

Cultivating Collaborative Learning

How interactive tables facilitate effective collaborative learning

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Most great learning happens in groups. Collaboration is the stuff of growth.

-Sir Ken Robinson Ph.D.

Executive Summary

As an educator you know that if today's students are to become tomorrow's successful leaders they must develop 21st century collaboration skills. And research literature tells us that collaborative learning is the most effective way to help students attain these skills. Unfortunately, creating a collaborative classroom can be difficult and time-consuming for educators.

While there is no panacea when it comes to teaching and learning collaboration skills, educators and researchers are discovering that the features of interactive tables – such as a multi-touch, horizontal surface where students can work in small 360-degree collaborative groups – naturally encourage collaboration and the development of the precise skills that students need to flourish in school and the workforce.

In this research paper, commissioned by SMART Technologies to support educators in their efforts to incorporate collaboration into their classrooms, we will learn how interactive tables are being proven to engage students in collaborative learning more effectively than has been possible in the past.

Introduction

As an increasing amount of educators see the positive effects of taking a collaborative approach to learning in the classroom, these same educators are seeking out tools to support collaborative learning. Although interactive tables are a new technology, research is already emerging on the positive effects this technology has in collaborative learning settings. In this paper we report on why collaborative learning is important and how interactive tables support this method of teaching and learning.

Why is collaborative learning important?

Time and time again research has shown that collaborative learning – where students work together in small groups to make discoveries, solve problems, produce an artifact etc.– enhances and improves learning, helps develop critical thinking skills and much more.

“Collaboration can have powerful effects on student learning, particularly for low-achieving students. These effects are seen in the form of higher scores on work completed collaboratively, even when students turn in separate products. In addition, there appears to be a carry-over effect, such that individual performance on subsequent measures of achievement tends to be higher for students exposed to collaborative learning” (Lai 2011)

Why then, if collaborative learning is so effective, is this approach to learning not used more often in classrooms?

Why is collaborative learning difficult?

Dr. Emma Mercier, a research associate in the School of Education at Durham University, says, “The research is clear that collaborative learning is always better than working individually”. Unfortunately, she explains, it’s also difficult for educators to incorporate into their classes.

“The amount of time that kids spend working in groups in school is tiny. Teachers don’t use it because it’s incredibly difficult to do,” explains Mercier. Through her research she has learned that teacher concerns about collaborative learning include:

- How to ensure students are engaged
- How to ensure students stay on task
- And logistical concerns that include wasting class time handing out papers, tools etc.

What are interactive tables?

Interactive tables feature a large, interactive, horizontal surface designed to encourage face-to-face collaboration. Teachers can load digital content and activities on an interactive table for students to work on in a group setting. Up to eight students can interact simultaneously with the digital content on the surface

of a table making it easy for all students in a group to participate. These tables are usually wheelchair accessible, have scratch- and spill-proof surfaces and have a sturdy base to avoid tipping.

How are interactive tables different from other classroom technologies?

Researchers have found that unlike single-point-of-control technologies, the large horizontal, multi-touch surface of an interactive table supports collaborative learning by encouraging natural, active, 360-degree collaboration. These key features of the interactive table engage students and hold their attention, keeping them focused on their assigned tasks.

“A number of design features of large multi-touch interactive tables support collaborative interaction. Including the ability for several students to interact with the surface at the same time, making it significantly different from the single point of control provided by other technologies such as a computer and mouse or interactive whiteboards.
(Kharrufa, Leat, Olivier, 2010)

Well known-collaborative learning researchers Pierre Dillenbourg and Michael Evans provide a brief but concise explanation of how interactive tables differ from some of today’s most popular classroom technology in their paper *Interactive tabletops in education (2011)*.

“Our position can be summarized as follows:

- Desk(top)s are personal
- table(top)s are social
- (digital) whiteboards are public”

Dillenbourg and Evans’ paper goes on to explain that interactive tables are designed for co-location, multiple users, hands-on activities and multiple modes of communication – all of which allow for rich collaborative experiences for educators looking to bring collaborative learning to their classrooms. (Dillenbourg and Evans 2011)

Conclusion

Research has shown that interactive tables provide a natural platform for face-to-face collaboration, simultaneous contribution and in-depth discussions. As a result, interactive tables support students in collaborative learning settings in many ways including improving understanding, developing higher-level and critical thinking skills. But, most importantly, interactive tables are making it easier for educators like you to help students gain the skills they need to be more successful learners.

For more specific examples of how interactive tables support collaborative learning and the benefits this technology offers students, read the following case studies taken from recent research projects.

Case Studies

Case Study #1

*Collaborative Sensemaking on a Digital Tabletop and Personal Tablets:
Prioritization, Comparisons, and Tableaux*
University of Waterloo, Canada

Overview

Researchers at the University of Waterloo in Canada report that interactive tables strongly support sensemaking – the process of understanding knowledge and then using that knowledge to make decisions. While sensemaking is a skill that represents a significant portion of the work conducted in the workplace today, it is poorly supported by current software. (Plaue, Stasko 2009)

In their study researchers James Wallace, Stacey Scott and Carolyn MacGregor compared how students performed on sensemaking tasks when using an interactive table only, tablets only and a combination of interactive tables and tablets.

Their research showed the following:

- The presence of interactive tables led to improved student performance with 20 percent more insights discussed on sensemaking tasks
- The interactive table better supported a group's ability to prioritize information, to make comparisons between task data, and to form graphic representations
- The presence and equitable use of an interactive table was associated with improved group performance, while more equitable use of tablets was detrimental to group performance

Conclusion/Results

The key findings in this report show the importance of using the right tools in collaborative learning settings. Using a shared tool designed for groups had a positive effect on group performance while using personal devices in a group setting had a negative effect on group performance.

As the report conclusion states, "Our analysis also revealed correlations between equity of participation measures and group performance. A positive correlation between the use of shared devices and group performance, and a negative correlation between the use of personal devices and group performance were identified. These results provide insight into the impact that personal and shared devices can have on collaborative sensemaking processes."

Case Study #2

Digital Mysteries: Designing for Learning at the Tabletop (2012)
Newcastle University, United Kingdom

Overview

In this study researchers hypothesized that they could create a collaborative learning tool called Digital Mysteries that would use the interactive table's unique features to be more effective than traditional paper or computer-based tools. Researchers hoped to support externalization of thinking and higher-level thinking skills.

Students were given a mystery to solve and then divided into two groups. One group used a paper-based method for reviewing, sorting and solving clues while the other group used an interactive table in conjunction with the Digital Mysteries collaborative learning software which included digital clues that could be moved, resized and sorted.

Researchers found that the groups using the multi-touch interactive table were immediately better able to build on each other's ideas and engage in mutually responsive conversation about their tasks.

Conclusion/Results

After analyzing their findings researchers found that the large multi-touch interactive tables were more effective at supporting collaborative interaction in three key ways. (Kharrufa, Leat, Olivier, 2010).

1. Several students could interact with the surface at the same time, making it significantly different from the single point of control provided by other technologies such as a computer and mouse or interactive whiteboards
2. The multi-touch interactive surface engaged students and held their attention by displaying the information on a single visible plane in common view
3. Using the multi-touch features for positioning and resizing to indicate the relevance and importance of clues supported students in the joint construction of understanding in this kind of collaborative activity

As Ahmed Kharrufa, one of the researchers involved in the study, explains, "Among the main aspects of 21st century learning skills is to learn how to collaborate with others whether for learning or for work. And to have critical thinking skills or promote higher level thinking skills – both of these go hand in hand when you work on the interactive surface. It's inherently a collaborative learning environment and collaboration is strongly linked with the higher level thinking skills because of the type of discussions involved when you solve a problem collaboratively."

Case Study #3

Collaborative learning with multi-touch technology: Developing adaptive expertise
SynergyNet classroom, Durham University, United Kingdom

Overview

Emily Mercier and her colleague Steven Higgins report on a math-focused project in the SynergyNet classroom at Durham University that asked whether interactive tables would support the development of flexibility and fluency in Math. They explain the importance of these two math skills in their paper.

Developing fluency and flexibility in mathematics is a key goal of upper primary schooling, however, while fluency can be developed with practice, designing activities that support the development of flexibility is more difficult. (Mercier and Higgins, 2013)

The study compared how students perform on mathematical tasks using multi-touch interactive tables in conjunction with a collaborative learning activity called NumberNet and how they perform when completing the same task using the traditional pen-and-paper method.

Conclusion/Results

Results from the study of 86 students (44 using interactive tables and NumberNet, 42 using a paper-based comparison activity) indicated that all students increased in fluency after completing these activities, while students who used interactive tables and NumberNet also increased in flexibility.

Researchers also found that video analysis of groups showed that the students using interactive tables and NumberNet were able to collaborate, and learn from other groups, which may have also led to an increase in flexibility.

As Mercier and Higgins report, “Our findings confirm the importance of practice for developing fluency and routine expertise, while indicating that having the opportunity to collaborate over the creation of mathematical expressions may foster deeper engagement with the concepts and lead to increased flexibility and adaptive expertise.”

Learn more

Interested in learning more about interactive tables? Get to know the SMART Table interactive learning center, visit www.smarttech.com/table

References

- Chickering, A., & Gamson, Z., (1987) "Seven principles for good practice in undergraduate education" *American Association of Higher Education Bulletin* vol.39 no.7 pp.3-7
- Dillenbourg, P., & Evans, M., (2011) *Interactive tabletops in education* International Journal of Computer-Supported Collaborative Learning 6 (4), pp. 491-514
- Gokhale, AA. *Collaborative learning enhances critical thinking*. Journal of Technology Education Volume 7, Number 1 Fall 1995
- Mercier and Higgins (2013) *Collaborative learning with multi-touch technology: Developing adaptive expertise*.
- Higgins, S., Mercier, E., Burd, L., Joyce-Gibbons, A. (2012). *Multi-touch tables and collaborative learning*. British Journal of Educational Technology, 43: 1041–1054. doi: 10.1111/j.1467-8535.2011.01259.x
- Jamil, I., & Subramanian, S. (2012). *The impact of interactive tables and multiple surfaces technologies towards communication and learning*. Paper for Surface Learning Workshop '12.
- Johnson, D. W., & Johnson, R. T. (1996). *Cooperation and the use of technology* In D. H. Jonassen (Ed.), Handbook of research for educational communications and technology (pp.1017-1044). New York: Simon and Schuster Macmillan.
- Kharrufa, A., Balaam, M., Heslop, P., Leat, D., Dolan, P., Olivier, P. (2013). *Tables in the Wild: Lessons Learned from a Large-Scale Multi-Tabletop Deployment*. The Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems 2013. (Paris, France, 27 April-2 May). CHI'13 (To be published)
- Kharrufa, A., Leat, D., Olivier, P. (2012). Designing for Reflection: A Case Study with Digital Tabletops and Digital Mysteries. In Yang, H. H., & Wang, S. (Ed), Cases on E-Learning Management: Development and Implementation. (pp.268-292). IGI Global, USA
- Kharrufa A., Leat D., Olivier, P., (2010). *Digital Mysteries: Designing for learning at the tabletop*. The Proceedings of the ACM International Conference on Interactive Tabletops and Surfaces 2010. (Saarbrücken, Germany, November 7-10, 2010). ITS'10
- Lai, E., (2011) *Collaboration: A Literature Review*

Mercier, E., Higgins, S., (2013) *Collaborative learning with multi-touch technology: Developing adaptive expertise. Learning and Instruction* 25 (2013) 13-23

Resta, P., & Laferrière, T., (2007) *Technology in Support of Collaborative Learning. Educational Psychology Review* March 2007, Volume 19, Issue 1, pp 65-83

Wallace, J., Scott, S., MacGregor, C., (2013) *Collaborative Sensemaking on a Digital Tabletop and Personal Tablets: Prioritization, Comparisons, and Tableaux* CHI 2013: Changing Perspectives, Paris, France, Session: Multi-Device Interaction

