



# Embracing Collaboration and Social Perspective Taking Using Interactive Tabletops

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## Abstract

In a contemporary multicultural classroom in which students from diverse ethnic and cultural backgrounds learn together, it becomes necessary to embrace collaboration, social perspective-taking, and understanding of the *other* to help students comprehend classmates' values and perspectives. Based on the already researched affordances of interactive tabletops in education, as well as promising empirical results from their limited application in multicultural settings, the authors present a case of practical and impactful technology research in a culturally diverse classroom. The study was conducted with 44 students as part of their formal, socio-emotional education course in a public school in Cyprus. The study presents evidence of perceived collaborative learning around the tabletop, as well as gains in social perspective-taking propensity from pre- to post-test, demonstrating a promising use of interactive tabletops and related technologies in the field of education.

**Keywords** Technology-enhanced learning · Interactive tabletops · Shareable surfaces · Social perspective taking · Collaboration · Multicultural classroom · Peace education

## Introduction

The ability to interpret others' perspectives or beliefs, thoughts, and feelings is a critical social thinking skill that is central to group participation in the social world (Winner and Crooke 2009). Social Perspective Taking (SPT) can be defined as “all the attempts of one person to understand or perceive a situation in the way that another person understands or perceives it” (Tomasello et al. 1993, p. 510) or “the opportunity to actually see and experience the world as another person experiences it” (Jabali 2015, p. 125). SPT is considered an interpersonal competency necessary for success in today's workforce (Soland et al. 2013) and in “living in the world” of the twenty-first century (Binkley et al. 2012). It is important for SPT to be cultivated during school years, even though it will continue to grow throughout life (Linda et al. 2009). As Gehlbach (2011) explained, in the era

of globalization and multiculturalism, it is much more likely that students from diverse ethnic and cultural backgrounds will be learning together. Thus, it becomes necessary to help students comprehend their classmates' values, perspectives, and motivations so that they can learn from each other (see also Gehlbach 2017). This makes a multicultural classroom a unique but challenging opportunity for investigations of technology use for the improvement of students' tendency to engage in SPT.

Shareable surfaces, whether it is an interactive wall, floor, or tabletop, provide attractive technological venues for young people, who can stay engaged and enjoy the experience (Evans and Rick 2014). Tabletops, in particular, are well researched to date, with proven strengths in engaging students in communication and collaboration as well as playful learning experiences. In the past two decades, tabletops have been shown to support collaborative processes more fluidly than vertical displays, and to enable in-depth discussion with participants taking on diverse roles in a group, among other findings (Bruun et al. 2017; Dillenbourg and Evans 2011). In addition to these strengths, recent efforts have focused on promoting the adoption of tabletops in practice and in real-world settings, working towards real-world impact of tabletop research (Bruun et al. 2017). Along these lines, tailoring tabletop technology to support social thinking processes, such as SPT, is an emerging field of research.

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Unlike the massive amounts of research in education focused on using technology as a conveyor of content to improve achievement, this work aims to point to the role of shareable interfaces on mediating social thinking skills. The focus of the study is on creating an attractive technology-infused social environment in which students can communicate, work together, and consider the perspective of the *other*. Given some recent promising results from the application of tabletops in cross-cultural settings (Zancanaro et al. 2012; Ioannou and Antoniou 2016), the present study examines their integration in the socio-emotional education course of a multicultural classroom, aimed at promoting collaboration and SPT. The study does not consider student's SPT ability (i.e., whether they are developmentally capable of SPT) but instead, focuses on their tendency to apply this ability in their actual relationships, namely, in their interactions with peers and in handling cases of conflict, difference, and bullying.

The overarching goals of the study are to:

- Provide evidence of the practical utility and impact of tabletop research in a contemporary multicultural classroom.
- Present evidence of collaboration and gains in SPT propensity linked to the tabletop-enhanced lessons.

We first describe some of the past work on interactive tabletops and SPT. Then we detail the specifics of our methodology and procedures in a multicultural classroom setting. We conclude by presenting our findings and discussing plausible explanations.

## Related Work

This literature review considers definitions of SPT, previous work on technology-enhanced SPT, use of tabletops for collaboration, and use of tabletops for the enabling of SPT.

### Social Perspective Taking (SPT) as Social Thinking

SPT is the social-cognitive process of inferring another person's thoughts and feelings (Flannery and Smith 2017). SPT can be seen as a social thinking skill or as the process of social problem-solving, where the socially-based problem is an unexpected event or perspective, or an uncomfortable feeling (Winner and Crooke 2009). SPT is commonly thought to be essential for successful social relationships (Flannery and Smith 2017) and successful "living in the world" (Binkley et al. 2012). The multicultural classroom of the twenty-first century makes this skill even more important to nourish (Gehlbach 2011, 2017); students can be highly aware of their own perspective, but they may struggle to see another's point of view, leading to conflict-stressed school classrooms and environments, where students

fail to learn together and from each-other (e.g., collaborative learning). As Linda et al. (2009) explained, SPT may be very difficult to exhibit in cross-cultural interactions.

Some experts have considered SPT as a two-stage process: first people predict how they might feel in another person's position and second, they make adjustments to this prediction based on their understanding of how they are different from the target person (Van Van Boven et al. 2013). SPT is often discussed as being related to empathy or sympathy, sometimes referred to as affective or emotional SPT, respectively. As Linda et al. (2009) explained, there are pitfalls inherent in identifying with another person's emotional state. On one hand, empathy is a useful orientation to SPT, viewed as the "consideration of another [and] readiness to respond to his needs ... without making his burden one's own" (Szalita, as cited in Linda et al. 2009, p. 9). On the other hand, sympathy is not a useful orientation to SPT, viewed as an experience of shared suffering, which can lead to confusion and unsuccessful SPT (Linda et al. 2009). Considering the relationship of SPT with constructs such as empathy or sympathy is beyond the scope of this work. The present study focuses on students' SPT propensity as a distinct construct that assesses one's tendency to take the psychological point of view of another.

### Technology-Enhanced SPT

Several researchers have considered SPT a vital skill for a range of social outcomes, especially for developing and maintaining relationships (e.g., Eggum et al. 2011; see Hughes and Leekam 2004). Building on the affordances of emerging technologies, previous studies have targeted aspects of SPT, presenting a set of interventions which evolved around peacebuilding, conflict resolution, collaboration, positive social relationships, breaking down stereotypes and prejudices, democratic participation, historical empathy, reconciliation, social problem-solving, empowerment of agency, and voice (e.g. Carano and Berson 2007; Lee and Hoadley 2006, 2007; Rector-Aranda and Raider-Roth 2015; Zancanaro et al. 2012). These studies exposed students to multiple points of view in their attempt to endorse an understanding of the *other* and aiming to break down stereotypes and prejudices, establish positive social relationships, increase awareness and respect for diversity, and resolve conflicts. As Jabali noted (Jabali 2015), streaming digital video, interactive animations and simulations, touch-sensitive displays and handheld devices, online virtual worlds, virtual reality and augmented reality are some of the platforms that have the potential to be used for enhancing SPT. Overall, it appears that the use of technology has potential for helping students deal with difficult, tensed, and complex issues through an engaging, mild, and playful way.

A couple of previous studies are particularly relevant to the present investigation, with respect to drawing on a problem-based constructivist pedagogy and using technology to

promote SPT. Gehlbach et al. (2008) reported on the “GlobalEd”, a five-weeks web-based simulation in which students negotiated treaties involving current world issues (e.g., global warming, child labor), while taking the perspective of the country they represented (i.e., a role-playing simulation). In the “GlobalEd”, students had engaged in SPT, considering the thoughts and emotions of others and assessing their perceptions of the situation, which was particularly motivating for them. Likewise, Veletsianos and Eliadou (2009) proposed “Adventure Learning” as an approach through which Web technology can be used to promote peace. Adventure Learning challenged students with seeking solutions to real-world issues of societal concern, while also exposing them to multiple points of view, in an attempt to endorse an understanding of the *other* (Doering and Veletsianos 2008). Overall, technology-enhanced SPT has mainly revolved around the use of web technologies. Drawing on the affordances of shareable surfaces to support the development of students’ social skills and outcomes in collocated settings has been neglected in the educational literature to date.

### Interactive Tabletops and Collaboration

Tabletops are part of a family of shareable surfaces, including interactive walls, floors, and displays of various orientations. Tabletops are large horizontal displays that enable interaction by multiple concurrent and collocated users. Tabletops have attracted the attention of designers of both formal learning experiences (Dillenbourg and Evans 2011; Higgins et al. 2011) and informal learning experiences (Davis et al. 2015), as highly supportive systems for collaboration and interaction. During the past two decades, tabletop research has flourished, and tabletops have been successfully deployed to settings such as museums, classrooms, and science centers. Briefly, tabletops have been found to enhance the sense of teamwork (Piper et al. 2006), invite interaction and willingness to participate in groups tasks (Rogers and Lindley 2004), increase equity in physical interaction (Ioannou et al. 2013; Marshall et al. 2008a) and help users engage in “creative conflict;” that is, arguing and disagreeing directed at ideas rather than people (Basheri et al. 2013).

Moreover, previous investigations have shown that tabletops can encourage playfulness in the interaction (Hollan and Hutchins 2009; Ioannou and Antoniou 2017; Ioannou et al. 2013) and, therefore, improve the (learning) experience (Buisine et al. 2012). For example, Hollan and Hutchins (2009) discussed how the touch-input allowed freedom and playfulness in students’ interactions, which differed from paper/pen-based interactions. Overall, current research findings document that tabletops can respond to the need for promoting collocated interaction, communication and collaboration the so-called, by Veletsianos and Eliadou (2009), “antecedents to peace” or, in our view, founding blocks for

good student relationships and learning together in the multicultural classroom.

### Interactive Tabletops and SPT

Tabletops can provide opportunities for collocated interaction, communication, and collaboration, which has its own merit in the development and practice of social thinking. In a relevant claim, Nardi and Whittaker (2002) argued that “social bonding is affected through [...] engagement of the human body in social inter-action and [through] informal conversation” (p. 86). In this spirit, a couple of previous studies have endorsed the idea of collocated, technology enhanced interventions linked to aspects of SPT. The studies presented next argue for the potential of interactive tabletops to achieve social outcomes, as the technology becomes a means for collaboration (Dillenbourg and Evans 2011) enabling students to share a common space and consider issues from the perspective of the *other* (Ioannou and Antoniou 2016, 2017).

In particular, Stock et al. (2008) designed the NNR-Table which allowed the co-development of multimedia narrations from two opposing sides; participants worked together to co-design a narration acceptable to both viewpoints (i.e., by revising and completing the narration together). NNR-Table interventions were found successful in helping Jewish-Arab pairs of young people reach a compromise and learn more about each other’s viewpoint (Stock et al. 2008; Zancanaro et al. 2012). Furthermore, Ioannou and Antoniou (2016) used tabletops to enable collaboration and positive relationships among students in conflict (verbal and physical bullying) in an elementary school. In particular, a tabletop was used with game-like learning activities which required students of conflict-laden groups to work together, shifting their attention away from the on-going conflict. The study was conducted as part of the formal school curriculum on socio-emotional education, with several intervention sessions in a period of 3 weeks, demonstrating positive changes in the participant’s attitudes and behaviors from pre- to post- intervention testing. Overall, findings from the aforementioned studies have created positive expectations that shareable surfaces can be useful tools in culturally diverse environments, such as the multicultural classroom.

### Research Methodology

This study employed a mixed method research design that incorporated both qualitative and quantitative data collection and analysis. As Creswell and Plano Clark (2011) explained, collecting analyzing, and mixing both quantitative and qualitative data in a single study can provide a better understanding of the problem under investigation. In this case, the researchers were seeking evidence of the practical utility and

impact of tabletop research in a contemporary multicultural classroom, and evidence of collaboration and gains in SPT propensity linked to tabletop-enhanced lessons.

## Participants

The study was conducted at a small (about 100 students) primary, urban school in the eastern Mediterranean, with large minority enrollment (more than half of the students). The school is a conflict-stressed environment, with conflict encountered mostly between students of different ethnic and cultural backgrounds. Therefore, the school was purposively selected to participate in this study as an attractive case for investigations related to promoting collaboration and SPT. The school principal identified the 5th and 6th graders as ideal cohorts to receive the intervention, due to the frequent incidences of delinquency. Therefore, participants were 44 students (70% female) in the two 5th and 6th grade cohorts of the school. Students were diverse in terms of ethnic and cultural backgrounds including Palestinians, Syrians, Turkish Cypriots, Roma/Romani (Turkish-speaking), Bulgarians, Romanians, and Greek Cypriots (the dominant ethnic group on the country).

## Procedures

The study was conducted within the socio-emotional education course of the formal school curriculum, a course of two 80-min lessons per week. After 4 weeks of traditional lessons, the course continued with the technology-enhanced lessons for an additional 4 weeks. The course drew on a social constructivist pedagogy approach, both for the traditional and technology-enhanced lessons. In particular, the case method was used, as a problem-based instructional method that requires students to work in small groups on realistic problems, emphasizing the importance of practical experience in learning (Derry et al. 2006; Dottin and Weiner 2001). In practice, the case method involves problem solving, decision making, and negotiation of ideas, organized around case vignettes (i.e., realistic scenarios).

For the technology-enhanced experience, the lesson was conducted in a classroom equipped with two tabletops. Each cohort was split in four groups to allow teams of 4–6 students. Group assignment was decided on the basis of mixing abilities, gender, and ethnicity in every group. Because only two tabletops were available, two groups worked in parallel for 40 min, then switched with the next two groups (for another 40 min), and so on. The waiting time was used by another teacher for review (mainly math and science courses), as part of our arrangement for the study.

## Tabletop Activities

We used a series of text-based and video-based vignettes (different vignettes for each lesson, traditional and technology-enhanced). In all cases, students were presented with a socially-based problem. Depending on the problem, the students had to assume the role of the victim or observer in an unexpected event or an uncomfortable feeling (Winner and Crooke 2009). Text-based vignettes were shorter to facilitate quick reading on the tabletop screen. Video-based vignettes were longer and students needed to process the information, choosing the relevant and ignoring extraneous pieces (Dottin and Weiner 2001).

In preparing the activities we worked closely with the teacher of the socio-emotional education course. In terms of content, we found extensive support in a set of freely available resources, and in particular in the “Compassito” manual on human rights education for children (e.g., Picture game: children work with images to explore stereotypes, different perspectives, and how images inform and misinform), Pinterest (e.g., Perspective Taking “Think and Chat” Cards), Teacher YouTube (e.g., search for Social Thinking or SPT videos), as well as the Cyprus’s national curriculum on socio-emotional education. In terms of tabletop applications, we used two custom-built and open-source tabletop applications we developed in our previous work (Ioannou et al. 2013; Ioannou et al. 2015b), as well as free game-like applications with customizable content (e.g., Ioannou and Antoniou 2016). As presented in Fig. 1, the nature of the activities was to: decide the best way to respond to the socially-based problem amongst a set of predefined options (*What would you do?*), decide the best way to respond (no predefined options) and record a group-consensus solution (*Think and act*), decide the ending of a story of a socially-based problem and present a short group audio-recorded response (*Decide the ending*), sort a list of emotion-related images and reflect on how the protagonist of the scenario might be feeling and why (*Sort emotions*).

Overall, students were asked to apply concepts learned in the socio-emotional education course, as well as their personal experiences, to suggest solutions to the socially-based problems. Each case vignette concluded with a short debriefing, during which both groups and the teacher discussed the best elements of the group responses. Other than facilitating the debriefing session, the teacher’s experience was mostly limited to providing structural feedback (e.g., “You need to explain why the protagonist of the scenario feels the way s/he feels,” and “Please consider what we covered in class in relation to controlling emotions”).

## Data Collection

Both quantitative and qualitative data were collected, including data from two questionnaires and video data from the technology-enhanced sessions.

**Fig. 1** Sample activities: choosing from predefined options to solve social-based problem (1st row – left), sorting and reflecting on emotion-related images (1st row - right), recording the story ending (2nd row – left), recording the group response with no predefined options available (2nd row - right)



**SPT Questionnaire** The SPT questionnaire was given to all participants before and after the learning experience. The questionnaire consisted of the SPT scale of the Interpersonal Reactivity Index (Davis 1980). The seven-item SPT scale assesses the tendency to spontaneously adopt the psychological point of view of others (see Table 1). The scale was translated in the national language of Cyprus. Each item was followed by a seven-point scale, ranked from 1: strongly disagree to 7: strongly agree. The Interpersonal Reactivity Index has demonstrated good intra-scale, test–retest reliability, and convergent validity (Davis 1980).

**Collaborative Learning Experience Questionnaire** This questionnaire was given to all participants after the learning experience only. To assess students’ overall collaborative learning experience, we chose to measure three subscales typically used in the computer-mediated communication literature (see reviews by: Kreijns et al. 2003;

Tallent-Runnels et al. 2006): (1) communication and interaction, a six-item subscale assessing the extent to which students interacted with their group members during the activity (adapted from Yeo et al. 2006), (2) reflection, a five-item subscale assessing the extent to which students thought critically about issues in the case and their teammates ideas (also adapted from Yeo et al. 2006), and (3) perceived learning, a four-item subscale assessing the extent to which students thought they learned from the activity (Ioannou et al. 2015a). Each item was followed by a seven-point Likert scale, ranked from 1: strongly disagree to 7: strongly agree (see Table 2).

**Video Data Capture** Two cameras were placed in the room to fully cover student interaction and technology use. Verbal contributions were captured separately via audio recorders next to each team, which were later synced with the video.

**Table 1** Social perspective taking (SPT) scale

Social perspective taking (SPT):	
SPT-1	I sometimes find it difficult to see things from the “other guy’s” point of view. (–)
SPT-2	I try to look at everybody’s side of a disagreement before I make a decision.
SPT-3	I sometimes try to understand my friends better by imagining how things look from their perspective.
SPT-4	If I’m sure I’m right about something, I don’t waste much time listening to other people’s arguments. (–)
SPT-5	I believe that there are two sides to every question and try to look at them both.
SPT-6	When I’m upset at someone, I usually try to “put myself in his shoes” for a while.
SPT-7	Before criticizing somebody, I try to imagine how I would feel if I were in their place.

**Table 2** Collaborative learning experience subscales

Communication and Interaction (C&I):	
C&I-1	I explained my ideas to other students.
C&I-2	I asked other students to explain their ideas.
C&I-3	Other students responded to my ideas.
C&I-4	I related my ideas to other students' ideas.
C&I-5	I made good sense of other students' ideas.
C&I-6	I sought to improve the group answer (recorded essay).
Reflection (R):	
R-1	I thought critically about ideas we learnt in class.
R-2	I thought critically about my own ideas.
R-3	I thought critically about other students' ideas.
R-4	I sought answers to difficult issues presented in the cases.
R-5	I thought of how what we learnt in previous lessons applied to the cases.
Perceive Learning (PL):	
PL-1	The activity helped me understand things in socio-emotional education
PL-2	I learned new things by working on the cases.
PL-3	The activity was successful in promoting learning.
PL-4	I learned from my teammates while working on the cases.

## Findings

### SPT and Collaborative Learning

Quantitative data from all participating students ( $N=44$ ) were collected. First, Cronbach's coefficient alpha reliability was calculated for the SPT scale and for pre- and post-administrations, after scores on negatively-worded items were reversed. The scale had strong internal consistency (Cronbach's alpha = .85 for pre-test and .88 for post-test). To create a SPT variable, scores were computed for every student by calculating an unweighted mean score for the items in the scale. Next, to examine differences in students' scores from pre-to-post testing, a paired-samples t-test was conducted. There was a statistically significant difference on SPT propensity [ $t(43) = 8.67$ ,  $p < .001$ ], with students exhibiting higher levels of SPT in the post-test ( $M = 5.90$ ;  $SD = .56$ ) compared to pre-test ( $M = 4.96$ ;  $SD = .82$ ), with large effect size (Cohen's  $d = 1.30$ ).

With respect to the students' collaborative learning experience, a similar process was followed using the data from the post-only subscales. All subscales had acceptable internal consistency (see Table 3). Subscale mean scores were well above the midpoint of the scale, indicating that students

positively endorsed the experience in terms of communication and interaction, reflection and learning.

### Qualitative Evidence for SPT

Qualitative data analysis aimed to further support the evidence from the quantitative findings, as well as to provide insight on how SPT was enacted during the activity. The researchers delved into the video data to pinpoint potential evidence for elements of SPT, particularly looking at students' discourse and tabletop activity, around which episodes of SPT could be documented. Multiple episodes of such cognitive engagement were evident, in which students exhibited understanding of the situation from another point. For example, in the "sorting emotions" activity and through the thinking-aloud explanations recorded in the videos, e.g., a team elaborated:

"Orfeas [the story protagonist] feels anger because he cannot understand why people are cruel to him [student 1]. He might also be angry that none from his friends are brave enough to support him [student 3]. Or he might be angry with himself, asking 'Why am I different? Why can't I just be like everyone else?' [student 4]."

It also became apparent in the proposed endings of the story ("decide the ending" activity), often emphasising the inclusion and acceptance of Orfeas:

"...Students will realise that it is ok to be different, it is ok to be unique. Orfeas has things to offer...He is very good in art and maths, he is a great goalkeeper during football games. All of us are different and we all have

**Table 3** Subscales reliabilities and descriptive statistics ( $N=44$ )

Variable	Cronbach's alpha (post only)	M (SD) (post only)
1. C&I	.85	6.16 (.56)
2. R	.88	5.73 (.82)
3. PL	.78	5.98 (.67)

Note. 7-point response scale

something to offer to the classroom, to the school, and to our communities.”

Another student in the same activity, assumed the role of Orfeas as the victim of bullying and expressed his inner thoughts:

“I don’t deserve to be treated like this, because I am different. I will talk to my parents about this. I will also make sure I focus on my friends and ignore those bullies who have nothing better to do. I will stay strong!”

A yet another example of SPT, was evident in the “think and act” activity, in which a student assumed the role of a bystander, took the microphone and recorded:

“I cannot just observe Jane suffering from bullying. Jane needs a friend and I am not afraid to speak up. I stand up and say to the bullies: Hey, you guys, don’t you have anything better to do than to harass Jane?! Perhaps Jane is special then, and that is the reason she catches your attention and you are trying to catch hers...” (student imitates shouting voice).

Overall, the video data provided rich support for the quantitative findings via an in-depth (i.e., qualitative) account of how SPT was exhibited during the tabletop activities.

## Discussion

In the contemporary multicultural classroom of the twenty-first century, in which students from diverse ethnic and cultural backgrounds learn together, it becomes necessary to embrace collaboration, SPT, and understanding of the *other*. SPT as a form of social thinking and a process of socially-based problem solving is particularly relevant in this context. The present investigation is a step forward towards the practical impact of tabletop research in this arena. The study has demonstrated how interactive tabletops, along with constructivist pedagogy, have the potential to enable collaborative learning and promote gains in SPT propensity. Next, we discuss the initial goals of the study, while making remarks for advancing this area of research and application.

## Practical Utility and Impact of Tabletop Research

We present a practical example in which technology (tabletop) met pedagogy (case method) in the multicultural classroom. To achieve this, we worked closely with the teacher to design the activities and to form groups of mixed abilities, gender, and ethnicity for the experience. We also benefited from freely available educational content and tabletop applications. An

attractive technology-infused social environment was created in which students communicated, worked together, and considered the perspective of the *other*. Unlike the massive amounts of research in education focused on using technology as a conveyor of content to improve achievement, this work pointed to the role of tabletops (and shareable surfaces in general) in promoting the development of social thinking skills.

The study is unique in that it enabled collocated collaboration in a real classroom setting, while the technology was integrated in the school’s socio-emotional education course for 4 weeks. Previous work aimed at SPT was mainly done using web technologies (e.g., Gehlbach et al. 2008). Also, the limited previous work aimed at collocated SPT and social skills/outcomes has considered tabletops as informal learning activities (Zancanaro et al. 2012) or as school activities not directly linked to the school curriculum (Ioannou and Antoniou 2016). Although, our findings are preliminary and warrant replication, they demonstrate a practical utility of tabletop research and its potential impact in this arena.

## Evidence of Collaborative Learning and SPT

We demonstrated how students exhibited gains in SPT propensity during a four-weeks experience. These gains have a large effect, indicating they are meaningful and may have practical importance for education (LeCroy and Krysik 2007). Further support for SPT was found in video episodes of students exhibiting understanding of the situation from another point. These findings support previous research findings demonstrating how technologies have significant potential for enhancing SPT (Gehlbach et al. 2008; Veletsianos and Eliadou 2009). At the same time, the students experienced high levels of communication and interaction, reflection, and learning, in accordance with numerous previous research findings documenting the collaborative learning affordances of tabletops (Dillenbourg and Evans 2011).

We recognize that one might think that pedagogy (not technology) enabled student collaboration and SPT. However, one needs to consider that at the time of pre-testing, right before the tabletop was introduced, the participating students had already received 4 weeks of lessons within the same constructive pedagogy. That is, any gains on SPT can be reasonably attributed to the four-weeks tabletop experience, making it difficult to view tabletops as merely vehicles for delivering instruction (Clark 1994). For instance, the authors consider that the opportunity of recording on the tabletop encouraged acts and expressions in the form of dramatic play and therefore, perspective-taking. Also, the successful integration of pedagogy (case studies) and technology (Kozma 1994), made the activity relevant to the students and engaging, which might have resulted to the positive gains in SPT. Moreover, the affordance of tabletops

to promote collaborative learning might be another reason for the positive results of the study. Last, possible occasions of “embodiment” triggered by the tabletop activity might have offered an alternative way for students to articulate their thinking (Saleh et al. 2015); this idea merits further investigation as tabletops have recently been discussed in the realm of embodied cognition (Lee 2014). Although it is difficult to view tabletops as merely vehicles for delivering instruction (i.e., Clark 1994), the study would benefit from some further investigation of the mediating role of technology in engaging students in SPT.

As a limitation of this work, we recognize that the study lacks direct measures of social behaviour from school or homes, which could give a different impression of the effect of the technology-enhanced lessons in terms of SPT propensity gains. Also, the sample size of the study is small; yet, given the total school population of 100 students, 44 participants constitute an adequate representation of the school demographic. Moreover, although both the participating school and cohorts were purposively selected, which does not allow for generalization, the findings of the study should be transferable to other similar circumstance and contexts. Despite the limitations, the study demonstrates duration of the technology-enhanced learning experience (4 weeks long, two times a week) which reduces the possibility of an enthusiastic reaction to the technology and thus, a novelty effect being confused with true impact of the experience.

In conclusion, drawing on the affordances of shareable surfaces to support the development of students’ social skills and outcomes in collocated settings, the present study began to address how tabletops can help nourish collaboration and SPT in the multicultural classroom. Our preliminary findings are encouraging. We highlight the need for more studies that will replicate our findings, aiming explicitly at technology-enhanced collaboration and SPT, as “skills for living” in the twenty-first century (Binkley et al. 2012). Tailoring shareable surfaces to support social thinking processes is an emerging field of research with potential real-world impact of technology use (Bruun et al. 2017).

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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