A DESCRIPTIVE STUDY OF THE EFFECT OF K-12 DESIGN EDUCATION ON CHANGES IN SELF-ESTEEM

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Abstract

This research explores the hypothesis that introducing K-12 students to design education has the potential to introduce students to skills that are integral and vital to being a strong designer, with particular attention to self-esteem. A new K-12 design curriculum has been developed to explore this hypothesis. This paper presents an assessment of the impact of the design education curriculum on K-12 students' self-esteem, both presented and self-reported. Self-reported and presented student self-esteem measurements indicate no correlation with one another. Over the course of the curriculum, self-reported self-esteem increased slightly overall. Indicators for high presented self-esteem showed overall increases in individuals. The presented low self-esteem measurements stayed nearly constant over the course of the study. These preliminary results suggest formalized methods for assessing student outcomes in the context of design education research. Providing evidence that shows a correlation between design education and self-esteem builds a case for design education as a valid teaching tool, and opens the discussion for design as mechanism to address new educational demands.

Keywords: Design education, Design learning, Research methodologies and methods, K-12 design education, Self-esteem assessment

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1 INTRODUCTION

The Partnership for 21st Century Learning (P21) reports that as global connectivity and technological advance progress, so too will the need for students to be equipped with a skill set that extends beyond traditional classroom subjects (*Partnership for 21st Century Learning* 2015). New learners will need to be equipped with skills in career preparedness, interpersonal communication, and technology. P21 argues that partnerships between "education, business, community and government leaders [are needed] so that all learners acquire the knowledge and skills they need to thrive in a world where change is constant and learning never stops" (*Partnership for 21st Century Learning* 2015). Within academia, there is a growing body of work supporting P21's philosophy, in addition to an agreement that those responsible for meeting these goals extend beyond traditional teachers and educators (Mishra *et al.* 2011).

One industry who has joined this effort is the design community. In Article V of the IDSA Articles of Ethical Practice, it states, "We will be responsible to design education by holding as one of our fundamental concerns the education of design students" (Industrial Design Society of America 2015). Industrial design, like other sectors of design, have made it part of their mission to proliferate and enhance the industry through education. This has been particularly evident in the rise of the maker movement and STEAM education (Kim and Park 2012). Our hypothesis is that design has a tremendous potential to introduce students to many of the 21st century skills, such as teamwork, communication, self-efficacy, and leadership, vital to being a strong designer.

A new K-12 design education curriculum has been developed to explore this potential. For reference for those outside the United States school system, "K-12" is a term used to describe primary and secondary education in the U.S., usually for children from ages 4-6 years until ages 17-19 years old. Attendance to K-12 school is legally required of children, either through a free public school, home school or private school. "Charter" schools, like the one studied here, are a subset of public schools. The curriculum consists of a suite of classroom and independent activities geared at introducing children to the process of design, while also facilitating the acquisition of 21st century skills. The development of self-esteem is one of the curriculum's core objectives. This paper presents an assessment of the impact of the design education curriculum on K-12 students' display of self-esteem.

2 BACKGROUND

The success of American public schools is evaluated according to a growing body of requirements determined by state exams, Common Core exams and No Child Left Behind (Carroll *et al.* 2010). These are coupled with an increased emphasis on overall graduation rates and academic performance. In order to meet these performance measures, policy makers have determined two skills sets that will help students and educators achieve these goals: STEM literacy (Mishra *et al.* 2011) and 21st Century Skills (*Partnership for 21st Century Learning* 2015). Encompassing science, technology, engineering and mathematics, it is argued that STEM education and technical literacy will be critical in giving students the skills to compete in the modern workforce (Mishra *et al.* 2011). 21st Century Skills include skills such as leadership, collaboration and critical thinking, with the theory that these skills will lead to increased socialization (Calsyn *et al.* 1980, *Partnership for 21st Century Learning* 2015). Despite these efforts, teachers, themselves, are not necessarily equipped with the tools and knowledge to teach these skills (Appleton 1995).

To meet this challenge, a growing body of research has begun studying the design process, and how the skills learned through design can be applied to other academic settings (Carroll *et al.* 2010, Kim and Park 2012). Over the past decade, there has been a rise in what is known as the STEAM movement. In this construct, the "A" stands for "arts", with the underlying hypothesis that those who explore artistic and creative outlets achieve higher levels of success in the STEM fields (Kim and Park 2012) by building problem solving and hands-on skills.

Outside of the STEM construct, skills learned in the design process closely align with 21st century skills. For example, skills learned in design such as problem solving, creative thinking, empathy, and teamwork are embodied by both successful designers and successful global citizens. Research performed by Carroll *et al.* (2010) concluded that, through design, "students engage in hands-on projects that focus on building empathy, promoting a bias toward action, encouraging ideation, and fostering active problem solving." Further work examined design's ability to build human centered thinking (Rauth *et al.* 2010), person-to-person communication (Calsyn *et al.* 1980) and increased socialization (Carroll *et al.* 2010,

Rauth *et al.* 2010). Therefore, a trans-disciplinary approach to learning through integration of design could be a powerful tool (Mishra *et al.* 2011).

These observations regarding the potential impact of design have led to the construct known as creative confidence. Explained in detail by IDEO's Tom Kelley and David Kelley, creative confidence is the theory that the skills designers learn help build a sense of self-efficacy, or a belief in one's abilities and skills (2012). In children, design thinking can be especially effective in developing creative confidence (Carroll *et al.* 2010, Rauth *et al.* 2010). The concept theorizes that the problem-solving techniques of prototyping and an emphasis on failure's necessity encourages exploration, risk taking and pushes students outside of their comfort zone (Carroll *et al.* 2010, Gerber and Carroll 2012). Kelley and Kelley specifically cite how creative confidence helps designers overcome four common fears that hold people back: fear of the messy unknown, fear of judgment, fear of the first step, and fear of losing control (2012). Over time, it is theorized that this creative confidence translates into overall feeling of increased self-belief.

In order to effectively assess the effects of design and creative confidence on self-belief, it is important to first look more closely at these belief constructs. Self-belief describes how a person feels about their skills, abilities and competencies in relation to their self and their environment (Bong and Skaalvik 2003). Variations in self-belief between people lead to varying degrees of social, emotional, and academic success (Bong & Skaalvik, 2003). Three common research areas about self-belief are self-esteem, self-efficacy and self-confidence. The remainder of this literature review will focus on self-esteem and its relation to academic success.

Self-esteem can be described as how a person perceives their abilities, and how these abilities relate to others (Heatherton and Wyland 2003), in addition to how they believe these abilities will affect the future. Pioneering psychologist Stanly Coopersmith described self-esteem as:

> *"The evaluation which the individual makes and customarily maintains with regard to himself: it expresses an attitude of approval and indicates the extent to which an individual believes himself to be capable, significant, successful and worthy. In short, self-esteem is a personal judgment of the worthiness that is expressed in the attitudes the individual holds towards himself" (1967).*

Self-esteem can be further divided into global self-esteem and local self-esteem. Local self-esteem is one's self-esteem "as related to a specific behavior" (Rosenberg *et al.* 1995). Global self-esteem relates to the "overall psychological wellbeing of an individual" (Rosenberg *et al.* 1995). While these two areas are related, there is not necessarily a direct correlation between high global self-esteem and high local self-esteem (Rosenberg *et al.* 1995). However, this same study did show a stronger positive correlation between academic success and local self-esteem, when compared to the relationship between global self- esteem and academic success.

High self-belief, with specific regard to self-esteem, is often associated with leading more productive lives (Heatherton and Wyland 2003). Since the 1960's, a growing body of literature has been produced to support the theory that self-confidence is highly correlated to academic and social success (Bandura 1993, Bandura *et al.* 1996). A meta-analysis of 116 studies showed that programs that focused on increasing self-esteem correlated with better academic coping skills and feelings of academic success (Haney and Durlak 1998). It is important to note, however, that the academic effects of programs aimed at increasing self-esteem can vary between children, and are closely tied to the cognitive, social and emotional engagement of children in their schools and academic environments (Bandura *et al.* 1996, Bong and Skaalvik 2003).

The literature points to a wide and varied collection of evaluations geared towards assessing self-esteem. A comprehensive literature review published in Measures of Personality and Social Psychological Attitudes (Blascovich and Tomaka 1991) aggregated a list of all published journals that cited self-esteem scales since 1967. Based on the list, 306 articles were cited as original sources of a novel self-esteem test or scale. Blascovich and Tomaka selected the 40 most commonly cited scales for analysis. The two most commonly cited scales were the Rosenberg, 1965 Self-Esteem Scale (25% of the tests cited) and the Coopersmith, 1967 Self-Esteem Inventory (18% of the scales cited).

The Rosenberg Scale (1965) is one of the most commonly referenced self-esteem tests and was chosen as a measurement tool for the present research due to its ease of administration, scoring, and interpretation. In addition, it has a high internal consistency and test-retest reliability (Blascovich and

Tomaka 1991). The Rosenberg Self-Esteem Scale assesses global self-esteem (Rosenberg *et al.* 1995) and has shown a moderate correlation to evaluations of local self-esteem (Demo 1985, Rosenberg *et al.* 1995). One drawback to the Rosenberg Scale is that it only records the "experienced self" –or what the user feels – and that it does not accurately reflect the "presented self" – what others see about a person (Savin-Williams and Jaquish 1981, Demo 1985). To alleviate this, it is recommended to use the Rosenberg Scale in conjunction with multiple measurements for evaluating self-esteem such as peer or observational data (Demo 1985). The use of a behavioural checklist has been shown to be a reliable presented self-esteem measurement (Demo 1985).

3 METHODS

The study took place at a K-6 charter school in a major city in the southeast United States of America. A semester-long afterschool class was facilitated in order to ascertain the effect of design education on self-esteem in children ages 8-13. The class was held 4 days per week for 10 hours per week, and extended from January to May of 2016. This study was approved by the institutional review board, and proper parental permission and participant assent was obtained for all data presented in this paper.

During the first week of the curriculum, the instructor gave students a weeklong overview about the design process, followed by an opportunity to individually present about themselves and what they hope to gain from the semester. During this first week, students were given a preliminary Rosenberg Self-Esteem form prior to the start of their presentations. Students were video and audio recorded during their individual presentations, which served as baseline assessments for student levels of self-esteem. In the results section, these data are referred to as "Project 0". The details of these assessment tools are described later in the methodology section.

Following the baseline data collection, the students undertook a series of four design projects, each lasting approximately 4 weeks in length. In the results section, these data are referred to as "Projects 1-4". Though the design curriculum cannot be shared in detail, due to intellectual property protection, it can be described more generally. The four design projects covered the breadth of the design process and a range of design disciplines, increasing in complexity and sophistication over the course of the semester. Each of the four projects concluded with a student presentation day, similar in format to baseline data collection (Project 0). On each of these presentation days, students were assessed in the same manner as the baseline presentation. Again, prior to presenting, students completed a Rosenberg Self-Esteem scale. Students were video and audio recorded throughout their individual presentations.

3.1 Participants

Participants were children of ages 8-13, enrolled in a charter school in a major city in the southeast United States of America. Participants included 6 females and 4 males. Though the study began with 10 participants, only 3 participants completed all four projects, and 2 additional students completed 3 out of four of the projects. This attrition is due to multiple commitments and after school programs for the students, causing some students to switch programs half-way through the semester, or attend other programs on data collection days. Though the sample size is small, the authors believe the results are useful to the design education community as a starting point for preliminary results, and as a reference for experimental design and analysis for this type of research. As participants were minors, special institutional review board approval had to be obtained to collect data with them. Written forms of consent were provided to all parents and legal guardians of the participants. These forms of consent came with a proposed syllabus for the semester course and a notification of the 6 dates in which recorded observations would occur. If parents or legal guardians were non-native English speakers, a bi-lingual staff member or member of the research team went over the form with them to ensure they fully understood it before making their decision to sign or not. Prior to the start of the program, students were also given a form of assent and told in clear language that at 6 times throughout the program there would be observations made regarding their activities and persons. Again, if students were non-native English speakers, a bi-lingual staff member or member of the research team went over the form with them to ensure they fully understood it before making their decision to sign or not. For ongoing assent, they were reminded of their rights and assent procedures verbally, as a group, and given the opportunity to opt out of participation at each data collection event.

3.2 Metrics

Based on the literature review of self-belief factors, the following metrics were employed to evaluate

self-esteem, as defined by the Coppersmith (1967). Metrics included evaluations of both experienced and presented self-esteem. For experienced self-esteem, the Rosenberg Self-Esteem Scale was used. For presented self-esteem, the behavioural checklist (Demo, 1985) will be used. These were chosen due to their tested reliability, ease of administration, and ease of interpretation. For these metrics to be rigorously applied, it was crucial that multiple coders process the data using the chosen metrics, and their level of agreement be confirmed with inter-rater agreement analysis. The results of this analysis are presented later.

3.2.1 Rosenberg Self-Esteem Scale (1965)

Following the completion of the curriculum, the collected data was analyzed. Prior to the analysis, Rosenberg scales were coded so that the identities of the students were blind to the researchers. The scores of each subjects' Rosenberg scales were analyzed to see if there was a correlation between a progression through the curriculum/time and reported self-esteem. The questions include positively worded items and negatively worded items, with responses on a 4-point Likert Scale (Strongly Disagree, Disagree, Agree, Strongly Agree). The "neutral" option was omitted to elicit a choice in one direction or another. Each response was scored from 0 to 3, with Strongly Agree given 3 and Strongly Disagree given 0 for positively worded items. The scale was reversed for negatively worded items. The questions in Table 1 below were posed to the participants at each data collection.

Table 1. Rosenberg Self-Esteem Scale (1965) Questions

Positively Worded Questions	Negatively Worded Questions
On the whole, I am satisfied with myself.	At times, I think I am not good at all.
I feel that I have a number of good qualities.	I feel I do not have much to be proud of.
I am able to do things as well as most other people.	I certainly feel useless at times.
I feel that I'm a person of worth, at least on an equal plane with others.	I wish I could have more respect for myself.
I take a positive attitude toward myself.	All in all, I am inclined to feel that I am a failure.

3.2.2 Behavioural Checklist (1985)

The audio and visual recordings of each subject were coded based on the items outlined in the behavioural checklist (Demo, 1985). Because this analysis required researchers to hear the voice and view the physical features of the subject, this part of the analysis cannot be blind. The behavioural checklist can be seen in Table 2 below.

Table 2. Behavioural Checklist (1985)

High Self Esteem Behaviours	Low Self Esteem Behaviours
Has a wide range of interests o Explored a range of design ideas o Talked about their process, and mentioned prototyping an iteration o Commented on learning from their failures or mistakes	Tends to be self-defensive o Controlling, bossy, inflexible o Makes external excuses for behaviour rather than excepting blame o Puts blame on teammates or others
Initiates humor o Attempts to make a joke o Laughs at their own jokes o Students laugh at their jokes	Seeks reassurance from others o Gives into peer pressure from others o Defers questions or comments to others o Shows concern over the opinions of their peers
Is productive; gets things done o Completed the requirements of the assignment o Cooperates with others in a group/shows elements of teamwork o Gives others instructions or directives	Judges self and others in conventional terms o Self-critical comments, such as "I never do anything right," "Nobody likes me," "I'm ugly," "It's my fault," or "Everyone is smarter than I am." o Puts down others by testing, name calling or gossiping o Verbally puts self down; self-deprecation
Is calm, relaxed in manner o Does not show signs of emotional/physical aggression or anger o Voice quality is appropriate for situation	Is basically anxious o Indecisive o Prefers not to talk or be the center of attention o Physical signs of anxiousness (fidgets with hands,

o Little hesitation in speech, speaks fluently	shuffles feet, avoids eye contact, etc.)
Has insights into own motives and behaviours o Expresses opinions about decisions and ideas o Expresses negative feeling openly and directly o Gives rationale to the motives and behaviours of their decisions	Compares self to others o Brags excessively about achievements, skills, appearance o Tries to "one-up" the behaviours and actions of their peers or partner o Appears to seek validation from peers or teammate (looks around room, asks for reassurance, etc.)
Feels satisfied with self o Freely admits to failures and mistakes o Praises the actions and roles of their peers o Appears to be happy and satisfied with the result of the project	Abnormal physical behaviour o Inappropriate touching or avoids physical contact o Speaks too loudly, abruptly or in a dogmatic tone o Physical behaviour indicative of aggression or anger
Has social poise and presence o Maintains eye contact with the group and others during the conversation o Peers ask questions and show interest in the work of the student o Answer questions asked by their peers with friendliness and poise	Unvaried or reclusive behaviour o Does not take leadership role; is spectator o Does not express views or opinions, especially when asked o Physically withdraws and assumes a submissive stance overall
Values own independence and autonomy o Self assertive—> Takes initiative o Tries to be the center of attention o Praises their own actions and decisions	Self dramatizing; historic in nature o Dramatic Physical gestures o Lies or fabricates stories o Has grand and fantastic explanations to events (historicizes events)

3.2.3 Student Post-Project Assessment

In addition to the above assessment techniques, students completed post-project assessment forms to gauge their reactions to instruction and to class activities. These assessments were drawn from *Classroom Assessment Techniques: A Handbook for College Teachers* (Angelo 1993). While these are not used to assess self-esteem, they can assist with for quality control and to ascertain if the students were engaged in the design education curriculum.

Student Feedback Form Group Questions
* If you had teammates, was working with a teammate a good, okay, or bad experience? Why?
* If you had teammates, what did you learn about working with others from this project?

Student Feedback Form Project Assessment Faces Questions
Color in the face you feel best describes you given each statement. (See Figure 1.)
* I thought the project directions were clear.
* I was interested in the product I was making
* I was interested in the learning process I was going through.
* I am proud of the work that I have done.
* I learned from looking at my classmate's works.

Student Feedback Form Project Assessment Open-Ended Q's
* How do you feel about how long the project went for?
* What was your favorite part of the project?
* What was your least favorite part of the project?
* What did you learn from this project?
* Are there skills that you learned from doing this project that you will want to try outside of class? If so, which ones will you try out? How?
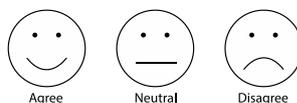
Figure 1. Face responses to "color" in as response – one set of 3 faces per question

4 RESULTS

4.1 Rosenberg Self-Esteem Results

Figure 2 presents the results of the Rosenberg (1965) self-reported self-esteem assessment students completed at the conclusion of each project. This figure shows responses to questions that were worded positively. Here, positive responses to positively worded questions indicate higher self-reported self-esteem. The general direction in these questions is toward more positive responses over time, with the exception of question 1, which shows negative responses rising in Project 4, and questions 3 and 4, which show negative responses rising during Project 3. Students felt less sure of their abilities to "do things as well as most other people", compared to the rest of the positively worded questions.

Figure 3 shows the results of the same Rosenberg assessment but only for questions that were worded negatively. Here, negative responses to negatively worded questions indicate higher self-reported self-esteem. There may be a slight tendency toward higher self-reported self-esteem over time in the responses to these questions. Students tended to feel more strongly that they "wish they had more respect for [them]selves", in comparison to the other questions in this set. Again, across the responses, we see there may have been a drop in self-esteem after Project 4. Our goal in presenting this data is to introduce means of evaluating self-reported self-esteem over time in K-12 design education contexts, in hopes of advancing design education research methods
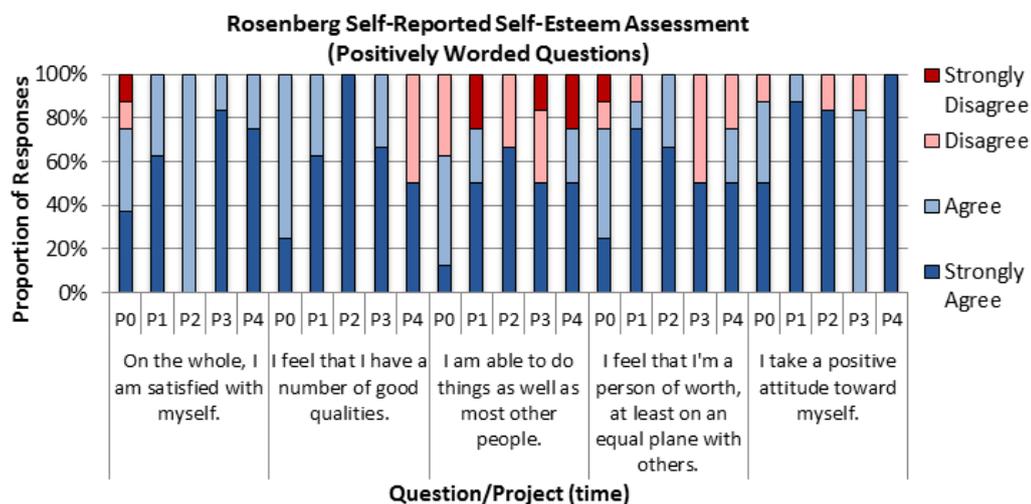
Figure 2. Rosenberg Self-Reported Self-Esteem for Positively Worded Questions
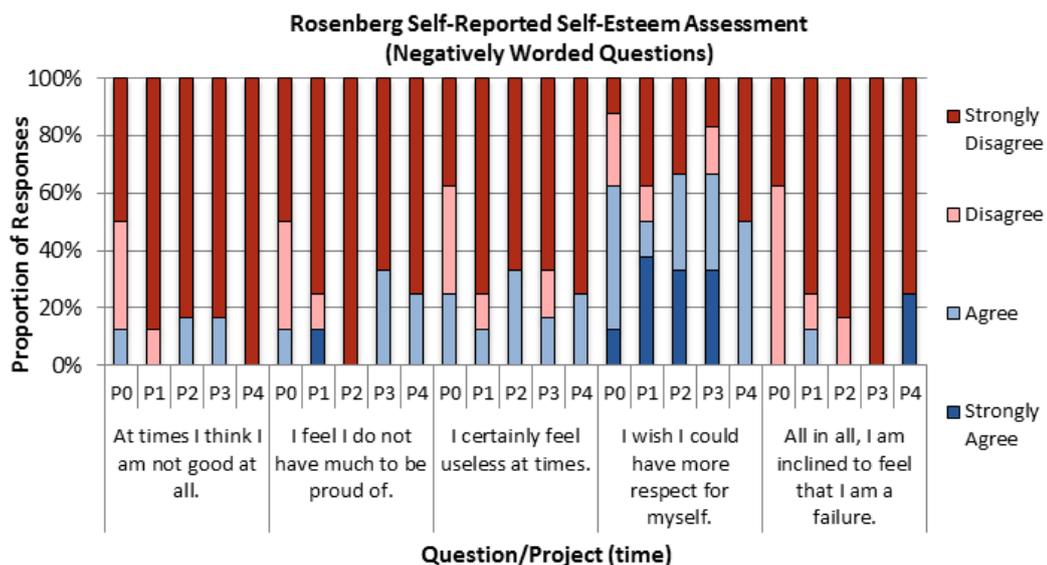
Figure 3. Rosenberg Self-Reported Self-Esteem for Negatively Worded Questions

4.2 Block Presented Self-Esteem Student Outcomes

To verify the reliability of the behavioural checklist scoring, a second rater scored a portion of the collected data. The two scored sets were compared, and Cohen's kappa was calculated to be 0.953, indicating near perfect agreement. Figure 4 presents the presented self-esteem during the recorded presentation of the five participants who completed at least three of the four total projects. The number of high and low self-esteem indicators were totalled separately for each student over the course of the curriculum. Low self-esteem indicators were each given a value of -1 so the resulting total would be negative. Students A, D, and perhaps B appear to have maintained a consistent set of positive and negative self-esteem indicators over the course of the curriculum. Student G shows an increase in positive self-esteem and decrease in negative self-esteem indicators over time, while Student F exhibits the opposite response.
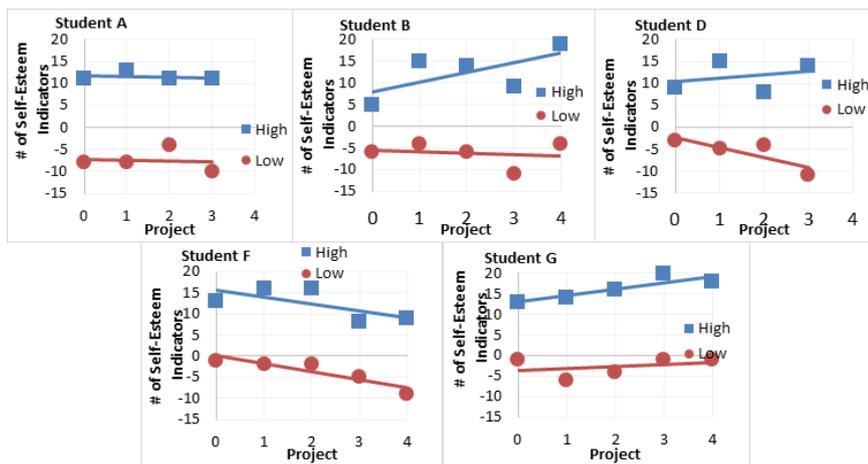
Figure 4. Number of High and Low Self-Esteem Indicators by Participant with at least 3 out of 4 project data points (A, B, D, G, F)

Figure 5 is a scatter plot of the high and low self-esteem indicators for all participants over the course of the curriculum. This includes students who participated in three or fewer projects. The plot shows a a seeming increase in positive self-esteem indicators, shown by the upward slope of the blue/green data points. Negative self-esteem indicators seem to stay relatively flat, excluding a couple of lower anomolies in Projects 2 and 3. It is important to note that these plots are descriptive of individuals, and as such results can only be discussed as descriptive observations rather than statistical trends.

To get an idea of the overall presented self-esteem of the students, the number of indicators for students who participated in four or more projects was averaged and is presented in Figure 6. The results of students who participated in three or fewer projects are not included in this average. From Figure 6, we can again observe the slope of increase in positive self-esteem indicators and the negative slope of negative self-esteem indicators. Again, with the small sample size of the study, no statistical significance can be derived from these results.
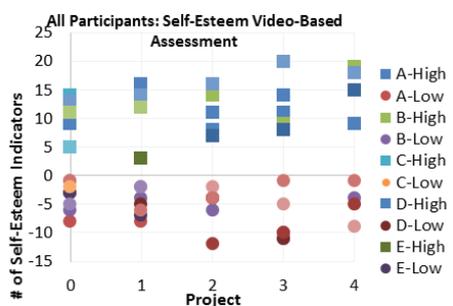
Figure 5. Number of High and Low Self-Esteem Indicators for All Participants from Video-Based Assessments
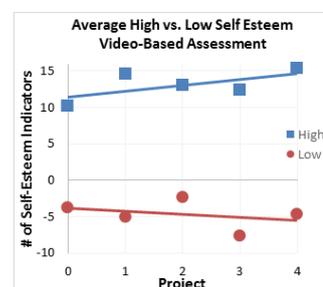
Figure 6. Average High and Average Low Self-Esteem Video-Based Assessment

4.3 Relationship Between Self-Reported and Presented Self-Esteem

To check if there was corroboration between the self-reported self-esteem data and the presented video-based self-esteem data, the data were compared to check for correlation. All values were converted to t-scores and plotted in Figure 7. Given the current data, there is no observable or statistical correlation between the presented self-esteem indicators and the self-reported self-esteem.

4.4 Student Feedback Form Post-Project Assessment Faces Questions

Figure 8 presents the results of the student project assessment intended to measure students' opinions of the projects themselves. Student self-reported interest and engagement peaked in the middle of the curriculum, during Projects 1, 2, and sometimes 3. Students may have been particularly interested in the themes of these projects over projects 0 and 4. Another possible influencing factor is the collaboration aspect of these projects. Students may have enjoyed collaborating with certain individuals over others thus influencing their overall engagement. Interestingly, responses to the last question regarding learning from one's classmate was increasingly negative toward the end of the curriculum. This could be due to unsuccessful collaboration within groups however, it is difficult to draw a conclusion from the limited dataset. The influence of the collaborative nature of the projects within the curriculum could be explored further in future work.
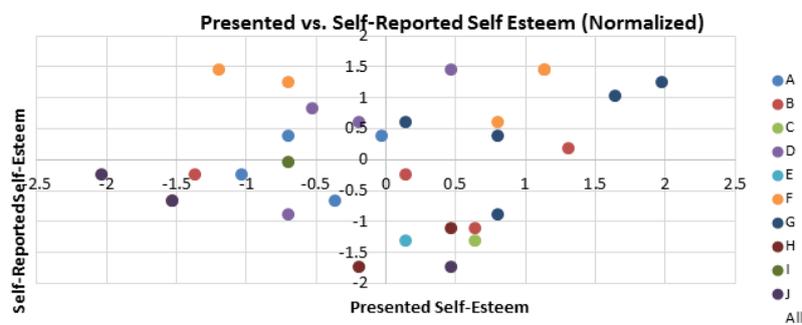
Figure 7. Normalized Presented and Self-Reported Self-Esteem Data
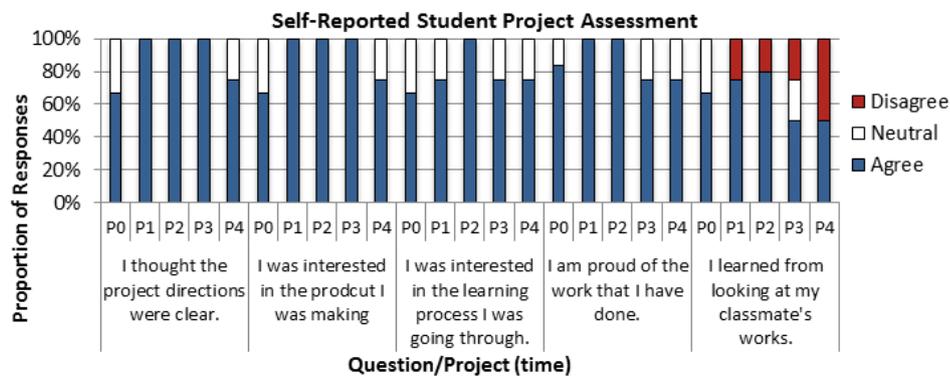
Figure 8. Self-Reported Student Project Assessment

5 DISCUSSION

Over the course of the four projects, both the self-reported self-esteem and the presented self-esteem scores increased slightly. However, due to the small sample size, it is unclear if this increase is a result of the curriculum. There are many factors that can affect a person's self-perception, including home life, academic performance, social interaction and success, among much more. This study did not attempt to account for these external factors, making it impossible to control for them and isolate the effects of the curriculum alone. The effect size would have to be very large in order to drown out these interfering factors. One way to improve this is to include a mood assessment and life status survey with each project assessment to attempt to control for these external factors.

6 CONCLUSIONS

Self-reported and presented student self-esteem measurements indicate no correlation with one another.

Over the course of the curriculum, self-reported self-esteem increased slightly overall. From the presented self-esteem measurements, indicators for high-self esteem increase on average. The presented low self-esteem measurements stayed nearly constant, indicating little change in low self-esteem. The results of this project could help determine if there is a correlation between levels of self-confidence and student participation in design education programming, and suggest formalized methods for assessing these attributes in the context of design education research. Educational frameworks such as the Common Core, The Partnership for 21st Century Learning, and a push for STEM education have created new targets teachers and students must meet. Providing evidence that shows a correlation between design education and self-esteem builds a case for design education as a valid teaching tool, and opens the discussion for design as mechanism to address these educational demands.

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