TECHNOLOGY TRENDS IN MOBILE COMPUTER SUPPORTED COLLABORATIVE LEARNING IN ELEMENTARY EDUCATION FROM 2009 TO 2014

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ABSTRACT

This paper analyses mobile computer supported collaborative learning in elementary education worldwide focusing on technology trends for the period from 2009 to 2014. The results present representation of device types used to support collaborative activities, their distribution per users (1:1 or 1:m) and if students are learning through or around the technology. The major findings show that in the last five years tablet computers and small handheld devices are used nearly with equal frequency as mobile learning devices, mostly in 1:1 distribution simultaneously being an instrument through which collaborative activities are performed.

KEYWORDS

Mobile learning, collaborative learning, elementary education

1. INTRODUCTION

The purpose of this analysis was to point out the recent trends in mobile computer supported collaborative learning (mCSCL) as well as the role of technology in mCSCL throughout the last five years, from 2009 to 2014, focusing on elementary education worldwide. Although there are several different definitions of mCSCL depending on the context in which it is used, the authors of the paper adopted definition in which mCSCL includes usage of mobile devices as tools for in-classroom and out-of-classroom teaching and collaborative learning (Zurita & Nussbaum, 2004) where, as defined by Dillenbourg (Dillenbourg, 1999), collaborative learning is "a situation in which two or more people learn or attempt to learn something together".

The paper is organised as follows: Section 2 presents research methodology carried out in order to gather data relevant for the analysis. Section 3 discusses the results, while Section 4 points out the major findings.

2. RESEARCH METHODOLOGY

Three research questions were defined in order to analyse recent technology trends in mobile computer supported collaborative learning in elementary education worldwide: 1) What types of mobile devices are used in collaborative activities?, 2) What is the distribution of devices per users (1:1 or 1:m)?, and 3) Do students collaborate around the devices or through them?.

23 papers in total were selected as relevant for this research as a result of online databases search carried out in October and November 2014. The databases searched were: ACM Digital Library, ERIC, IEEE Xplore and Science Direct. The summary of selected papers is presented in the Table 1.

Table 1. Summary of selected papers

Authors	**Paper description**	**Devices used**
(Lan, Sung, & Chang, 2009)	This study attempts to implement a cooperative reading environment for EFL early reading using a mobile-device-supported computer-assisted reciprocal early English reading (CAREER) system.	Tablet computer
(Nussbaum et al., 2009)	This paper reports on the design of a digital system that aims to support the practice of face-to-face collaboration on open ended tasks.	Handheld device
(W. Chen, Looi, & Tan, 2009)	This paper analyses the role of different communication modes in students' collaborative learning.	Tablet computer
(Hung, Young, & Lin, 2009)	This study is aimed to develop a face-to-face collaborative English vocabulary acquisition game system on portable devices, called Wireless Crossword Fan-Tan Game (WiCFG).	Tablet computer
(Lin, Wong, Shao, Niramitranon, & Tong, 2010)	The paper investigates the effects of collaborative concept mapping of a 1:1 digital learning environment, comparing with a 1:m environment in terms of students' overall learning gains, knowledge retention and quality of the concept maps.	Tablet computer
(W. Chen, Looi, & Tan, 2010)	This exploratory study analyses how students use different communication modes to share information, negotiate meaning and construct knowledge in the process of doing a group learning activity.	Tablet computer
(Looi, Chen, & Ng, 2010)	This paper describes the findings of an exploratory cycle of a design-based research project and examines the learning effectiveness of collaborative activities that are supported by the GroupScribbles.	Tablet computer
(Guerrero, Ochoa, & Collazos, 2010)	This paper presents the design of a Collaborative Learning activity and the corresponding mobile software tool developed to support teaching grammar to primary education students.	Handheld device Personal computer
(Roschelle, Rafanan, Estrella, Nussbaum, & Claro, 2010)	The paper investigates whether an existing face-to-face CSCL tool from Chile called Eduinnova might serve as the basis of an effective CSCL practice in U.S. primary school classrooms.	Handheld device
(Sánchez & Olivares, 2011)	The paper presents the results obtained with the implementation of a series of learning activities based on Mobile Serious Games (MSGs) for the development of problem solving and collaborative skills.	Tablet computer
(Chang, Chen, & Hsu, 2011)	This paper demonstrates the impact of different teaching strategies on the learning performance of environmental education. The major contribution of this study is the introduction of WebQuest into the outdoor instruction.	Handheld device Personal computer
(Hwang, Chu, Lin, & Tsai, 2011)	In this study, a grid-based knowledge acquisition approach is proposed and a Mindtool is developed to help students organize and share knowledge for differentiating a set of learning targets based on what they have observed in the field.	Handheld device
(Wong, Boticki, Sun, & Looi, 2011)	This paper narrates researchers' journey of conceptualizing, prototyping, implementing trials, reflecting, refining, and doing the design formalization of Chinese-PP – a mCSCL solution for Chinese character learning.	Handheld device
(Pemberton & Winter, 2011)	The paper reports the results of an empirical evaluation of the learning experience with Invisible Buildings, a mobile collaborative game-based activity for schoolchildren.	Handheld device
(Lin, Shao, Wong, Li, & Niramitranon, 2011)	This study aimed to develop a collaborative and manipulative virtual Tangram puzzle to facilitate children to learn geometry in the computer-supported collaborative learning environment with Tablet PCs.	Tablet computer
(Lu et al., 2011)	The paper proposes a hybrid approach to combine the key elements and appeals of traditional arts with the convenience and immediacy of interactive technologies.	Tablet computer Multimedia environment and other
(Nordmark &	The paper explores indicators for creative collaboration, of learning	Handheld device

Milrad, 2012)	supported by mobile technologies, and of awareness of multimodal approaches for self-expression and meaning making for further DBR.	
(Y.-H. Chen, Lin, Looi, Shao, & Chan, 2012)	The paper provides an account of learning arithmetic skills in an interesting way through the collaborative playing of a puzzle game.	Tablet computer
(Bollen, Gijlers, & van Joolingen, 2012)	This paper reports on the results of research efforts in investigating conditions that are advantageous in collaborative drawing activities in learning scenarios for young students.	Tablet computer
(Boticki, Wong, & Looi, 2013)	The paper describes the design of a technology platform for supporting content-independent collaborative mobile learning in the classroom.	Handheld device
(Furió, González-Gancedo, Juan, Seguí, & Rando, 2013)	The study determines whether the AR iPhone game has better learning outcomes than a traditional game.	Handheld device
(Chiang, Yang, & Hwang, 2014)	In this study, a location-based augmented reality (AR) environment with a five-step guiding mechanism is developed to guide students to share knowledge in inquiry learning activities.	Handheld device
(Falloon & Khoo, 2014)	This paper explores young students' talk in iPad-supported collaborative learning environments.	Tablet computer

3. RESULTS

The gathered data from the selected papers was analysed on the bases of the research questions. The results are presented hereafter.

Three different groups of devices used for mobile learning were identified by the authors: 1) small handheld devices, being devices that one can hold in his/hers hand and are pocket-sized, 2) tablet computers, essentially being bigger handheld computers, and 3) other devices which are not mobile devices but are used to support the activity in combination with the mobiles. The analysed data from selected papers showed moderately higher representation of tablet computers (44%) compared to handheld devices (41%). The other devices, for example personal computers or projector screens, were used 15% of the time in combination with handhelds and tablet computers.

Secondly, the distribution of devices per activity was observed and classified into one of three categories: 1) one-per-one or 1:1, 2) one-per-many or 1:m, and 3) combined usage of these two per activity. The 1:1 distribution refers to one device per user usage, while 1:m indicates one device per more than one user usage. Also, a collaborative activity can be carried out in combination of these two, for example if every student has its own device but shares the work on common screen. The devices are mostly used in 1:1 distribution (76%), followed by 1:m distribution (20%) and in combination (4%).

And third, the purpose of devices was explored and was determined that the activity can be carried out in three ways: 1) through and 2) around the device or 3) in combination of these two. The activity in which collaboration is facilitated and carried out by the device as infrastructure through which students communicate and collaborate is referred to as "through", whereas the situation in which students are gathered around the device in order to collaborate is referred to as "around". Also, the activity can be a combination of these two when, for example, a group of students is working together around technology, but with another group through technology. The activities are most frequently organized through devices (70%), while minority is held around (26%) or in combination of these two (4%).

4. CONCLUSION

This paper analysed the context of collaborative mobile learning activities that took place in the elementary education worldwide from 2009 to 2014 focusing on technology trends. From the gathered data it can be concluded that the tablet computers and small handheld devices are used almost equally throughout this period. The most common distribution of devices for the last five years was 1:1. The devices mostly serve as instruments through which the collaborative activity is performed.

According to the gathered data it is to be expected that in the near future the research in mCSCL will continue on 1:1 distribution of devices per users spawning the development of software and frameworks which use mobile devices as tools for collaboration.

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