) all involved the innovative development of an IT resource in an educational setting and the measurement of its impact on teaching and learning. However, the 'Media' in our conceptual framework has changed; the CS technologies used were extremely innovative, including merging video analy- sis with Web 2.0 technologies to create a semantic network, large-scale multi-touch screen table surfaces that can be used by a whole classroom, and a haptic- based virtual dental chair enabling students to practise treating virtual dental problems before working on the real patient (TLRP-TEL, 2011)The E-learning media used in education has not only changed in terms of power and applicability but in terms of accessibility. We are therefore increasingly seeing the use of small portable devices (e.g., Looi et al., 2011) and connected online learning opportunities that enable students to engage in learning activities anytime and anywhere. For example, referring to the paradigm shift discussed above, one of the most ubiquitous CS resources, which is impacting on the learner, the learn- ing resource and the support mechanisms, is the mobile (cell) phone. Recent research has shown that many children and young people in developing countries (as well as in the developed world) have access to mobile devices such as mobile phones. For example in a study in South America, 90% of 10- to 18-year-old teenagers in Argentina, Venezuela and Chile reported having a mobile device and 82% of Chilean youngsters of similar ages reported having used this technology for sending messages (Fundación telefónica, 2008). This is an example in which researchers may need to account for the impact which this kind of activity (e.g., text messag- ing) might have on young persons' formal or informal learning and how findings in this context compare with research carried out in developed countries. reported having a mobile device and 82% of Chilean youngsters of similar ages reported having used this technology for sending messages (Fundación telefónica, 2008). This is an example in which researchers may need to account for the impact which this kind of activity (e.g., text messag- ing) might have on young persons' formal or informal learning and how findings in this context compare with research carried out in developed countries. The relationship between the teacher and the media will directly determine the effec- tiveness of E-learning on the learning process. Further-more, the effects of the learning support mechanisms, that is, the training of teachers (Voogt, 2010) and col-laboration among teachers (De Koster, Kulpert, & Volman, 2012), are also important influences of the impact of IT in education on the learning process.In spite of 50 years of researching the effects of CS in education and how these are changing the ways in which students learn, and where that learning occurs, there While we have attempted to be clear in our use of terminology here, what often limits the value of research evidence is that the actual CS resource being investigated is either not clearly specified or not under- stood by the researchers themselves (Cox & Marshall, 2007). Although defining the lexicon for CS in educa- tion is well beyond the scope of this article, our expe- rience with discussing key issues within the working group clearly pointed out the need for clarification of the terms we use. This lack of shared, agreed-upon conventions within the methods and practices we use.

Previous research in E-learning shows that some research methods ignore the learning conditions which might promote changes in cognitive structures and, therefore, how the CS environment will impact the learner (Marshall & Cox, 2008) new ways of reasoning and hypothesizing about existing and newly developed knowledge. There- fore, measuring the effect of CS on students' learning needs to address student literacy in the CS medium as well as learning outcomes related to the aims of the curriculum. As evidenced in JCAL and discussed in detail in the International Handbook of CS in Primary and Second- ary Education (Cox, 2008), research methodologies can be broadly classified as quantitative, typically involving surveys or experimental studies that include statistical analyses, or qualitative, such as case studies, or those involving collection and analysis of observa- tional or interview data (Marshall & Cox, 2008). . They used the technology itself to play a major role in data collection, having the children regularly save drafts of their multimedia narratives as they developed them. These files then provided data, along with post-lesson interviews and the researcher's log of observations for analysis of the processes of development of the narratives. Jones (2010) argues against the use of experimental methods in classroom-based research because there are so many different variables at play that one can only focus on a few, losing the value of the meth- odological approach by attempting to keep some nec- essarily limited subset of factors constant while examining the variable of interest. His solution to this problem for educational CS research draws on the pio- neering work of Clarke, Emanuelsson, Jablonka, and Mok (2006) who used multiple-camera video data collection and analysis, enabling case study-like approaches to be used in research into interactions within classrooms. Research studies of specific uses of modern CS com- munications are examples of many studies that show the lack of agreement among researchers about the reliability and effectiveness of different research methods, and hence outcomes, which may explain why policymakers often find it difficult to draw any clear conclusions from the published research which can inform policy and future funding strategies. Many still believe that main- stream education must be school based using tradi- tional face-to-face lessons as a matter of course. E-Learning is, at most, seen as one of many tools that support classroom lessons (Cox & Sakamoto, 2011; Passey, 2010). In the past, lack of advanced communi- cation networks meant, aside from distance education by post, traditional face-to-face lessons were the only teaching and learning method available. This is still the case in many classrooms around the world (Resta, Searson, Patru, Knezek, & Voogt, 2012). For this reason, the traditional face-to-face lesson was consid- ered the bedrock of education, a belief which has now been rocked by the advent of E-Learning and the impact of CS on society as a whole. This is resulting in new challenges for educational research and the use of appropriate methodologies which include:The analysis and enhancement of network-related competencies.Evaluating E-learning experienced through computer-supported collaborative learning.Measuring network-related support and collaboration.R&D of E-educational methodology, E-competency analysis, E-assessment, accreditation,E-portfolios, and so on.

This range of interrelated factors identified from the development of this conceptual framework and emerg- ing from unanswered questions in previous research (Cox & Marshall, 2007), shows that researching CS in

education will increasingly require a range of research expertise. In order to devise appropriate studies that take account of the complexity of the technology itself, the impact of a range of psychological and sociological factors, and the impact across different subjects and contexts, research teams will need to have diverse dis- cipline expertise as is often the case with scientific and health sciences research. The digital divide Opportunities to participate in the digital culture, including access to E-learning between developing and developed countries, or within regions (in some coun- tries), can show large differences. However, our research agenda for examining the digital divide needs to be updated to include attitudes, culture, abilities, cognition and literacy. Although there is clearly a divide between the haves and the have-nots, there are clear cultural and individual differences and interpre- tations concerning the value and use of technology, as well as a divide in utilization and productive applica- tion of CS for learning even among those who have CS skills. Researchers and policymakers need to consider what communities can and are doing to overcome digital divides, and respect differing learning cultures related to digital resources. It is often impossible to distinguish between global and regional uses of E-learning or how policy-based solutions might improve its use.There is a lack of homogeneity in different research contexts: countries, regions, communities and classrooms.For example, for many years students have contin- ued their learning outside of formal school settings without access to CS. If we use ‘digital divide’ (as defined earlier) as some having and using access to IT in education and some not, evidence suggests that there is also a digital divide among students in the same school due to uneven availability of resources, different levels of CS literacy skills among students, and different abilities and pedagogical content knowledge of teach- ers to use CS (Plomp, Andersen, Law, & Quale, 2009). Therefore, it can be misleading to assume that there is consistent use even within a particular region of the world or a specific school. The digital divide, in terms of CS access and skills between developed and developing countries, requires diverse approaches to researching CS at the learner, institution, national and global levels. For example, does the same CS resource used in a secondary science classroom in which most pupils have mobile phones have the same impact on the students’ learning as in one where electricity supplies are intermittent and a mobile phone costs as much as a teacher’s annual salary? These questions raise issues about the types and approaches to research that we can adopt and rely on in the future, and limitations to research approaches and methods that have been used in the past. We therefore propose replacing the use of ‘digital divide’ with ‘digital differences’ which more accurately represents the range of CS resources and use across different con- texts, regions and countries. Roles Among Researchers singly or in teams, or by government or international agencies commissioned to conduct specific investiga- tions. In many other areas of research, governments have recognized the need to help researchers collabo- rate and consolidate previous methodological approaches and findings, and to support the wider research community (e.g., the recently established UK Innovation Research Centre, set up to host a strategic research and capacity building programme together with a knowledge exchange hub; and the Swiss National Centres of Competence in Research to promote long-term research projects in areas of vital strategic importance for the development of science in Switzerland).In order to enable CS education researchers and poli- cymakers to improve

using technology. Computers & Education, 51(3), upon past methods and evidence, an international centre would facilitate the sharing of methods, data and research expertise across regions and countries as is achieved in other research sectors. One research centre model, which has been success- fully used in the field of astronomy over many years, is the scientific observatory, for example, The Royal Greenwich Observatory, founded in 1675, which has enabled storage and consolidation of an international body of knowledge and allowed researchers from many nations to collaborate. A major challenge in forming a clear and coherent strategy for researching CS in education lies in the fact that there are multiple stakeholders with differing aims, goals and objectives. Some of the myriad relationships among stakeholders, included in the conceptual frame- works above, are represented in Figure 3. The central triangle shows elements that are foundational to sup- porting relationships among practitioners, researchers and policymakers. One key to success involves coop- eration and collaboration among stakeholders. In many cases, stakeholders have seemed to be at odds with each other, with policymakers viewed as imposing mandates and regulations on practitioners, practitioners viewing researchers' work as too theoretical and removed from the real world of teachers, and research- ers questioning the effectiveness of teaching practices and challenging the wisdom of mandated policies.Arrayed around the ring of Figure 3 above are the stakeholders: practitioners, policymakers and researchers; some key concepts that link the stakehold- ers: mandates and initiatives, applied research, and funding and support; and some concrete ways that stakeholders and key concepts interact with each other. For example, applied research provides

Conclusion-

As we are becoming an increasingly connected (but in many ways still divided) international community, researching CS in education faces specific issues and unresolved questions that go well beyond oversimpli- fied conceptualizations of challenges like the digital divide issue discussed above. In this final section, we reflect on what we conclude as the key issues from previous evidence interpreted in relation to the para- digm shift explained through the conceptual frame- work for E-learning.The paradigm shift required in schools to account for the pervasiveness of CS in society, which has resulted in a local and global networked society, shows that for a research agenda to address the interrelationships among the different stakeholders in formal and infor- mal educational settings, research teams will need to have diverse discipline expertise, perhaps accom- plished through forming interdisciplinary teams. The review of past research, and the changing types of methods used, has shown that current methodologies will no longer cover the complex factors that impinge upon the teacher and the learner as CSresources impact both formal and informal education. CS provides new knowledge representations that are dynamic and unsta- ble as the technology evolves.

References-

1. Amory, A., & Mars, M. (1994). Evaluation of the efficacy of multi-media learning: Project development and strategies. In P. Alexander (Ed.), Conference proceedings of the International Alessi, S. M., & Trollop, S. R. (1991). Computer-based instruction: Methods and development (pp. 483–489).
2. New Jersey: Prentice Hall. Al-Fudail, M., & Mellar, H. (2008). Investigating teacher stress when Conference on Computer-assisted Education and Training in Developing Countries (pp. 1–6).

3. Midrand. Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: Identification of appropriate game types and game elements. British Journal of Educational Technology, 30(4), 311–321. doi:10.1111/1467-8535.00121
4. Wittrock, M. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Longman Publishers.
5. Anderson, P. (2007). What is Web 2.0? Ideas, technologies and implications for education. JISC Technology & Standards Watch, February 2, 1–64. Retrieved from http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf
6. Andrew, L. (2007). Comparison of teacher educators' instructional methods with the constructivist ideal. The Teacher Educator, 42(3), 157–184. Retrieved from http://dx.doi.org/10.1080/08878730709555401
7. Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). Computers & Education, 52(1), 154–168. doi:10.1016/j.compedu.2008.07.006
8. J., Amory, A., Graham-Jolly, M., & Indoshi, F. C. (2010). Visualization skills and their incorporation in biology curriculum. Educational Research and Reviews, 5(6), 282–291.
9. Ottevanger, W. (2002). Teacher support materials as a catalyst for science curriculum implementation in Namibia. In C. Malcolm & C. Lubisi (Eds.), Proceedings of the 10th Annual Conference of the Southern African Association for Research in Mathematics, Science and Technology Education (pp. 313–320). Durban.
10. Oud, J. (2009). Guidelines for effective online instruction using multimedia screencasts. Reference Services Review, 37(2). doi:10.1108/00907320910957206 Ozok, A. A., & Salvendy, G. (2004). Twenty guidelines for the design of Web-based interfaces with consistent language. Computers in Human Behavior, 20(2), 149–161.

****