



Evidence of the Effectiveness of Self-Organized Learning Environment (SOLE) in the Classroom in Imparting Twenty-First Century Skill Sets

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Last year in *Journal of Child Guidance*, Weisblat and McClellan (May/June 2017) articulated their theory of change for how the Self-Organized Learning Environment (SOLE) can positively disrupt students' relationship to their education, increase their ability to develop twenty-first century skills and transform the classrooms and educational environments in which they are learning. In this article, we provide evidence from our study of SOLE that the process is improving the twenty-first century skill sets of the students who are using them. We also show evidence for an analogous transformation for teachers as a result of the SOLE process, increasing confidence in their roles as de-centered, yet still essential, classroom facilitators.

The Need

Before we discuss our project, we briefly review the need for very different kinds of learning than we have typically seen in the traditional classroom setting. In the twenty-first century, the nature of work has changed as well as the skills that are essential for success. The seven skills sets, listed and defined in the table below, are critical to students' academic and future work success. These skill sets form the foundation for twenty-first century learning.¹

TABLE 1: SEVEN SKILLS SETS ARE CRITICAL TO STUDENTS' FUTURE

KEY 21ST CENTURY SKILLS	DEFINITION AS OBSERVED WITHIN THE CONTEXT OF THIS STUDY
Problem solving	Problem solving means using “the knowledge, skills, competencies and other attributes ... relevant to economic activity” (Becker, 1964 and Schuller, 2001). It also includes the attributes of individuals in terms of knowledge, skills, competencies, and attitudes conducive to personal development and societal well-being (Lee, Cornwell, and Babiak, 2012).
Collaboration and leadership	Research indicates that collaboration and leadership are critical components for academic achievement (Heyneman, 1998). According to the literature and noted by the World Bank, collaboration and leadership can occur in education in several ways: a) students practice social skills such as participation and reciprocity; b) schools provide forums for community activity; and d) through civil education students learn how to participate responsibly in their society. Education has also been linked to building societal cohesion and strengthens citizenship (Putnam, 2000).
Agility and adaptability	Increased youth adaptability is directly correlated to an increased sense of self-mastery, self-esteem, and a sense of belonging as well as the capacity to cope with adversity (Institute of Medicine, 2009).
Initiative and entrepreneurship	Students who set their goals and evaluate their progress experience greater academic success than students who rely on external goals and evaluations (Moeller et al., 2012).
Effective oral and written communication	Effective oral and written communication are a practiced skill set that improve from multiple interactions leading to new iterations of thought and practice. Academic self-management is control over ones' own metacognition and self-regulation leading to new perspectives, characteristics or behaviors that better demonstrate these skills (Dembo, 2000).
Ability to access and analyze and information	Learning to find information relevant to a problem or situation is a critical new skill of the digital native, as the amount of new information increases daily. Students' understanding of their own processes (meta-cognition) to learn and understand this information and leverage it within their context and apply it in the greater system is pivotal in analytical application of thinking today.
Curiosity and imagination	Imagination and curiosity stem from seeing what is not there and realizing the possibility of the missing factors' impact. Additionally, these skills are honed by learning how to take entropic events and share a linear narrative that applies contextually.

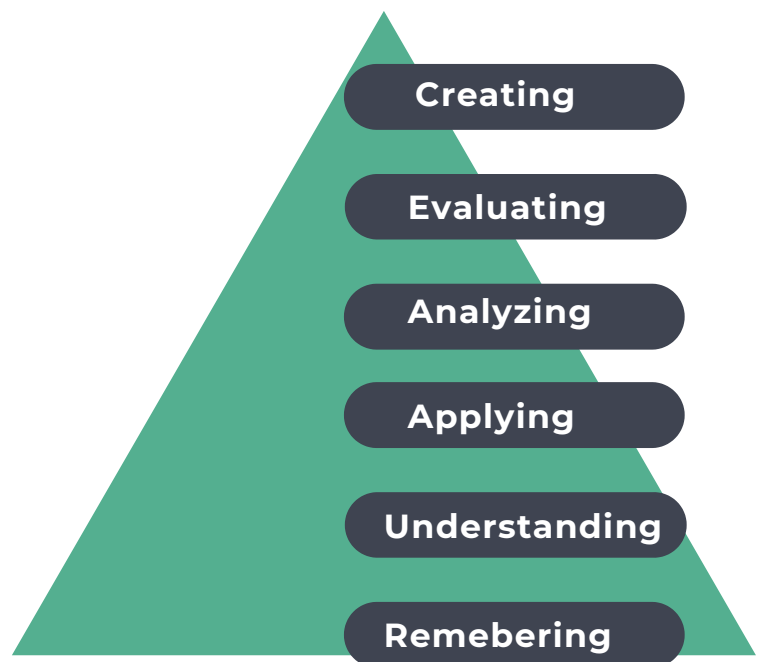
Examining these skills sets, we can see that 21st century work requires more complex communication and expert thinking with fewer routine cognitive and manual skills. Further, learning and innovation skills, digital literacy skills and life and career skills are necessary to thrive in the 21st century (Trilling and Fadel, 2009).

"SOLE has made kids more aware of how to think about questions and a critical approach to a question that they may not know the answer to. That makes them better able to create questions. Thinking of questions heightens students' awareness of what they still don't know and being able to ask and that becomes the (next) SOLE question." - 6th grade teacher

However, many schools have not adapted their curriculum to address these changing needs (Wagner, 2010; Trilling and Fadel, 2009). There is a resistance among some educators as well as members of the larger public to prioritizing these new kinds of skill sets for fear that it will require the sacrifice of content knowledge since there are only a few precious hours of learning in each day. There is also trepidation about the use of technology to advance learning. However, what is useful knowledge at one point in time may not be useful in a few years as society and technology is changing rapidly (Brandt, 2011). Anyone who has had to relearn a software package due to an upgrade can understand that point!

Thus, as Alvin Toffler said, "the illiterate of the 21st century will not be those who cannot read and write but those who cannot learn, unlearn and relearn." This statement can apply to teachers as well as they work to find new pedagogies to ensure that students are learning what they must to succeed in this rapidly evolving society. We believe the role of the teacher is critical to navigating students and communities from the early stages of Bloom's taxonomy of memorization to the highest levels, consisting of understanding, synthesizing and applying knowledge in the classroom and in life (see figure 1 Bloom's taxonomy).

FIGURE 1: BLOOM'S TAXONOMY



The SOLE Process and How it Addresses the Need

SOLE is an innovative pedagogy designed to facilitate student development of 21st century learning skills. Briefly stated, students consider a research question provided by websites such as startsole.org, by the teacher, or by the students themselves. The students then break into groups. Although the name Self-Organized Learning Environment implies that students organize themselves into groups, the actual process for organizing varies. Some teachers allow students to create their own groups, some assign groups, and for others it is a negotiated process between teacher and students.

Each group, consisting of four to five students, typically has at least two devices with access to the internet. Students spend approximately thirty minutes researching the research question in a group process. After the research period, there is typically a twenty-minute presentation preparation period. Students present using some sort of visual display, which can include poster boards, presentations, software or even artistic efforts such as plays or songs. Each group then presents to the class and usually a question and answer period follows. After the presentation, there is sometimes an opportunity for students to reflect and self-assess and sometimes teachers provide feedback on one or more aspects of the process.

Aspects of each SOLE activity help student develop twenty-first century learning skills (see figure 2). All questions may be aligned with state teaching objectives (for example, Start SOLE has a question bank where all questions are aligned and an app where teachers are supported in all aspects including application).

FIGURE 2: STUDENT SOLE SOLE ACTIVITIES TRANSLATED INTO 21ST CENTURY LEARNING SKILLS

Self Organizing	•Selecting into groups or learning to interact with pre-selected groups, demonstrating collaboration
Consider Question	•Reflecting with group members allows practicing potential avenues for answers. Students gain from the diversity of group thinking and comparison.
Research	•Learning skills that improve with practice and observation of peers. Strategizing how to approach a problem and then finding the answer offers an opportunity to share thinking styles and problem solving abilities.
Prepare Presentation	•Conveying information in the best format is critical in a 21st century community. In a world of short texts and sound bytes, students must create, articulate and share information wisely to succeed.
Present	•Collaborating in a group setting and sharing the pride of work and credibility of the learned knowledge is a pivotal skill of the 21st century thinker.
React and Assess	•Reflecting and assessing at the end of the SOLE exercise develops metacognition and group metacognition skills.

Evidence of Effectiveness for Students

Each semester for two years, our research team studied the implementation and effects of SOLE on students and teachers in five schools and one STEM-focused after school program. In total, we observed over 500 SOLE groups in about a hundred classrooms, conducted focus groups with teachers, conducted surveys of teachers and interviewed school administrators. From this research, we were able to identify a twenty-first century development trajectory for students and teachers who use SOLE regularly (see table 2).

Our results show that using SOLE, students are taking control of their learning and developing new skills (e.g. communication, presentation, leadership, teamwork, research and technology) to address research questions. Teachers report changes in these skill sets over the course of the first academic year using SOLE. Once developed, they apply these skills in other academic contexts. At that point, as one teacher in a focus group put it, “students are in charge of their own learning.” We observed that almost all of the communication during SOLE sessions is student-to-student as opposed to a more traditional teacher-to-student pattern. Further student participation is broad with 90% of students speaking at least once during a five minute observation period (the median was 6 contributions per student in five minutes).

During the second year of SOLE, students display more complex mental and relational constructs such as self-reflection and meta-cognition. As a result, students have transformed their relationship to learning to become better critical thinkers, more aware of their own strengths and weaknesses as learners, and better able to develop their own strategies for improvement. For example, one teacher reports that “the kids are good at coming up with their own SOLE questions. If they are doing a [non-SOLE] lesson and something comes up that they don’t know, they automatically make a SOLE question out of it.” Our student observations also show greater ability to go into depth on a topic, elicit peer interest, build upon previous knowledge, exhibit self-reflection, and engage in individual and collective meta-cognition.

TABLE 2: PROGRESS ACROSS SEMESTERS ON KEY SOCIAL AND ACADEMIC INDICATORS

Semesters Being Compared	1 & 2	2&3	3&4	1&4
Presentation Quality	.47@	-.33	-.07	.07
Give Each Member a Role	.19	.19	-.07	.30@
Answer Question	-.24	.40@	-.07	.09
Create Logical Sequence	.08	.23	-.41*	-.09
Go Into Depth	-.11	.22	-.66***	-.55***
Elicit Peer Interest	.22*	-.41*	-.16	-.34***
Build Upon Previous Knowledge	.00	.07	-.32	-.25**
Exhibit Self-Reflection	.26*	-.53*	-.03	-.30**
Exhibit Meta-Cognition	-.09	-.86***	-.03	-.98***
Exhibit Collective Meta-Cognition	.14	-.115*	-.03	-.104***

*statistically significant at .05 or less

**statistically significant at .01 or less

***statistically significant at .001 or less.

@statistically significant in the opposite of the expected direction

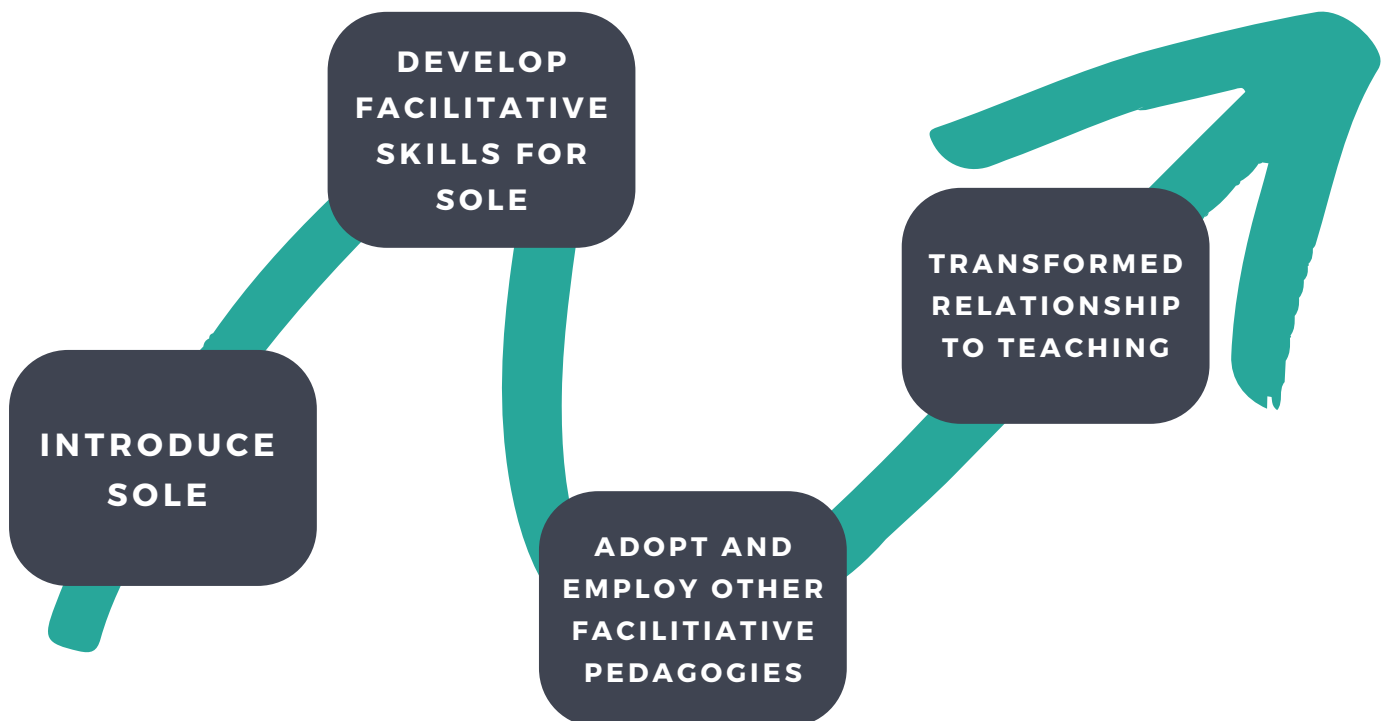
Evidence of Effectiveness for Teachers

We find through our focus groups that teachers go through a distinct but complimentary type of trajectory with SOLE (see figure 3). They begin the process by introducing SOLE to their classrooms. During this introductory period, they are more concerned with logistics and processes, sometimes wrestling with a desire or habit of exerting more control in the classroom. One teacher says that she is “a control freak and it’s hard for me to let go but now it’s easier for me to let go having seen what SOLE has done and what the students can do.”

Once they see the enthusiasm of the students as well as the improvement in academic, social and self-management skills described above, they de-center themselves in the classroom, in the process developing the facilitative skill sets that help their students the most. Since they are no longer always the transmitters of knowledge, they also feel less pressure to know all of the answers, which frees them up to be curious and open to learning with their students. One teacher reported “I like that I can say I don’t know.” As they internalize and become comfortable with their new roles as facilitators, we find that teachers may pass on the SOLE methodology to other teachers who are not aware of it and reinforce it with those teachers who are using it.

Although teachers are de-centering themselves and acting in a facilitative rather than a directive role, we still do find their facilitative skills to be critical to student success. For example, when teachers pace the SOLE sessions well either by using the SOLE app or by their own implementation, the quality of the presentations is higher. Similarly, when teachers allow time for questions from the class, they create more opportunity for students to develop meta-cognition and self-reflection skills.

FIGURE 3: TWENTY-FIRST CENTURY DEVELOPMENT TRAJECTORY FOR TEACHERS



Discussion

Helping students to learn to think is a different process than teaching them content. Dewey (1910) and Schon (1985) argue that the act of thinking arises from a confrontation with confusion or ambiguity (in Zimmerman, 2013). Holding the confusion while pursuing the inquiry is critical to thinking but is uncomfortable. The easiest solution is to accept the first suggestion presented in order to resolve the issue and ease the discomfort.

Learning not to rush to conclusion, to consider different points of view and to weigh the evidence (self-reflection) and to consider one's own learning process (meta-cognition) and one's group learning process (collective meta-cognition) are essential elements to twenty-first century learning skills.

When students do a SOLE session for the first time, they are excited that they get to use the internet and work with their classmates. It is typical, however, for students working on SOLE for the first time to simply enter the SOLE question into the search engine and copy the information from the first source that is brought up. Over time, however, they learn to break down the question into component parts, to evaluate sources, and to sift through different and perhaps conflicting information from different sources. Once they gain experience with this kind of inquiry, they begin to understand themselves better as learners and thinkers and they begin to use these transferable skills in other contexts. In so doing, they have changed their habits, disrupted their orientation towards learning, and transformed themselves as learners.

When teachers do SOLE for the first time, they tend to be concerned with the logistics and the classroom dynamics. Teachers in focus groups expressed concern on a variety of factors, including how the group dynamics would play out, whether participation would be wide-spread, how students with a variety of learning styles and abilities would fit in. They also expressed concern with whether the students would be able to answer the question without direct instruction.

Skepticism notwithstanding, teachers do adapt facilitative teaching skills to help the students learn to be successful with SOLE. For example, they may help the students who are entering the SOLE question directly into the search engine and not getting the results they want by asking them how they can break down the question into component parts. Or teachers may help students develop strategies to assess the quality of the sources they are accessing. Once they have been practicing those facilitative skills with SOLE, they apply them to other types of learning. By facilitating student learning instead of directing it, they are creating room for student creativity and imagination as well as assisting students on group dynamics, communication and presentation strategies, and critical thinking skills as they encounter them. In this way, teachers have transformed their relationship to teaching.

However, SOLE does present some challenges in the twenty-first century classroom. Sometimes the reliance on technology can result in a failed SOLE session. Second, helping students learn to navigate appropriate sites is a critical skill that teachers must learn in preparation for doing SOLE. Finally, SOLE is most effective when used in a metered dose, or else students will suffer fatigue from the process. Other innovative techniques such as flipped classrooms and personalized learning would complement this approach.

Conclusion

SOLE is an innovative and critical pedagogical technique that disrupts the traditional didactic, teacher-centered classroom and provides a framework for a student-centered approach to learning. Further, teachers learn to become co-navigators in classroom practice. These dynamics in students and teachers lead to deeper learning (Bransford et al, 2000) as well as steps to Wagner's Seven Principles for the Twenty-First Century Classroom (2010) and Bloom's transformative learning model where students progress from early stages of memorizing to later stages of analyzing, synthesizing and applying their learning in the classroom and beyond.

We are continuing to study a host of impacts that SOLE may have on student outcomes. For example, by providing more opportunities for group work, does it increase social and emotional learning? By increasing critical thinking skills, does it help students perform better on standardized tests? Does it better prepare them for college? Can researchers develop better learning analytics to measure the short and long-term effects of intermediaries such as the SOLE pedagogy?

Notes

1Although there are many lists of twenty-first century learning skills from different researchers, there is coherence to their call to engage students in collaborative, digital based efforts designed to improve critical thinking and communication skills (Dede, 2009).

2Meta-cognition and self-reflection are much-debated, sometimes overlapping terms in the education literature (Zimmerman, 2013). Self-reflection is defined as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends (Dewey, 1910). Meta-cognition depends on knowledge of one's own cognition and involves monitoring and regulation of one's own knowledge. Although this can sound complicated, it needn't be. Some simple examples include realizing one is not sure of what is expected from an assignment or that has more trouble mastering one kind of learning task than another (Zimmerman, 2013).

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