Research Proposal

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Makerspaces and "learning labs" are places where individuals are encouraged to create with tools, mentors, and even digital media. The framework on which Learning Labs and Makerspaces are built is that children benefit from unstructured learning (Ito, M., Baumer, Bittanti, Boyd, Cody,Herr-Stephenson, Tripp, 2009). Makerspaces were created to provide young people with a space to create and tinker in setting less formal than the classroom. The Institute of Museum and Library Services (IMLS) supported the development of makerspaces, as a way for youth to "discover and pursue their passions while being introduced to new opportunities they might never have encountered elsewhere" (IMLS, n.d., p. 1). As such, school libraries began to create makerspaces (Loertscher, Preddy, and Derry, 2013). The problem presented in present research about makerspaces, particularly those within school libraries, is the lack of investigation about the impact of makerspace participation on student achievement and behavior.

Literature Review

According to Koh and Abbas (2015) most of the available literature about makerspaces are about one of four things: makerspace history, case studies, advice about makerspaces or technology suggestions. Loertscher and colleagues (2013) introduced the "uTEC Maker Model," a model of engagement for school libraries, based on each of their professional experiences and observations. The model names four stages learners progress through while making and tinkering in school library makerspaces. The first stage is "using" at which point the user is sampling something new. Then learners move into the "tinkering" phase, at which learners use tools in a way other than the intended use. Next, learners enter the "experimenting" phase, where they "seriously abandon what has been created by others" to explore more creative

ways to use the tools. The final level of the uTEC model is creation, at which point learners have a novel idea or product to share (Loertscher, Preddy, and Derry, 2013, Abrams, 2015).

Makerspaces, or "community workshops" (Holm, 2015) have many perceived benefits. The first benefit of student participation in makerspace education is that such tinkering is applicable to work environments. The process of making is believed to enhance "problem-solving skills" as well as "encourage collaboration and persistence" (IMLS, n.d., p. 1) which equips young people with skills necessary for the modern workplace. Based on the creativity makerspaces inspire, one claim is that makerspace participation encourages entrepreneurship. Because makerspaces encourage tinkering, and experimenting, Holm (2015) claimed that continuous participation in makerspace activities may lead to user-led inventions. Makerspaces teach problem-solving skills, and as a result, Holm (2015) asserted that makerspaces users learn and refine skills relevant and translatable to entrepreneurial ventures.

Another benefit of makerspaces is the opportunity for professional growth for makerspace professionals. Firstly, professionals working in makerspaces are able to witness innovation take place through the participants developing from user to creator (Loertscher et al., 2013). Secondly, makerspace professionals get the chance to refine their skills necessary to be effective makerspace professionals as researched by Koh and Abbas (2015). Koh and Abbas (2015) noticed a gap in literature about professional development conducted research about competencies necessary for information professionals in charge of makerspaces. In order to understand what competencies information professionals needed to possess to successfully run makerspaces or learning labs, Koh and Abbas (2015) conducted extensive interviews with seven information professionals who worked in makerspaces. The researchers then coded the

interviews to determine common themes between the interviewees. According to their research, the five competencies pertinent for information professionals in makerspaces are: the ability to learn, ability to adapt, ability to collaborate, ability to advocate, and the ability to serve diverse people.

While the literature on creating makerspaces is robust (Kurti, et al., 2014, Abram, 2015), and such literature acknowledges the importance of assessing the purpose of a makerspace in a school library, there has been no research done on the impact of a school library's makerspace on student achievement and behavior. In order to prove the worth of a school library's makerspace, Abram (2015, p. 10) asserted that librarians need to consider how the offerings of the library's makerspace help solve the real problems that schools are trying to solve. In other words, Abram (2015) asserted that librarians need to consider how makerspaces fit into a school's vision to equip students with problem-solving skills translatable into the job market. Investigators can follow the model of research modeled by Klemmer, Zajicek, and Zajicek (2005) in regards to the impact of school gardening on student learning and behavior in the classroom to begin research about the impact of makerspace participation on student achievement. Klemmer, Zajicek, and Zajicek (2005) found that students who received supplemental science instruction in a school garden received higher scores in science than students who did not receive such instruction. It is predicted that makerspace participation would yield similar results to Klemmer, Zajicek, and Zajicek's (2005) findings about student participation in school gardens.

Abram (2015, p. 10) argues that makerspaces "can be viewed as trendy or as essential" to a school library. In order to support school libraries appeals for funding, and in order to prove the impact of makerspaces, further research needs to be conducted about the actual impact it has on

student achievement. In a three part study, Kurti, Kurti and Fleming (2014) researched a process to assess a makerspace, but offered no insights about how to assess student achievement. The seven steps included: observation, review curriculum, consider culture, create a makerspace theme, build makerspaces one tool at a time, promote student ownership, and continual assessment of the makerspace (Kurti et al., 2014). Makerspace research needs to go beyond theoretical processes and advice to measure the impact of makerspace experiences on student achievement and behavior.

In order to measure student achievement, researchers will first need to conduct extensive interviews with school librarians, teachers and principals with makerspaces to determine what impact industry professionals expect to see from student makerspace participants. The process of interviewing professionals will be similar to that of Koh and Abba (2015). After coding the interviews, researchers will be able to construct a measure which evaluates the effect of makerspace instruction on student achievement in the areas which professionals expect to see improvement. Based on the makerspace literature, it is expected that students who received supplemental makerspace instruction would receive higher scores in some measures than students who did not receive such instruction.

Method

The proposed experiment will be a mixed methods, exploratory sequential design. The experiment will focus on the impact of school library makerspaces on student effectiveness. The purpose of this experiment will be to identify educators' goals and predictions about the impact of school makerspace participation on student achievement. Further, the experiment will aim to measure student achievement in relation to educators' goals and predictions. Based on the

research of Klemmer, et al., (2005) whose research indicated higher student achievement scores in science by students who participated in school gardens compared to students who did not, it is predicted that students who participate in school makerspaces will have improved achievement scores as compared to students who do not participate in school makerspaces.

The qualitative part of study will be comprised of elementary school teachers, librarians and principals who have experience with school library makerspaces. Researchers will conduct interviews similar to those of Koh and Abbas (2015) about educators' perceived benefits of school library makerspaces. The goal of the interview is to understand what student achievement improvements educators perceive or expect from students' participation in school library makerspaces. Educators will be interviewed several times about student growth and achievement they have noticed amongst their students, or that they would hope to see with their students. All elementary school educators will be asked to sign a consent form to participate in the study, and will be able to drop out at any time, at their will.

The quantitative part of the study will be comprised of elementary school students in third to fifth grade in the Denver Metro area. Participants will be from different schools, and will be required to have consent from their legal guardian before being able to participate. Throughout the research, students will also be asked for their assent to ensure that researchers are not causing undue stress or harm, although this experiment will be minimally invasive to the students. The schools chosen to participate in this study will be a mix of schools that have library makerspaces and schools that do not. The students who have access to a school library makerspace will be part of the experimental group; that is the group who participates in makerspace activities. The students who do not have access to a school library makerspace will

be part of the control group; that is the group which does not participate in makerspace activities. This way, no students who have the opportunity to participate in makerspace activities will be deprived of that chance. Schools populations will reflect diverse socioeconomic, cultural, and racial demographics to ensure reliability.

During the instructional time in the makerspaces, students will engage in loosely structured activities. For example, students across all schools will be given the same overarching project, given the same instructions daily, and then given free time to solve the problem. The purpose of giving students time in a makerspace is to enhance their problem-solving abilities. Makerspaces were founded on the research of Ito et al. (2009) which suggested that allowing children unstructured time to tinker enhanced their interest and ability to solve problems related to the instruments with which they tinkered.

For the quantitative part of this experiment, both the experimental and control groups will take a pre-assessment and post-assessment. The assessment will measure student achievement in content areas which will be identified by educators during the qualitative data collection. If a reliable measure already for content areas identified by the educators, then researchers will not develop new reliable measure. For example, if educators identify science and math as the two main content areas they believe to be improved by makerspace participation, then researchers will use existing science and math measures to assess children's math and science abilities. Based on the research of Klemmer, Zajicek, and Zajicek (2005), about the impact of school gardening on student achievement in science, it is predicted that educators will anticipate makerspace activities to positively impact students' science scores.

The goal of this experiment will be that students in the experimental group, that is the group receiving time in a school library makerspace, will receive 18 instructional days in their school's makerspace. Before those 18 instructional days begin, students will be administered a pre-assessment. After all students reach this threshold, students from both the experimental and control group will take a post-assessment. After all students take post-assessments, the data will be analyzed using ANOVA analyses. ANOVA will be run so that researchers can compare the scores of the experimental and control groups across grade, gender, and any other strata.

At the end of this experiment, researchers will analyze their work for opportunities for further investigation, as well as any unexpected errors or occurrences in their own research. Researchers will strive publish their results in school library journals, and to present their findings to library and museum professionals who work with makerspaces. It is expected that through this research, investigators will find many new ways to explore makerspaces in school libraries and the breadth of research in the area will widen.

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