Tabletops for Peace: Technology Enhanced Peacemaking in School Contexts

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ABSTRACT

This article describes an empirical investigation of technology-enhanced peacemaking in a conflict-stressed school environment. The peacemaking intervention required students in conflict-laden groups to collaborate on various game-like learning activities on a multitouch interactive tabletop, over the span of three weeks. Student interviews and video observations provided evidence that tabletops can become a means for communication and collaboration giving the chance for students in conflict to share a common space, shifting attitudes and improving their relationships. The study elaborates on the affordances of tabletops as they become apparent in the context of peacemaking, unpacking the still widely unexplored potential of multitouch interactive technology in peace education.

Introduction

Promoting peace or educating for peace in school contexts through the means of technology is a topic we rarely see addressed. Although technology has been extensively employed to improve instructional design, development and delivery of instructional content, and access to information, its potential to foster peace within educational interventions is relatively unexplored (Veletsianos & Eliadou, 2009; Buckner & Kim, 2011).

Veletsianos and Eliadou (2009) conducted a systematic review of research on the use of technology in educational initiatives to promote peace and peace-related outcomes. Their exhaustive search resulted in only 37 relevant works in the period 1990-2009 out of which only five presented empirical evaluations of technology-infused interventions aimed at promoting peace outcomes (the remaining included theoretical papers or descriptions of technology-infused interventions without empirical data). The focus of these 37 efforts, revolved around the use of the Internet technologies mediating long-distance collaboration, in particular: (i) virtual learning environments to host learning activities related to peace, (ii) Web 2.0 technologies (blogs, wikis, social networks and video sharing sites), Email, and video conferencing to promote communication and collaboration among people of diverse backgrounds, and (iii) serious games or MMORPGs to promote exposure to diverse populations and social interaction, such as the PeaceMaker game (Burak, Keylor, & Sweeney, 2005) which simulates the Israeli-Palestinian conflict and engages dyads in negotiating peace (Veletsianos & Eliadou, 2009).

Building on Veletsianos and Eliadou (2009) and further reviewing literature from 2009 to 2015, we argue that empirical work on technology-enhanced peace interventions in educational contexts continues to be very limited and sporadic. Internet-based interventions dominate any efforts, for example using mobile devices to share narratives of digital stories with a broader community (Buckner & Kim, 2011) or learning about conflict management through simulations and games (Brynen & Milante, 2013; Gehlbach et al., 2008). Collocated technology-enhanced peacemaking educational interventions are virtually non-existent in the literature.

We set the present work on the basis that schools can be conflict-stressed environments where peacemaking actions are needed, yet very little work in this area has taken advantage of the current educational innovations. We seek to investigate the mediating and supportive role of multitouch interactive tables (tabletops) in shaping relationships and reducing conflict among students, recognizing the potential of this technology to redefine collocated collaboration and communication. We further consider physicality and collocation to be important factors in peacemaking efforts, especially in cases where language barriers to effective communication exist. The study took place in a conflict-stressed school environment where increased incidents of violence and delinquency existed (including verbal and

physical conflict and bullying). The leading research question of the study was: Do tabletops provide a means for communication and collaboration, enabling students in conflict to share a common space, perhaps breaking down barriers? Given the lack of research in the area, we consider this work timely and relevant, while serving an important purpose.

Mutlitouch interactive tables

Tabletops are large horizontal displays that enable interaction by multiple concurrent users. They are relatively new technology, being commercially available only since 2009 with the introduction of MS Surface. Despite this, there is substantial research around them. Tabletops have attracted the attention of designers of formal (Dillenbourg & Evans, 2011; Higgins, Mercier, Burd & Hatch, 2011) and informal (Davis et al., 2015) learning experiences as highly supportive systems for collaboration and interaction.

Briefly, investigations of tabletops have shown that being able to see another's physical actions on the shared display can enhance awareness, which in turn can support fluid interaction and coordination (Hornecker, Marshall, Dalton, & Rogers, 2008; Fleck et al., 2009). Also, their horizontal orientation allows users to hover their hands easily over the surface, and as a result, gesture-based communication can supplement or even replace verbal communication (Rick, Marshall, & Yuill, 2011). Tabletops have been found to encourage playfulness in the interaction. For example, Piper, Friedman, & Hollan (2012) discussed how the touch-input allowed freedom and playfulness in students' interactions which differed from paper/pen-based interactions. Also, Jamil, O'Hara, Perry, Karnik, and Subramanian (2011) demonstrated how specific interaction techniques promoted playfulness in students' interactions during a learning task. Moreover, tabletops have been found to enhance the sense of teamwork (Morris, Huang, Paepcke, & Winograd, 2006), "invite" interaction and willingness to participate in groups tasks (Rogers & Lindley, 2004), increase equity in physical interaction (e.g., Ioannou, Zaphiris, Loizides, & Vasiliou, 2013b; Marshall et al., 2008), promote joint attention on the task (Fleck et al., 2009; Higgins et al., 2011), and improve the (learning) experience and engagement with the task (Buisine et al., 2012; Ioannou, Christofi, & Vasiliou, 2013a; Ioannou, Zenios, & Stylianou, 2014).

Tabletops and peacemaking

Despite the substantial work on the use of tabletops in formal and informal learning settings, their affordances for peacemaking in school contexts have yet to be explored. A couple of previous works have considered tabletops as "peace technology" but none of them was conducted in a natural school environment with young students in conflict.

First, Stock et al. (2008) designed a collocated tabletop interface as a tool for reconciliation. The so called NNR-Table allowed multimedia narrations to be contributed from two opposing sides; participants worked together to achieve a narration acceptable to both viewpoints (i.e., by revising and completing the narration together). Interventions with the use of NNR-Table were found successful in helping Jewish-Arab pairs of youth reach a compromise and learn more about each-other's viewpoints (Stock et al., 2008; Zancanaro et al., 2012). Second, Ioannou, Zaphiris, Loizides, and Vasiliou (2013b) designed a collocated brainstorming tabletop activity to facilitate dialog and consensus decision-making in groups of college-students discussing sensitive and controversial topics, including peace-building in a country of long-term ethnic conflict. The authors found that discussion around the tabletop was fluent with no evidence of tension, anxiety or strong disagreement among the participants. Furthermore, although not in the context of peace, other studies have presented affordances of tabletops that are relevant and pertinent to this work. For example, it is argued that, because tabletops support concurrent input and shared control, they enable collaborators to negotiate conflict (Fleck et al., 2009; Falcão, & Price, 2011) and can help engage users in "creative conflict" that is, arguing and disagreeing directed at ideas rather than people (Basheri, Burd, & Baghaei, 2013).

Method

Participants and setting

The participants were twenty (20) students 9-11 years old at a small (80 students) public elementary school in the eastern Mediterranean. The school is located in an area with low socio- economic indicators and is characterized by

large numbers of foreign students (i.e., minority enrollment), high drop-out rate and increased incidences of conflict (verbal and physical), violence and delinquency. The school belongs to the "Zone of Educational Priority" – an educational initiative linked to Europe's tactic to support students from areas with low social and economic indicators in order to reduce dropout and promote educational success. All students attend (official) language lessons as the National Curriculum requires. Yet, many of them have limited oral and written communication abilities, perhaps because in many cases a different language is spoken at home. To mitigate the frequent incidences of violence and delinquency, teachers in this school make efforts to infuse conflict management principles into the everyday curriculum helping students to understand conflict and handle anger appropriately. Also, the National curricula on Heath and Life Education covers topics such as the development of personal, social and communication skills, effective management of emotions, promotion of self-esteem and improving the psychosocial school climate. Despite these efforts, the school continues to be a conflict-stressed environment.

We collaborated with the school teachers of grades 4-6 to decide (i) the synthesis of the groups and (ii) the peacemaking tabletop activities. These teachers were 3-5 years in this school and were familiar with ongoing conflict between particular students (i.e., physical and verbal conflict and bullying) beyond temporal or typical fights and arguments. Based on this knowledge, five groups of four students were nominated to participate in the study: two groups of 4th-graders, two groups of 5th-graders, and one group of 6th-graders. The teachers' perceptions of conflict between students were cross-checked with students' self-reports during pre-intervention interviews. In fact, the proposed grouping for the intervention was finalized after student' self-reports of regular and ongoing conflicts with specific classmates, which was fully consistent with the teachers' input. Within-group conflict had various forms, e.g., all four students in conflict between them, or two pairs in conflict, or three students in conflict with the 4th group-member. Table 1 presents the synthesis of the participating groups in terms of gender split, ethnic minority and within-group conflict.

Table 1. Group synthesis (*N* = 20)

Group name	Grade-level	Gender split	Ethnic minority group-members	Group-members in conflict
Group 1	4th-grade	3 girls/ 1 boy	3	MO, KA, AI in conflict with AL
Group 2	5th-grade	2 girls/ 2 boys	2	AA, CH, DI in conflict with AS; CH in conflict with DI
Group 3	5th-grade	2 girls/ 2 boys	4	RO in conflict with ST, AN OS; OS in conflict with RO, AN, ST
Group 4	4th-grade	4 girls	4	MA in conflict with AS; KL in conflict with AP
Group 5	6th-grade	1 girl/ 3 boys	4	AX, XO, RU, OM all in conflict between them

Peacemaking activities

Building on the idea of gamifying the learning experience (Garris, Ahlers, & Driskell, 2002), we aimed to create an engaging and fun learning environment using applications in which the educational content was combined with game characteristics. Additionally, we aimed to engage students in tasks which did not require extensive language use, considering the participants' literacy levels as a potential barrier to participation; the use of a tabletop was deemed ideal in this case, affording gesture-based around verbal communication (Rick et al., 2011). Last, we sought "neutral" activities to turn attention away from peacemaking and life education as formal curricula activities. That is, we sought an intervention to bring students closer through play and teamwork, expanding on the English, math and the general education curricula.

We used the Samsung SUR40 tabletop which can respond to approximately 50 simultaneous inputs. We used a total of six applications. Four applications (designed for children aged 6-12) were freely downloaded from the Windows Apps Store - Education and Entertainment category (Age appropriate and free or very cheap tabletop applications can be found on the Windows Apps Store in all subject areas and can be easily customized and linked to aspects of the general education curricula.). Together with the school teachers we set the difficulty level of each application for

each participating group. Additionally, we used two custom-built applications developed at the [Lab Name, authors' reference], populated with age-appropriate content, again in collaboration with the school teachers. In particular,

- iMath allowed students to practice addition, subtraction, multiplication, division, decimals and fractions through a series of calculation activities and games such as Math for Speed, Sudoku, and Match Card (Figure 1A).
- English Club allowed students to work on English (as a second language) vocabulary and spelling tasks through animated videos and games like Hangman and Wordsearch (Figure 1B).
- PuzzleTouch allowed students to entertain themselves with jigsaw puzzles of various difficulty levels (Figure 1C).
- Kids Play & Learn allowed students to interact with mini educational games such as learning the time, color mixing, and shapes (Figure 1D).
- IdeasMapping supports the collaborative classification of ideas or pictures (authors' reference). We used this app with pictures related to recycling, four seasons, musical instruments and animal groups (Figure 1E).
- IdeaSpace supports collaborative story design and storytelling. This activity was based on a rich collection of images taken from a textbook specialized in civic education to present bullying at school, classroom conflict and family violence. Students were asked to collaborate on designing a story, which was saved and expanded in follow-up sessions (Figure 1F). Teacher facilitation was provided for this activity as storytelling was challenging for the participating students due to literacy levels.

The peacemaking activities run for three weeks in two 30-minutes intervention-sessions per week for each group, for a total of 180 minutes (or 3 hours) tabletop interaction per group for the duration of the study. Groups worked with two or three different tabletop applications per session (10-12 minutes per app) while the difficulty level was adjusted from session to session to maintain engagement considering carry-over effects (e.g., learning, fatigue). Students completed all activities associated with this investigation during school time.

Data collection

We conducted semi-structured interviews with the participating students at three time points: before the intervention (pre-interviews, 10-15 minutes each), at the completion of the intervention (post-interviews, 15-20 minutes each), and three months later (delayed-interviews, 10-15 minutes each). All interviews were undertaken by one of the school teachers who made students feel comfortable in talking about their feelings. At the time of pre-interviews, information about the upcoming intervention and the participating groups was not disclosed. The interviewer (knowing the potential synthesis of the groups) carefully extracted information about the relationships between teammates in a natural discussion about student's daily school experiences and interactions with all their classmates, in and outside the classroom. Also, during the discussion, the interviewer asked the participants to rate their feelings about several classmates (potential teammates and others) on a Likert-type response scale from 1: Hate to 10: Love (scale with both numbers and smiley faces for better understanding). Last, a close-ended question concerning students' access to technology was asked. The same questions regarding students' relationships were repeated in the post and delayed interviews; a couple of additional questions were asked about students' experiences working on the tabletop (in the post-interviews) and their memories of the experience (in the delayed-interview). During the intervention we video recorded students' interactions around the tabletop for a total of 18 hours of video (3 hours per school visit). Two cameras were placed in the room for a full coverage of students' body language (including gestures, posture and movement), facial clues, and tabletop activity together with their verbal communication.

Results

Two investigators worked closely together to examine the data corpus; consensus decisions were made on the observed patterns, while disagreements were resolved via discussion. First, the pre, post, and delayed interview data were fully transcribed by the interviewer, who was capable of understanding the participants' talk and therefore, an accurate transcription of the dialog. The datasets were then examined (i) as separate corpuses and (ii) chronologically - tracking students' talk about their teammates over time. The video data were split into episodes; an episode was typically 10-12 minutes long and involved a group's work with one tabletop application. We looked at the episodes of the groups working on each application over time (e.g., group A working on iMath in sessions 1, 2, and 3).

Figure 1. Tabletop collaboration: (A) iMath, (B) English Club, (C) PuzzleTouch, (D) Kids Play & Learn, (E) IdeasMapping, (F) IdeaSpace

Pre-interview data

Following Attride-Stirling's (2001) thematic networks approach to analysis of textual data, we mapped the nature of conflict at school and the kinds of conflicts within the participating groups, based on the pre-interview data. Two organizing themes of conflict emerged – conflict during recess and conflict in the classroom – broken down to several basic themes of behaviors as in Figure 2.

Furthermore, we noted students' concerns and feelings about specific classmates to juxtapose with (i) the reports from our collaborating teachers in order to finalize the group composition (described earlier), and (ii) the post-interview student data in order to identify potential changes in students' relationships. Overall the pre-interview data confirmed the existence of conflict and bad emotions amongst teammates. In particular, we noted the reporting of physical and verbal conflict and bullying between specific teammates and associated numeric (Hate-Love) ratings

being well below average on our 10-point Likert scale (mean = 5.75; *SD* = 3.06; *N* = 60). Pre-interview data also provided information regarding students' access to technology. Although none of the students had seen a tabletop before, 18 (out of 20 students) had a computer at home and 16 of them had access to the Internet. Also, about half of the students had access to tablets or smartphones, either owned by them or their parents.
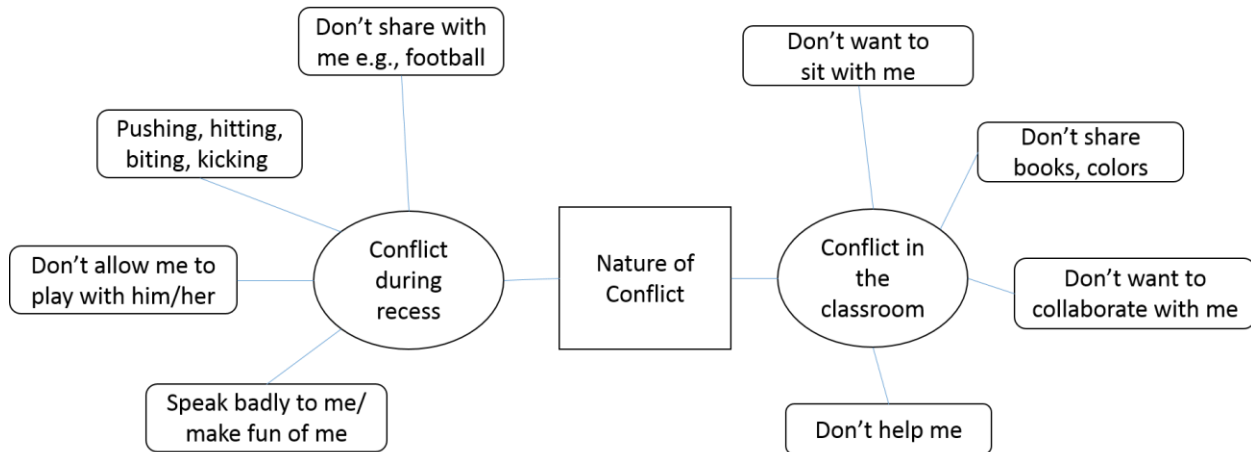

Figure 2. Thematic network of the nature of conflict based on the pre-interview data

Post interview data

We examined the post-interview data aiming to uncover potential changes in students' relationships and persistent or non-persistent behaviors. Tracing students' responses back to the pre-interview reports about specific teammates, it was evident that conflict between them was reduced and their relationships were improved. The dialogue excerpts below illustrate patterns of the positive outcomes of the intervention, with similar patterns traced for nearly all the participating students. It should be noted that during the post (also delayed) interview, students naturally spoke about their teammates, even though the interviewer asked more general questions about their daily school experiences and relationships with all their classmates. In a sense, students wanted to compare and be specific about the shifts in behaviors they had experienced.

[Group 1, post-interview with AL]
    R: Tell me more about your current relationships with your classmates.
    AL: Yesterday for example, KA and AI played hide-and-seek and I asked them to join. KA let me play with them!
    R: Different than before?
    AL: Yes, before he [KA] never let me play with them.
    R: Are you telling me that you noticed a change in KA's behavior?
    AL: Yes, he [KA] is nicer to me recently.
    R: Do you think this has to do with you being in the same team for the recent tabletop activities?
    AL: Yes I think so. Things with MO are also better because of this, I think…I think she [MO] is nicer after we played together on the tabletop.
    R: Do you collaborate in class? outside of class?
    AL: Both. During recess we play together and with some other friends too.
    R: Any fights with her [MO]?
    AL: Rarely… we are friends now…she [MO] changed…her behavior has changed, perhaps because we were in the same team…

[Tracing back to the pre-interview with AL with reference to the same students].

    [AL talks about KA]
    R: Tell me more about this issue with KA ….what is the problem exactly?
    AL: I don't know. He [KA] simply does not like me.
    R: He [KA] does not like you….Perhaps there something you both like/have in common?

AL: Nothing.

R: There is nothing the two of you have in common?

AL: Absolutely nothing. I give him [KA] my pencils and I help him in class, but he never does the same. The other day I asked for his sharpener and he was screaming at me. And during the physical education class, the other day, he hit me… 2 or 3 times he threw me on the floor.

R: Was it on purpose?

AL: It is always on purpose.

R: How do you feel about this?

AL: I am sad...i want to be friends but he [KA] does not like me…I don't know why.

…..

[AL talks about AI]

R: Give me an example of how you don't get along with her [AI].

AL: For example, one day I sat next to her and she asked me to leave.

R: She [AI] prefers to sit with another friend?

AL: She just does not want ME!

R: But did she [AI] ever say so?

AL: But she never talks to me. The only thing she says is asking me to leave.

R: How do you feel about this?

AL: I want to play with them, but…

R: Do you think there is something AI and you have in common?

AL: Nothing.

[AL talks about MO]

R: Some days she [MO] likes you, some days not?

AL: Yes and I asked her why she does this to me, and she [MO] said I am a mean person.

R: Did you even do anything mean to her?

AL: No, I think it is something else…she does not like me.

Furthermore, we aimed to map students' perceived value of the tabletop experience. A thematic network analysis (see Figure 3) showed that students' reactions were overwhelmingly positive. The tabletop experience was perceived successful in bringing them closer together and in helping them realize that collaboration between them is possible. Also, in students' talk about their experiences we could trace evidence of the affordances of tabletops to support collaboration and shared control, as illustrated below.

[Group 1, post-interview with KL]

R: So what you are telling me is that your group collaboration was always good except in one case when you and "AL" fought because she wanted to dominate?

KL: Yes, but everyone played in the end…Everyone could touch the tabletop because it was large and multitouch.

….

[Group 3, post-interview with AN]

R: Did you work together as a group?

AN: Yes, we collaborated and if a teammate needed some help the rest of us would help. Last time for example [referring to IdeaSpace], one teammate started the story, another teammate continued, and then another one added more to it, until we had a very good story. It worked very well because we did it together.

R: So there was good collaboration? And everyone participated?

AN: Yes, everyone.

[…]

AN: I think the tabletop experience brought us closer together. Before this, we either did not talk or we talked badly to each-other. Now we play together.

R: Didn't you play together before this experience?

AN: No, we never played before.

R: And what else do you do together now?

AN: We play football and volleyball during recess. We draw together during Art class and we do various other tasks together when the teacher assigns group work.
R: And do you fight at all?
AN: Not any more. […] On the table, all tasks required collaboration; I think this helped us come closer together and learn to support each-other in order to complete the tasks.
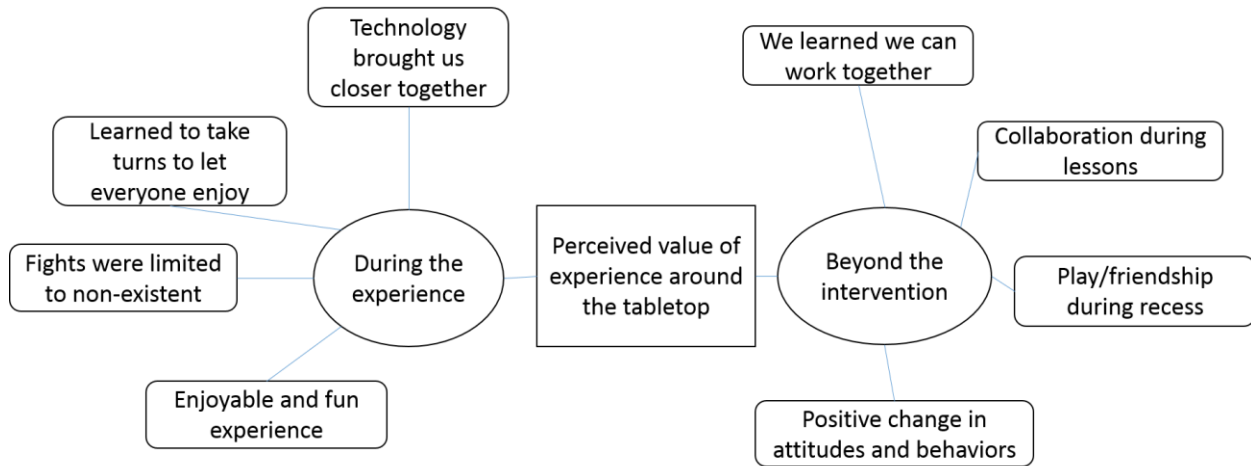

Figure 3. Thematic network of the perceived value of the experience based on post-interview data

Last, using the numeric data of the "1: Hate to 10: Love" response scale, a *t*-test was carried out to explore potential differences in students' feelings about their teammates from pre to post testing. The results showed statistically significant increase in students' "Love", $t(59) = 5.7$, $p < .001$, from pre-testing (mean = 5.75, $SD = 3.06$) to post-testing (mean = 8.51, $SD = 2.7$). This difference constitutes a large effect size, Cohen's $d = .96$ (see guidelines by Cohen, 1992)), indicating that it is meaningful and may have practical importance (LeCroy & Krysik, 2007).

Delayed interview data

Last, we examined the delayed-interview data aiming to understand whether our intervention had long-lasting effect (3 months later). However, in this case the results were split and contradictive. With respect to relationships, students' views can be summarised in three themes: (a) approximately one-third of the students reported good relationships with their teammates, (b) another one-third explained that they had good relationships with some teammates and not with others, and (c) another one-third disclosed information about conflict, similar to what we had recorded in the pre-interviews. With respect to recalling the experience and its value, results were again contradictive and various views were heard, regardless of the students reporting being in conflict or not at the time of the delayed interview. These views can be summarised in four themes: (a) some students believed the tabletop experience played a major role in their (at the time) good relationships, (b) others argued it helped temporarily but did not last for long, (c) others thought it did not help, even though they had a more positive view at the time of the post interviews, and (d) others were confused and unsure about the effects of the intervention. For example, in the case of AL (presented earlier), at the time of the delayed interview things were better with one teammate (MO) but not with the other two (AI and KA) and she felt the effect of the intervention did not last (see 1st excerpt below). Then, in the case of AN (also presented earlier) she enthusiastically elaborated on details of the tabletop experience and how it improved her relationship with her teammates (see 2nd excerpt below).

[delayed-interview with AL, Group 1]

R: How are your relationships with the other children these days [three months later]?
AL: With MO things are good. We sometimes we argue about things, but nothing major.
R: What kinds of things do you argue about?
AL: I don't remember…it is small things (laughter).
R: With AI, KA? In the classroom? Outside the classroom?

AL: With KA we have problems.

R: Problems like in the "old days"? Big fights?

AL: Yes ...we totally don't get along.

R: Can you give me an example?

AL: The other day, by mistake I gave the answer aloud to a question he [KA] was about to respond (the teacher asked him). During recess he hit me and made me cry… even though I had apologised he still wanted to hit me.

R: And with AI?

AL: Same thing. When I try to speak with her [AI], she screams at me and she kicks me. She does not like me. [….]

R: Do you remember the experience with the tabletop…when you guys worked together…?

Yes I remember, it was good back then, but it did not last long...

[delayed-interview with AN, Group 3]

R: And do you remember the experience when you collaborated with your teammates…

AN: Yes I do. It was an educational table which helped us collaborate without actually noticing we were coming closer to each-other this way. It kind of promoted friendship between us, and it is lasting till today, and it was social, playful and fun.

R: But is it the tabletop really? Perhaps time just healed your relationships. Perhaps something else happened which helped…think about it a bit…

AN: I don't know …but I do think it [the intervention] played a major role.

R: How? It was such a short experience…

AN: All games and activities on the tabletop required collaboration. One member did one thing, the others had to help him. For example, in the puzzle we should help each other find pieces quickly because time was running out and we wanted to win. And this made us work together and learn how to do this nicely (laughter).

Last, considering the numeric data of the "1: Hate to 10: Love" response scale, we found a statistically significant decrease in students' "Love," $t(59) = 4.5$, $p < .001$, from post-testing (mean = 8.51, SD = 2.7) to delayed-testing (mean = 6.23, SD = 3.26) with a medium to large effect (Cohen's d = .76). Yet, there was still a statistically significant increase in students' "Love," $t(59) = 3.7$, $p < .001$, from pre-testing (mean = 5.75, SD = 3.06) to delayed-testing (mean = 6.23, SD = 3.26), with a small effect size (Cohen's d = .15).

Video data

We examined the episodes of each group working on the same application across intervention sessions. As expected per design of the peacemaking activities and considering the literacy level of the participants, verbal communication was limited to short and simple conversations. Yet, together with the body language (including gestures, posture and movement), facial clues and tabletop interactions, it was possible to extract important information about the within-group collaboration over time. Overall, it was apparent that the technology facilitated students' communication and collaboration as they took turns in trying inputs and completing the tasks together. In general, students engaged with the activity and cooperation did not appear to be forced or artificial. The investigators were able to identify patterns of behaviors across time, evident across all five groups. These theme-behaviors were consistent with the findings from students' post-interviews (Figure 3), thus serving as a form of triangulation of findings:

- Conflict was evident at times, especially at the beginning of the intervention. Typically, teammates not involved in the particular conflict helped in order for the activity to proceed peacefully.
- From session to session collaboration got better in all groups. Typically after the first couple of sessions, students realized the importance of working together and appeared more willing to collaborate, take turns, consider everyone's input and help each-other in order complete the task successfully.
- The technology allowed everyone to be involved and engaged in the activity. Dominant moves existed at times, but the multitouch capability allowed everyone to persist and continue to play/contribute. Typically after the first couple of sessions, students learnt to participate fairly and equally within their groups, demonstrating turn taking behavior.
- Students' behavior was characterized by enthusiasm, engagement and playfulness, suggesting this was a positive experience for all. None wanted this to end, and at the end of each session, everyone asked to participate in the next session.

Furthermore, the video analysis allowed us to take a closer look at how each activity facilitated peacemaking differently. For example, the use of iMath initially promoted competition within the group and encouraged the strongest players in math to dominate the activity by choosing the right answer before anyone else could think. In the early sessions of the intervention, this practice enforced conflict in the group, particularly between individuals being already in conflict. Soon however, a turn taking behavior was adopted by all groups, when students realized that (i) the tabletop was picking the wrong answer when everyone touched concurrently and aggressively therefore points were lost, and (ii) time lost in arguments and fighting was counting against the group winning the game. To provide a second example, the use of IdeaSpace encouraged students, especially the less talkative ones, to share their feelings and emotions. In particular, during the storytelling activity, some students related themselves to actors of their story and expressed thoughts which, rather unconsciously, communicated a message to their teammates. Also, these expressive moments revealed aspects of the students' family situation (for which the investigators were already informed), suggesting further indirect benefits of the activity. For example, in a student's own words:

"Who wants their mom and dad to be fighting? Who wants to be screamed at all the time, at home and at school? This boy in our story is probably very sad. We need to add some friends for him in the story and a teacher who tolerates and excuses his behavior." [XO, Group 5]

A detailed analysis of how our six tabletop activities supported peacemaking in different ways is beyond the scope of this manuscript and is considered elsewhere.

Discussion

The potential of multitouch interactive technologies for peacemaking is widely unexplored to date. This is the first investigation of collocated technology-enhanced peacemaking with young student-participants in a real conflict-stressed school environment. Our findings suggest that collocated collaboration around tabletops can mediate peace within conflict-laden groups. We have evidence that the technology becomes a means for communication and collaboration giving the chance for students in conflict to share a common space, shifting attitudes and improving their relationships. Below we discuss these findings in relation to prior research, while pointing to future possibilities.

First, our findings suggest that tabletops can promote collocated collaboration among students in conflict. It is not new that tabletops afford collocated collaboration and teamwork within groups (e.g., Dillenbourg & Evans, 2011; Morris et al., 2006), but our work takes a step further to demonstrate collaboration among students *in conflict*. In previous peace-related work, the NNR-Table (Stock et al., 2008; Zancanaro et al., 2012) promoted dialog and understanding of culture between participants from two opposing sides. Yet, the adolescent participants, did not exhibit conflict between them per-se. Instead their volunteered participation in the study might be suggesting the opposite, i.e., their interest in reconciliation and peace. Similarly, in the case of PeaceMaker (Burak et al., 2005) the participants did not know each other personally prior to the study, i.e., there was no personal conflict between them. In the present investigation, we worked with young (elementary-school) students in conflict, forming conflict-laden groups nominated by their teachers and confirmed by the students themselves. Our study showed evidence that collocated collaboration around tabletops helps students in conflict share a common space and shape better relationships among them.

Second, we demonstrated that tabletops are well suited for collaborative activities in case of low literacy levels and communication barriers. Previously, Rick et al. (2011) argued that gesture-based communication around tabletops supplements, and even replaces, verbal communication. The present investigation confirms this argument. We observed fluent collaboration over limited verbal communication (supported by non-verbal communication) within all the participating groups. We acknowledge however that in IdeaSpace, teacher facilitation was needed as narrating a story was challenging for the students. This is consistent with Buckner and Kim's (2011) reports about low literacy levels being a barrier to students' ability to read, write, and share their stories during peacemaking interventions using mobile devices. Yet, all other activities in our intervention (e.g., those with more game-like characteristics) were completed successfully without facilitation. Therefore, we can argue that tabletops, enriched with game-like activities, afford gesture-based communication and collaboration over language barriers and therefore, become well suited for collocated peacemaking interventions when language barriers to communication exist.

Moreover, we suggest that tabletops are well suited for peacemaking school interventions because they help create a playful learning environment. Playfulness around tabletops has already been reported in the literature (e.g., Piper, Friedman, & Hollan (2012); Ioannou, Zaphiris, Loizides, & Vasiliou, 2013; Jamil et al., 2011). For example, Ioannou et al. (2013b) found no evidence of tension, anxiety or strong disagreement when college-students discussed sensitive issues around a tabletop; the authors discussed how the playfulness of the tabletop interaction, as documented in utterances of social talk and laughter, had possibly made the activity fun, rather than emotional. In the present investigation, through self-reports and video observations, we gathered evidence that the intervention was fun, playful and enjoyable for all the participants despite the existence of conflict between them. Thus, not only we confirm previous research findings about tabletops promoting playful interactions, but we further argue that this affordance makes them well suited for peacemaking interventions. In a broader sense, we can argue for the potential of using tabletops for gamifying the peace education curricula activities.

Furthermore, our findings extend the notion that tabletops are "peace technology" in that they allow power to be shared and distributed over the display enabling participation by all collaborators (e.g., Fleck et al., 2009; Ioannou, Zaphiris, Loizides, & Vasiliou, 2013; Marshall et al., 2008) and even "forcing" the participants to consider the interests of the "other" (Ioannou et al., 2013b). As described earlier, through video analysis, we noted the adoption of turn taking behavior in all groups, which suggests virtually equal participation between the collaborators. Moreover, students' self-reports informed how the technology allowed everyone's input to be considered, preventing one from dominating the activity, which also suggests a more democratic participation to the activity. Veletsianos and Eliadou (2009) argued that for peace-seeking initiatives to be effective, it is necessary that they promote an understanding of the "other." We acknowledge that because tabletops enabled democratic participation, it does not mean an understanding of the "other" took place. For this goal to be achieved, we argue that a stronger pedagogical aspect aimed explicitly at social perspective taking is needed (e.g., Gehlbach et al., 2008; Goldsworthy et al., 2007).

Last but not least, we could argue that infusion of tabletops in the general curriculum might be able to help promote peace-related outcomes. To elaborate, tabletop use in this study expanded on the math, English, and general education curricula to turn attention away from peacemaking and life education as formal curricula activities. This design decision seems to reveal a possibility – that activities and applications explicitly designed for peacemaking (e.g., PeaceMaker, Burak et al., 2005) or dedicated peacemaking interventions might be less needed. Instead, technology infusion in the general curriculum, can feed into peacemaking by targeting "antecedents to peace" (Veletsianos & Eliadou, 2009), such as supporting and mediating collaboration, interaction and communication. For example, using tabletops in everyday collocated collaborative activities (math, science, English or other) might allow students in conflict to work together and experience shifts in attitudes such as those reported here. In this sense, tabletops can "expand" the peace education curricula, which is often under-emphasized, helping to promote peace-related outcomes through their infusion in the general curriculum. We acknowledge these ideas are preliminary and warrant further investigation.

With respect to the limitations, we acknowledge that much enthusiasm was evident in students' feedback, stemming from the use of tabletops. Although this finding relates to students' endorsement of the tabletop experience (e.g., Buisine et al., 2012; Ioannou, Zenios, & Stylianou, 2014; Ioannou, Christofi, & Vasiliou, 2013a), it might also be suggesting a novelty effect, which can be confused with the true impact of the intervention. A novelty effect becomes particularly relevant when we consider the variability in the results of the delayed-interview data, with a few students returning back to the baseline with regard to their relationships and feelings about their teammates. In their review, Veletsianos and Eliadou (2009) found that there is generally limited empirical support for the sustainability of the claimed positive outcomes of various technology-infused peace initiatives. Indeed, collecting delayed-interview data in this work was an attempt to address this concern, nonetheless the mixed and conflicting results leave us with no clear picture of the lasting effects of the intervention. We therefore argue that longitudinal studies using ethnographic approaches are needed, in order to examine issues of "depth" related to technology-enhanced peacemaking and sustainability of any positive outcomes. Furthermore, like it is also true with many new and emerging technologies, theorizing the use of tabletops for peacemaking, but also for collaborative work/learning in a broader sense, is in very early stages. Future work should focus on presenting a theoretical account of how tabletops might promote peace-related outcomes by eliciting and supporting various types of interactions.

Conclusions

Overall, this study presented evidence that tabletops are "peace technology" that is well suited for use in peacemaking interventions aiming to promote communication and collaboration among students in conflict. This is the first empirical work of collocated technology-enhanced peacemaking in school contexts with great promise for future work. Our findings should be informative for researchers and educators dealing with phenomena of school conflict, as well as researchers and practitioners in the broader area of using technology for peace and social change. We summarize a few tentative implications of this work for these stakeholders:

- Tabletops can promote collocated collaboration among students in conflict.
- Tabletops enable democratic participation and consideration of everyone's input.
- Tabletops enable communication over language barriers.
- Tabletop can help create a playful learning environment.
- Technology interventions that involve collocated users, present the potential to help change perceptions, improve relationships and break down social barriers.

Closing, tabletops are a new generation of educational technologies that offer new possibilities for engaging students in communication and collaboration. New forms of collaborative practice can be supported by this technology, especially as it gets more advanced and equipped with relevant software applications. What is also important, this kind of technology is attractive for young people who stay engaged and enjoy the experience. Tailoring this technology to meet the need for peaceful attitudes and peacemaking in conflict-stressed environments is a great area for research and development while serving an important purpose. We believe that tabletops provide a revolutionary approach to collocated technology-enhanced peacemaking in school contexts and beyond. Its integration in education, might give us the opportunity to deal with social issues in ways we have not had the chance to do before.

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