Do 21st Century Learning Environments Support Self-Directed Learning? Middle School Students' Response to an Intentionally Designed Learning Environment

Christopher Fahnoe
Michigan State University
United States
fahnoech@msu.edu

Punya Mishra
Michigan State University
United States
punya@msu.edu

Abstract: 21st Century Learning Frameworks identify Self-Directed Learning (SDL) as a being a critical skill for students. Little empirical research, however, is available regarding the SDL capabilities of younger students, particularly as they work and learn technology rich classroom contexts. This mixed-methods study focuses on examining the development of self-directed learning skills by middle school students as they engage in an intentionally designed, technology rich learning environment. Participants in the study were two groups of 6th graders in an upper middle class suburban school. One group worked in an innovative 21st century learning environment while the other group of students worked in the traditional classroom. The Self-Directed Learning with Technology Scale (SDLTS), an assessment focusing on younger learners, was utilized for the study to collect data in both environments. Student in both groups were interviewed to gather additional qualitative information regarding their experience with each of these environments. The results shows that students in the intentionally designed 21st century learning environment reported a higher perception of self-directedness than their traditional counterparts. Additionally, interviews suggest that the design of the environment provides the types of opportunities to allow for students to engage in topics of interest and problem solve collaboratively. We believe that these findings support the value of open-ended technology-rich environments for developing self-regulated learners.

21st Century Frameworks and Self-Directed Learning

Self-directed learning is a concept present in many of the current frameworks on 21st Century Learning and has often been regarded as critical part of individualizing learning experiences (Caffarella, 1993). The P21 Framework Life and Career Skills (2010) included "Initiative and Self-Direction", the ISTE Standards for Students (2007) specifically called for students to be able to "plan and manage activities to develop a solution or complete a project", the AASL Standards for the 21st Century Learner (2009) noted that learners should "pursue personal and aesthetic growth", and the enGauge 21st Century Skills (2003) Inventive Thinking section included "adaptability, managing complexity, and self-direction." Although the research on self-directed learning has been around for several decades, the context has changed with online learning, greater access to technology, opportunities for more personalized learning experiences, and connection to information and resources that were not previously available. Schools are recognizing the importance of self-directed learning as a necessary skill needed for the 21st century as well as the need for teachers to "enhance students' abilities for accessing self-directed learning" (Chou, 2008). Self-directed learning remains a relevant life skill and requires a new examination under the current educational contexts and the opportunities provided by access to new technologies for learning.

Along with the standards and frameworks, concepts related to self-directed learning are prevalent in educational technology and leadership discussions as a way to differentiate learning, change the role of learner and teacher in the classroom, alter the time/place of learning, and potentially alter the structure of traditional schooling. New developments in 21st Century educational landscape such as online learning opportunities, shifts in pedagogy, and Internet-connected mobile device put additional expectations on all learners (not just adult learners) to take more initiative in their own learning (Teo, 2010). Similarly innovations such as Khan Academy (www.khanacademy.com) or the Flipped Classroom (vodcasting.ning.com/video/the-flipped-classroom) have sparked intrigue about the value of self-directed learning in elementary schools and consequent changes in the role of the traditional classroom teacher. In these models additional class-time is not needed for direct instructional purposes and the teacher is more available to address questions and individualize instruction. In such flipped classrooms students must be able to manage resources, demonstrate independence and be capable of self-discipline in order to be successful.

Despite this emphasis on SDL, in these frameworks and other writing, there are some significant limitations to the existing scholarship in this area. For instance, a majority of research on SDL has centered solely on adult learning – with little attention to elementary and middle school students. Moreover, much of the work has been theoretical in nature with the consequence that there are few instruments and measures for researchers to use. Finally, despite a significant level of agreement about the how technology can change the learning context, there is little work on how innovative 21st century, technology-rich classrooms can influence the development of SDL.

The remainder of the article summarizes the research on the relevance and value of 21st century learning environments to enhance the SDL of younger students. The next section focuses on the design of the study in particular describing the methods and instruments used, as well as a description of the two learning environments. Subsequent sections describe the data and analysis of both the quantitative and qualitative data collected and the findings of the analysis.

Self-Directed Learning and the Learning Environment

Current research on the development of SDL has focused both on the internal characteristics of the learners as well as the broader context the learners are situated within. For instance, Guglielmino (1977) commented that certain learning contexts are more effective at promoting self-directed learning. Confessore (1998) concluded from existing research that there is "evidence that the characteristics used to describe the learning organization are necessary ingredients for SDL to flourish." The emerging learning environments of the 21st century combine different pedagogies and technologies and provide ample reason to reexamine the opportunities for self-directed learning.

Candy (2004) suggested, that self-directed learning "provides a more direct route into understanding the actual dynamics of and relationship(s) between learning and technologies." Technology can constrain direction and focus allowing for a user to quickly seek and record relevant yet it also can be a distracting environment leading to inefficiency or reduced motivation. Technology affords incredible access for learners to connect with others, explore topics of interest, and participate in opportunities they might not otherwise engage in. In addition, technology provides vast amounts of resources in terms of information and people to serve as material for further inquiry. These affordances can also be detrimental as the vastness of resources can reduce the ability to select relevant materials or stay on target for the learning activity. The connected era creates a new need for learners to be knowledgeable about resource selection as well as the ability to manage the collection, management, and use of relevant information (Lankshear, 1997). Current digital technologies also allow for newer ways of configuring classrooms, allowing for greater flexibility to students in selection of topics to study as well as approaches to studying them (individually, collaboratively and so on). Clearly these have significant implications for the development of SDL. All this said, there has been little research and discussion of the direct impact of technology, and the manner in which it can afford and constrain SDL, particularly for younger learners. In this context, utilizing appropriate assessment tools (customized to the age and developmental level of the population of interest) based on clear definitions of self-direction can help better understand the impact of technology on self-directed behavior and skills. Focusing, in particular, on intentionally designed environments that broadly support SDL principles (such as a modified schedule to allow for longer times for projects and collaboration, pervasive access to technology, problem-solving content design, and intensive professional development for the teachers) could be informative to both theory and practice.

Research Design – Methods and Procedures

This study used a mixed-method non-equivalent group design examining the relationship between the perception of self-direct learning by students and the design of their learning environment in a middle school setting.

Site & Participants

The research centered on a new model of instruction at a high achieving middle school in a mid-to-high socioeconomic suburb northwest of Chicago, Illinois. The total population of the school exceeds 900 students and serves grade 6-8.

The new model, called Sigma team, consisted of a two-teacher instructional team serving 30 students at 6th grade. The parents of the students opted into this team after a brief overview of the structure and goals of the model. The core subjects for all teams included mathematics, language arts, science, and social science. Two staff members volunteered to take on this project and their selection was approved by the building administration. One constraint on the selection process was that the students had to choose between Spanish or Chinese as their language instruction.

The staff in this model had a lot of latitude and flexibility when it came to scheduling and grouping students. Further, the students had constant access to technology (enough laptops and iPads for each student) and Internet (with limited filters intended for supporting learning and engaging in the content). The staff members had the opportunity for professional development prior to the beginning of the school year including a national conference focusing on educational technology and specific training on understanding the TPACK model (Koehler & Mishra, 2008). One goal of this model was to leverage the flexibility to individualize learning experiences supported by technology. Specifically, the foundation of the Sigma Team was an environment that leverages technology to provide students with alternative ways to connect, collaborate, discover, engage, and reflect throughout the learning process. The opportunity for students to have constant Internet access, personal devices, flexible schedules, and a variety of experiences can lead to more self-directed learning opportunities. These opportunities were supported by connections to experts in the field, time for deeper exploration, technology tools to collect and manage information, and ability to extend the learning beyond the traditional school periods. Further, the staff members were committed to the idea that students should have an integral role in the learning process. The teachers also received significant training on both 21st century learning tools and methods in increase their technology pedagogical knowledge. The combination of teacher preparation, learning environment design, access to technology, and foundation on student ownership of learning could certainly generate meaningful self-directed choices for students to explore their interests and passions not available in other settings.

The remaining participants (in what can be called the traditional or control condition) came from the two additional teams (Alpha & Beta) at the 6th grade. Each of these teams consisted of between 140-160 students and 6 staff members. This model was a traditional team set-up at the middle school level in the school district. Each teacher was responsible for specific subject/curricular area, times of classes are fixed (38-42 minutes), and students move from once class to the next. Technology was available for these students in the form of laptop or iPad carts for checkout and access to a computer lab but not constantly with each student in each classroom. Students on these teams did not have a choice of placement on one team or the other. Similarities existed between the two environments. The same curriculum standards, assessments, materials (besides technology), general content areas and district expectations were in place for both teams. The main difference between the two team configurations was the instructional constraints such as timed class periods focused on a particular content area with more restricted access to technology. Further, the teachers in these classes had not received the same type of focused professional development experiences or time to explore related resources. Due to these factors, student did not have the same opportunities to explore areas of interest on their own, move away from a traditional scope and sequence within a topic, or spend the necessary time collaborating on the learning experiences that can proceed without the direct intervention or planning from a teacher.

Further examination of the teachers in these two environments is important in order to provide a more complete understanding of their background and past performance. Although the recent training opportunities differ, the teachers that volunteered and were selected for these roles had similar outcomes as their peers when examining prior student performance on standardized tests. In order to account and appreciate the possibility that the two teachers may inherently provide a more robust or successful educational experience regardless of environment,

Measures of Academic Progress (MAP) and Illinois State Achievement Tests (ISAT) data were examined at the classroom level for the past 4 years. The teachers were thoughtfully selected based on their willingness to explore alternatives, grow professionally, and their past strong performance with students. Clearly there are numerous differences between teachers and their effects cannot be discounted. However, the dimensions outlined indicate a strong level of uniformity between the teachers in both environments.

Statement of Purpose

The described learning environment (the Sigma classroom) offers unique characteristics and design elements that distinguish it from a typical middle school classroom (The Alpha and Beta classrooms). The alternative configuration of the Sigma classroom, with a focus on 21st Century skills, alternative schedule, and increased presence of technology can provide self-directed learning opportunities and experience for students that would not take place in a traditional setting. Therefore, this study examined the relationship between the design of the learning environment (configuration, lesson design, presence of technology) and the self-directed learning perception of students.

It was anticipated that after time in the learning environment designed for 21st century learning, the students experiencing the environment would show a larger increase on the Self-Directed Learning with Technology Scale (SDLTS) than the remaining members of the 6th grade team.

Demographics

Information from the district student management system (SMS) was used to collect demographic on all sixth grade students involved in the research. The demographic data included gender, ethnicity, IEP status, gifted status, and LEP status. This information was collected to identify any distinct characteristics that differ between the team configurations (for example, much higher percentage of LEP students on team or another) that may have an impact on the interpretation of the results or observations.

Demographic data are displayed below for each of the teams. These data indicate several areas of consistency between the teams including the percentage of LEP (Limited English Proficiency), gifted, and ethnic breakdown. However, there are noticeable differences in the composition of the teams including the percentage of males and females and students with an IEP (Individualized Education Plan). The differences must be considered in all discussion of implications and generalizability.

Table 1. Demographic Information by Team Membership

Team	% Male	%Female	%IEP	%LEP	%Gifted	%White	%NonWhite
Sigma	62%	38%	0%	0%	10%	79%	21%
Alpha/Beta	49%	51%	16%	1%	9%	81%	19%

Instruments: The Self-Directed Learning with Technology Scale (SDLTS)

The majority of scales related to measuring self-directed learning focus on adult learners (Guglielmino, 1977; Oddi, 1986; Stockdale & Brockett 2010). Further, the scales generally do not specifically include technology as component in the measurement tool. Researchers from the National Institute of Education at Nanyang Technological University in Singapore developed and tested a scale that is more appropriate for younger learners and recognize the presence of technology in learning (Teo, 2010). The Self-Directed Learning with Technology Scale (SDLTS), a 6-item, two-factor was piloted and validated in their study. The two factors in the scale measure the self-management and intentional learning perception of students. This scale is relevant to this research not only because of the focus on younger learners and the inclusion of technology but also because "the results from this scale may also assist teachers in promoting a learning climate that fosters student autonomy and mutual responsibility." Overall, this measure is best suited to gather the information for the population in the current study due to the inclusion of technology and the intentional development for young students.

Data Collection and Analysis

Data collection was a three-step process to gather various information about the performance and perceptions of the learner as well as observations about the learning environment and activities.

> Step 1: Demographic information about students in the 6th grade was collected in the summer prior to the beginning of school as were the performance information based on past assessments for the 6th grade teachers. Students in the 6th grade filled out the self-directed learning with technology scale (SDLTS) in September at the beginning of the school year.
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> Step 2: The self-directed learning with technology survey (SDLTS) was re-administered for 6th grade students for both team models in January of the same school year.
>
> Step 3: After the follow-up survey was completed, interviews were conducted (Appendix B) with six students, three on the Sigma team and three students on the Alpha/Beta teams in February. The students were selected based on their responses on the SLDTS. Two students were randomly selected from one standard deviation from the mean, two from one standard deviation above the mean, and two from one standard deviation below the mean. This selection provided a more accurate reflection of the team experience than concentrating solely on the high or low end.

Non-Equivalent Group Studies

For this study, a non-equivalent group design was used to attempt to understand the relationship between the team environment and self-directed learning. This design is very common in educational research and includes an existing group of participants who receive a treatment (Sigma team) and another existing group of participants to serve as a comparison group (Alpha/Beta members). Since the students in the Sigma group were able to opt-in, the participants were not randomly assigned to the teams (non-equivalent), but rather received different experiences, or treatments, with the others in their existing group. The goal of the Sigma team was not specifically to improve self-directedness however it must be considered whether the selection process is directly related to the outcomes on the self-directed survey. Although this is similar to correlational design with a lack of manipulation of variables and important cautions when interpreting results, the non-equivalent group design strives to compare two groups as similar as possible. In this case the students are from the same school and grade with relatively comparable demographic and achievement characteristics. Despite many similarities, it is important to understand that the groups may be different and those differences may affect outcomes.

Quantitative Data

A one-way analysis of covariance (ANCOVA) was conducted for the study. The independent variable, team membership, includes two options: Sigma and Alpha/Beta. The dependent variable was the post-test results on the SDLTS and the covariate is the pre-test results on the SDLTS (See Table 2 for summary of responses). For each question on the measurement, the interaction effect between team membership and the pre-test scores was assessed to rule out a violation of regression homogeneity assumption. Then, an ANCOVA was conducted to determine whether the post-test results on the SDLTS for the team membership groups differed after adjustments for pre-test differences. A summary of these evaluations is listed below by questions and an alpha level of .05 was used for all statistical tests. Note, a lower score means a higher degree of use.

Table 2. Student perception of self-directedness as measured by the Self-Directed Learning with Technology Survey (SDLTS)

Team	**Q1**		**Q2**		**Q3**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Sigma	5.06 (1.39)	4.70 (1.53)	4.61 (1.54)	4.26 (1.65)	3.29 (1.29)	2.83 (1.42)
Alpha/Beta	5.16 (1.38)	5.29 (1.37)	5.19 (1.30)	5.38 (1.21)	3.82 (1.52)	3.78 (1.53)

Team	**Q4**		**Q5**		**Q6**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**

	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Sigma	3.00 (1.26)	2.39 (1.38)	3.58 (1.75)	3.43 (1.36)	3.77 (1.65)	3.13 (1.57)
Alpha/Beta	3.97 (1.74)	3.83 (1.82)	4.02 (1.32)	4.44 (1.41)	4.41 (1.64)	4.23 (1.76)

Quantitative Summary

For all six questions on the SDTLS, the homogeneity-of-regression assumption is met. On five of the six questions, the null hypothesis that students on the Sigma team will score the same on the SDLTS than students on the other 6th grade teams is rejected based on the information from the ANCOVA. Therefore, the after the adjusting the group means for the pre-test performance, team membership proves significant in five of the six questions on the SDLTS. The only question where this was not significant was "6. I use the computer to get ideas from different websites and people to learn more about a topic." This may be a result of significant technology access throughout the school and several experiences using the computer to do research for various assignments in both team environments. However, the 5 remaining questions were statistically significant and indicated that the Sigma team went online to connect with their teachers outside of school time more often than the Alpha/Beta team. The results also indicated that the Sigma students were more inclined than the Alpha/Beta Team to share their ideas using the computer. Examples from the student interviews included multiple opportunities for blogging and posting work on the team Web page. The Sigma students also went to the Internet as a resource for their school work more often than the Alpha/Beta Team and were more likely to use the computer to further work with the information from their lessons or units. Although the exact use for the computer is not defined, this shows the possible extension from the content lessons to more integrated or technologically extended experiences for Sigma students. The Sigma team indicated a higher use of the computer to further develop skills of interest than the Alpha/Beta Team. Sigma teachers provided several experience based on student choice (this was recognized in the student interviews as well). This opportunity for selected interests for exploration in school may be directly related to the results of this question.

These results strongly suggest that such an open-ended technology-rich environment (as provided by the Sigma team) supports the development of self-directed learning attitudes and behaviors in middle school students. The environment was not specifically designed to increase self-directedness, *but the study shows that students in the Sigma team were more likely to connect with their teachers online and after-school, share their work and ideas online, conduct information searching to solve their own problems, and initiate skill development on topics of interests.*

Qualitative Data

The quantitative analysis showed that the Sigma team results indicated statistically significant differences in their perception of self-directed learning (for 5 of the 6 questions). This however, does not provide insight into why this happened or the nature of the student experience in each of these team settings. Additional qualitative data provided a deeper understanding of the process by which this happened. To gather more information, six students (3 from the Sigma team and 3 from the Alpha/Beta Team) were interviewed. These interviews focused on their perceptions of their experiences in the classroom, about the work they were asked to do, the relationship between teachers and students, and the use of technology. This process provided important insight that go beyond the numbers in the scale. Although they represent a small portion of the study, the comments were an important source of student viewpoints.

Quantitative Summary

The objective of recording and cataloging the interview with the students was to determine the categories that formed the students' view of the experience in the classroom. In this stage, terms were identified from the transcripts and a close examination of conceptual linkage led to a set of core concepts. Four major themes emerged from their accounts of the classroom experience of the Sigma group and the Alpha/Beta group: choice, work style, work type, and technology. The Sigma team respondents generally felt that there was plenty of choice for students including picking topics, deciding whom to work with, and alternative forms of output. These students indicated an even representation of group work and individual work, several longer-term, high interest, project-based learning experiences and constant availability to technology. The responses from the Alpha/Beta team students showed a feeling of limited options for choice noted by the students. All students commented that the teacher directed the

lessons and activities. All three students noted some group work but the majority of the examples were isolated lessons or single units that students worked on individually. Finally, the students all indicated that technology was available when needed either in the room or in the computer labs. All three indicated that most of their work with technology took place in the school.

Discussion

The quantitative results indicated that after 6 months, students in the intentionally designed 21st century classroom were more self-directed on 5 of the 6 categories evaluated by the survey than the equivalent students in the traditional classroom. These categories include: online connection with teachers, increased utilization of technology throughout the process as a resource, increased self-management and intentional learning. Although both environments have strong teachers and similarly performing students, the perception of self-directed learning was strong in the environment where teachers allowed for more choice the topics, provided constant technology access, engaged in more project-based learning, and had a variety of group and individual of experiences. Not one of these factors would reasonably be used to explain the difference in performance based on this study. However, they do account for a different type of experience for both the student and the teacher. The interviews revealed a noticeable difference in assignment types, online experiences, and collaboration between students. The composition and expectations of the Sigma team design were distinct from the Alpha/Beta Team and the professional development supported those areas of focus. The qualitative and quantitative results show that a purposefully structured technology-rich learning environment can provide students with great opportunities and abilities to be self-directed in their learning.

Appendix

Items on the Self-Directed Learning with Technology Scale (SDLTS)

SDLTS is a 6-point scale, ranging from 6 for 'All the time', and 1 for 'Not at all' with two factors – self-management and intentional learning.

Self-Management
1. I go online to ask my teachers questions on my lessons when I am not in school.
2. I use the computer to share my thoughts and ideas about my schoolwork (e.g., through multimedia storytelling, voice-recording, blogs).

Intentional Learning
3. I find out more information on the Internet to help me understand my lessons better.
4. I use the computer to work with information for my learning.
5. I use the computer to become better at a skill that I am interested in e.g., learn a language.
6. I use the computer to get ideas from different websites and people to learn more about a topic. **Appendix B**

Questions for Student Interviews

What types of projects did you work on in class? Types of technology?
Did you ever work on your projects outside of school? How?
Who decided what types of projects/activities you worked on?
What types of projects did you work on individually? How did you like those?
What types of projects did you work on in groups? How did you like those?
How much did the teachers tell you to do before you started a project?
What would you do if you got stuck during your work and didn't know how to move forward?
What were your favorite projects/activities so far and why?

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