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A Pilot Study on the Effects of Comparative Feedback and Performance on Students' Self-

Efficacy and Self-Esteem

Claire Schneider

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Abstract

This study compared the effects that academic performance and comparative feedback have on student self-efficacy and self-esteem. Through mobile device polling, participants were able to complete in-class multiple-choice conceptual questions. Participants included 35 college students in two psychology classes assigned to a control and experimental group. For the control group, the class was shown a graph of student responses following each question and the experimental group was not shown how their peers performed. This allowed individuals in the control group to compare their own scores to peer scores while the experimental condition was not provided the comparative feedback. Data were collected over the course of one week and participants were administered pre and post tests to measure their self-efficacy (Self-Efficacy Formative Questionnaire) and self-esteem (Rosenberg Self-Esteem Scale). Results indicated no significant relationship between the concept question scores and the participants' post self-efficacy scores when compared within groups for either the experimental or the control group. Additionally, there was no significant relationship between total concept question scores and post self-esteem scores when compared within groups for the experimental or the control group. Though results indicated an overall positive increase in self-esteem scores regardless of group, when compared to their pre scores, this change was not significant. Implications as well as future research are discussed.

Keywords: self-efficacy, self-esteem, comparative feedback, clickers, polling devices.

Effects of Comparative Feedback and Performance on Students' Self-Efficacy and Self-Esteem

The use of technology in our society has grown exponentially. This can be seen especially in school settings as students utilize technologies such as computers, mobile devices, the Internet, and interactive whiteboards. One technology that is increasingly present in schools is one-to-one (1:1) devices, which refers to one device for every student. These technologies are often mobile devices such as laptops, tablets, or Chromebooks provided by the school to each student so that each has their own device.

Electronic student response systems are another example of 1:1 technology. Student response systems are “hand-held devices or mobile phone polling systems which collate real-time, individual responses to on-screen questions” (Davis, Farrelly, Muse, & Walklet, 2016, p. 35). Students can use their smartphones or personal computers to utilize this same technology with online quizzes and assessments created by their teacher. Using these assessments, there is often an option that allows students to see the distribution of responses from the entire class and thus make comparisons with their peers. This type of feedback is referred to as comparative feedback. Students can see on a graph what percent of their classmates responded correctly or incorrectly and provides an opportunity for students to compare themselves to their peers. The presence of comparative feedback can subsequently have an impact on an individual's emotions and how they feel about themselves, and this impact can change depending on the individual's level of self-esteem prior to the comparison. A study by Bailis and Chipperfield (2006) found that those with a high level of self-esteem felt more positive emotions and more positively self-evaluated when comparing themselves to those at a perceived worse-off level ($\beta = .35$, $t(144) = 3.66$, $p < .001$), and felt significantly more negative emotions after comparing themselves to those at a perceived better-off level ($\beta = .20$, $t(146) = 2.09$, $p < .04$). Additionally,

they found that an individual with a higher level of self-esteem appeared to contrast themselves more with their peers, which in turn amplified the potential for positive or negative emotions and self-evaluations when comparing themselves to a peer.

If a student can see that they answered a question wrong when the majority of their peers answered it correct, this would cause the student to compare themselves to their peers who did better, which Bailis and Chipperfield (2006) referred to as the “better-off” peers. Regardless of their prior level of self-esteem, findings from Bailis and Chipperfield’s (2006) study suggested that the student would feel negatively about themselves. These negative feelings can in turn eventually affect an individual’s self-esteem. A longitudinal study by Burke and Cast (2002) found that self-esteem works as a type of buffer that helps protect individuals from the negative feelings that come from disruptive or threatening experiences. This buffer allows the individual to find new ways to enforce their sense of self or to adjust their sense of self. However, they found that this self-esteem buffer has limits, and over time continued negative feelings prevent the individual from verifying their sense of self, and their self-esteem declines (Burke & Cast, 2002, p. 1059). Based on this, if a student does worse than their peers over a period of time, the social comparison may lead to negative emotions, and this occurring repeatedly can cause a decrease in an individual’s self-esteem as their sense of self is challenged.

An additional impact of feedback, such as the immediate performance feedback that polling devices allow, is that feedback plays a significant role in the relationship between self-efficacy and performance. A meta-analysis conducted by Beattie, Dempsey, Fakehy, and Woodman (2015) compared three studies that looked at the moderating role of performance feedback on the relationship between self-efficacy and performance. Results indicated that self-efficacy magnitude, which was defined as how difficult the participants believed the task would

be and what they expected their performance to be, had a significant positive relationship with performance in the first study ($r = .87, p < .001$), the second study ($r = -.26, p < .001$), and the third study ($r = .26, p < .001$). Of the three studies, the first had the largest effect size ($r^2 = .75$), and the second and third studies had an effect size that fell within the medium to small range. Overall, they found that self-efficacy has a positive relationship with performance when the individuals have been provided with feedback on their previous performances. Thus, the increased amount of feedback available to students as a result of classroom polling devices should allow for there to be a positive relationship between the student's performance and their self-efficacy level. Based on this information, the present thesis explored the effects of comparative feedback present when using an electronic student response system on student self-esteem, the relationship between academic performance and self-esteem when comparative feedback is provided, and the relationship between self-efficacy and academic performance.

Literature Review

Feedback

Feedback is defined as specific information given by an agent pertaining to aspects of another's performance or level of understanding (Brown, Peterson, & Yao, 2016). According to Hattie and Timperley (2007), the agent providing the feedback could be a teacher, peer, book, parent, self, or experience. Although one can generate feedback internally, feedback often comes from an external source, such as a teacher (Brown et al., 2016). In particular, when it comes to feedback from a teacher or parent, the feedback information is often corrective. In an academic setting, feedback is an essential part of the teaching process, with the goal being to reduce discrepancies between a student's current understanding or performance and a goal.

Feedback occurs after students have responded to initial instruction and feedback is based on their performance on the academic task (Hattie & Timperley, 2007). According to Price, Handley, Millar, and O'Donovan (2010) feedback is important to the learning process because it provides information that can be used to both improve and enhance future performance.

Feedback can be divided into two types: confirmatory and corrective feedback (Hattie & Timperley, 2007). Confirmatory feedback is when the individual receives confirmation that they have done a task well or accurately. Conversely, corrective feedback is when the student is informed that they did not do something well or correctly. However, both confirmatory and corrective feedback can have beneficial effects on learning. Hattie and Timperley (2007) refer to confirmatory feedback as “positive” and corrective feedback as “negative” feedback and reported that, “negative feedback is more powerful at the self-level and both types can be effective as task feedback,” and that, “there are differential effects relating to commitment, mastery or performance orientation, and self-efficacy at the self-regulatory level,” (p. 98). Confirmatory feedback, or “positive” feedback, is highly beneficial in academic settings as it can increase the likelihood that the student will continue to persist on a task and have an increased interest in it. For feedback to have the greatest impact, the academic goal needs to be specific and challenging to the student, but the complexity of the task needs to be relatively low. Feedback is most effective when it includes information about the student’s progress and about how to advance. Students often seek information about how they are doing, although they may not always accept and be happy with the answers (Hattie & Timperley, 2007).

Feedback comes in many forms and serves many purposes. According to Price et al. (2010), “The roles attributed to feedback fall broadly into five, but not entirely delineated discrete categories: correction, reinforcement, forensic diagnosis, benchmarking, and

longitudinal development (feed-forward)” (p. 278). Price et al. (2010) reviewed previous studies and findings regarding feedback to define their five categories and further explained that these categories act as a nested hierarchy with each category building on information from prior categories. The first role, the corrective role of feedback, is defined as taking what has been determined to be wrong and making it right, “correcting” that error. Corrective feedback is concerned with how well a task is being performed, including discerning correct from incorrect answers, attaining more information, and developing more surface knowledge (Hattie & Timperley, 2007). If an individual expects to be correct and turns out to be wrong, feedback will have the greatest effect. On the other hand, if individuals are unsure if they are correct and they end up being incorrect, the feedback they receive will largely be ignored. When feedback is delivered in groups, the feedback message may be confused by the individual with other members of the group (Hattie & Timperley, 2007).

The next role of feedback defined by Price et al. (2010) is that of reinforcement. When the feedback is confirmatory, it can reinforce the individual’s behavior and efforts. Often, praise is used as a positive reinforcer. According to Hattie and Timperley (2007), praise in combination with feedback is most effectively used if there is a low threat to the individual’s self-esteem. Both feedback and praise can be used to boost an individual’s confidence in their ability, but praise is meant to motivate the individual while feedback is aimed at developing and reinforcing skills and informing if change or improvement is needed. If there is a low threat, the individual is more likely to pay attention to the feedback. However, if the feedback is a high threat to their self-esteem the person may be more resistant to accepting the feedback.

The forensic role of feedback is when it diagnoses problems with the completed work, informing the individual of what they did wrong and what they need to correct. The fourth role,

benchmarking, occurs when feedback can help identify the gap between performance and what is expected, allowing for a better understanding of the discrepancy between the actual and expected performance of the individual. Next, longitudinal development aims to decrease this gap by focusing on future activities that will maintain performance or lessen the gap in performance. According to Price et al. (2010), these five roles combine to create an overall concept of feedback. Ideally, feedback aims to inform the individual if they were right or wrong and how they can improve. Yet Price et al. found that, in the academic setting of higher education, feedback often rests at the corrective stage.

Price et al. conducted a three-year study to investigate how to best engage students using feedback from assessments. Participants consisted of undergraduate and postgraduate students as well as university staff. Interviews were conducted with participants to better understand their perspectives and experiences with feedback in the higher education setting. Case studies were then completed across the three partner institutions involved in the study to investigate different feedback methods. Then, students completed questionnaires to evaluate forms of feedback. Overall, Price et al. (2010) found that students were generally critical of the feedback they received, though it was noted that students, “felt that interpretation could only be gained through dialogue or by comparing examples of good work,” (p. 282). This suggests that students would prefer more time to be spent on discussing the feedback they receive and for more opportunities to see what responses the teacher is looking for.

Self-Efficacy

Many roles of feedback are essential to learning. In addition, feedback also has an effect on students’ confidence and motivation, as characterized by their self-efficacy. As defined by Bandura (2006, p. 307), “self-efficacy is a personal judgment of how well one can execute

courses of action given their attainments.” According to Brown, Peterson, and Yao (2016, p. 609), “Feedback from successful performance on assessments is likely to contribute to a student’s sense of self-efficacy and greater self-efficacy reciprocally leads to greater performance.” Hattie and Timperley (2007) discussed that feedback can yield impressive gains in performance, as it can direct attention back to the task and result in increased self-efficacy and more effective self-regulation. This causes the individual to redirect their attention back to the task and to invest more effort. However, if the individual cannot relate the feedback on the task to their own performance, they may not try as hard in the future or may not understand how to improve. Hattie and Timperley (2007) explained that effective feedback needs to be clear, focused, meaningful, and must build upon and work with the students’ prior knowledge. Additionally, for feedback to be effective it needs to “prompt active information processing on the part of learners, have low task complexity, relate to specific and clear goals, and provide little threat to the person at the self-level” (Hattie and Timperley, 2007, p. 104). This means that feedback is most effective when the individual can relate it to what they are attempting to learn and accomplish as well as if it motivates them to complete an achievable task. Additionally, if an individual receives confirmatory feedback despite being wrong, this will increase the individual’s uncertainty about their own skills and abilities and may result in the individual engaging in self-handicapping strategies.

A student’s level of self-efficacy can also affect how that student will behave and respond to feedback. A study by Brown et al. (2016) looked into how the relationship between student beliefs about feedback relate to their self-regulation, self-efficacy, and academic achievement. Their study consisted of 278 university students who were administered surveys to assess their conceptions of feedback and self-reports of self-regulation, academic self-efficacy, and their

Grade Point Average. In regards to feedback and self-efficacy, Brown et al. (2016) found that students who reported that they actively utilized feedback information reported high academic self-efficacy and that academic self-efficacy was a better predictor of student Grade Point Average than metacognition. Additionally, if a student were to receive confirmatory feedback, their level of self-efficacy would change how they respond to later corrective feedback. Those with high self-efficacy may cope better with corrective feedback than their peers while those with low self-efficacy may attempt to avoid further feedback, despite how constructive it may be (Brown et al., 2016).

A meta-analysis conducted by Beattie, Dempsey, Fakehy, and Woodman (2015), further looked at the relationship between performance feedback, self-efficacy, and performance. They gathered and compared data from three studies, and each divided self-efficacy further into its magnitude and its strength. Self-efficacy magnitude refers to how difficult the participants believed the task would be and what they expected their performance to be. Self-efficacy strength measured the participants confidence in their ability to complete the task. The first study consisted of eighty-seven participants, with a mean age of 22.44 years, and participants were provided with either little feedback or were given opportunities to practice. Results indicated that self-efficacy magnitude had a significant positive relationship with performance ($r = .87, p < .001, r^2 = .75$) which implied that the more the participants believed they could improve their performance, the better their performance was. However, the strength of the self-efficacy was not significantly correlated with the performance ($r = -.02, p = .60$). This indicated that when the participants predicted that they would do well on the task, their performance improved. However, their level of confidence in their ability did not impact their performance significantly.

In the second study analyzed by Beattie, Dempsey, Fakehy, and Woodman (2015), there were forty-four participants with a mean age of 24.10. This study replicated the high feedback condition of the first study with more frequent measures of self-efficacy. Results showed a significant negative correlation between self-efficacy magnitude and the time it took participants to complete the task ($r = -.26, p < .001$). Self-efficacy strength also had a significant negative correlation with task time completion ($r = -.21, p < .001$). These results indicated that when both the participants believe that they could improve their performance and their confidence in their abilities was strong, the participants took less time to complete the task and their performance improved. Additionally, it should be noted that while both the self-efficacy magnitude and self-efficacy strength were found to be correlated with task time completion, the effect sizes fell within the medium to small range. The third study consisted of forty-five participants with a mean age of 28.22. Results indicated that there was a significant positive correlation between self-efficacy magnitude and performance ($r = .26, p < .001$) and the strength of self-efficacy and performance also had a significant positive correlation ($r = .26, p < .001$). Both self-efficacy magnitude ($r^2 = .07$) and strength ($r^2 = .07$) had an effect size that fell within the medium to small range. Overall, although there was not a significant correlation between self-efficacy magnitude and self-efficacy strength in the first study, they were related in both the second and third study. However, while results showed significance, the correlation coefficients were not particularly high. This study would have benefitted from increased sample sizes within each of the studies to increase power. Beattie, Dempsey, Fakehy, and Woodman (2015) also found there to be a positive relationship between self-efficacy and performance when the individuals have been provided with feedback on their previous performances. The third study reviewed provided participants with performance information from their previous trials before asking them to rate

their self-efficacy. In the first two studies, when participants were provided with minimal performance feedback there was not a significant relationship between their self-efficacy and their following performances. However, when participants were provided with more detailed feedback, both their self-efficacy magnitude ($\gamma_{30} = .40, p < .001$) and their self-efficacy strength ($\gamma_{30} = .004, p < .001$) were significant predictors for their following performances. These results indicated that detailed feedback, that which allows the individual to understand how to improve in future performances, will create positive increases in both self-efficacy and subsequent performances (Beattie, Dempsey, Fakehy, & Woodman, 2015). Based on this, the increased amount of feedback available to students as a result of classroom polling devices should allow for there to be a positive relationship between the student's performance and their self-efficacy level as they are provided with feedback on their performance, which will allow them to accurately identify their abilities and make improvements on later quizzes.

A study conducted by Kyprianou, Lane, and Lane (2004) investigated the relationship between self-efficacy, self-esteem, and academic performance. This study assessed 205 postgraduate management students who were enrolled in their first year of study at a business school ($M_{age} = 27.5$). The study collected self-esteem, self-efficacy, and previous academic performance data through questionnaires and their postgraduate academic success was measured through formal assessment of their class modules over a 15-week semester, and their mean performance was rated on a 20-point scale. This scale was completed by a class tutor and Kyprianou et al. (2004) felt this was a valid measure of performance though there were no measures of internal consistency or interrater reliability. Data was analyzed through descriptive statistics and a correlation matrix among measures. Results indicated a positive association between high self-efficacy and self-esteem with a positive perception of academic success.

Additionally, higher academic performance was correlated with higher self-efficacy scores.

Kyprianou et al. (2004) also found there to be a significant correlation between self-esteem and self-efficacy and believed that “self-esteem is likely to flow from perceived efficacy expectations, rather than the reverse,” (p. 254). Additionally, they found that self-efficacy was a predictor for a student’s future performance, but that self-esteem cannot predict academic accomplishment (Kyprianou et al., 2004).

Locke and Wood (1987) also examined the relationship between academic performance and self-efficacy. They conducted a meta-analysis of four studies each made up of undergraduate participants. The first study consisted of sixty-four undergraduates who were asked questions pertaining to self-efficacy on several tasks and were asked to rate their self-efficacy magnitude (SEM) and strength (SES) for each. For the magnitude of their self-efficacy, participants were asked if they believed they could achieve the task to a particular degree. For the strength of their self-efficacy, participants were asked to rate their confidence that they could perform at that level on a scale of 0 to 100. SEM and SES scores were then correlated with the participants’ final grades from the course and Locke and Wood (1987) found there to be a significant positive correlation between all but one of the SES scores with the grades. SEM scores were found to not be significantly correlated with grades, and suffered from a severe ceiling effect. The second ($N = 194$) and third ($N = 212$) studies consisted of undergraduate participants from later semesters of the same course in the first study and the fourth ($N = 111$) study consisted of undergraduate participants from a psychology class at the same university. Results from these studies indicated that SES was significantly correlated with the academic performance in all three studies and that SEM was significantly correlated in two out of the three. For these three studies, the correlation coefficients were found to be quite low ($r's \leq .23$). Overall, between the four studies, Locke &

Woode (1987) concluded that self-efficacy strength has a moderate relationship with academic performance when looking at the data combined ($r = .27$).

In a study by Bonsaken, Sadehgi, and Thorrisen (2017), they examined the relationships between self-esteem, self-efficacy, and different approaches to studying which included deep, strategic, and surface approaches. The study was a cross-sectional design in which 125 undergraduate students completed questionnaires measuring self-esteem and self-efficacy. A regression analysis was used to analyze the relationships and they found that there was no relationship between studying approach and self-esteem. Bonsaken et al. (2017) found that deep approach study behaviors were significantly associated with higher age, exposure to higher education before starting their current area of study ($r = -.18$), spending time independently studying ($r = .28$), and a higher level of self-efficacy ($r = .20$). Strategic study behaviors were significantly related to time spent independently studying ($r = 0.39$), having a higher level of self-esteem ($r = .19$), having a higher level of self-efficacy ($r = .33$), and is more associated with the female gender. Surface approach study behavior was found to be significantly associated with lower age, no prior higher education, lower levels of self-esteem ($r = -.35$), lower levels of self-efficacy ($r = -.38$), and is more associated with the female gender. These correlation coefficients signify weak linear relationships between the variables and the majority indicate small effect sizes. Overall, Bonsaken, et al. (2017) concluded that while self-esteem was not significantly associated with a particular study approach, higher scores on self-efficacy were significantly associated with deep and strategic approaches to studying.

Research from Burke, Henderson, Lightsey, and Yee (2006) found that self-efficacy “predicts, and may play a causal role in, development of self-esteem, and persons with higher self-efficacy may have a significantly higher chance of increasing their self-esteem” (p. 77).

Burke et al. (2006) hypothesized that generalized self-efficacy predicts future self-esteem and that self-esteem would predict incremental variance in future negative affect. To assess this, they reviewed data from two previous studies in which they had administered a packet of scales to a sample of undergraduate students two times over a five to six-week period, once at the beginning and once at the end. The first study consisted of a sample of 160 undergraduate students and the second study was made up of 75 undergraduate students. The packet of scales included The Rosenberg Self-Esteem Scale (Rosenberg, 1965), the Generalized Self-Efficacy Scale (Tipton & Worthington, 1984), and the Positive and Negative Affect Scales (Watson, Clark, & Tellegen, 1988). The data collected from these scales was analyzed through repeated measures multivariate analysis of variance and multiple regression analysis. Results indicated that self-esteem accounted for significant variance (2%) in negative affect in the first study, but was not significant in the second study, though the smaller N of the second study contributed to the null results. In comparison, they found that Generalized Self-Efficacy did not predict the presence of a negative affect, and the presence of a negative affect also did not predict self-esteem or Generalized Self-Efficacy in either study. Additionally, Burke et al. (2006) discussed that changes in self-efficacy are associated with performance changes and that performance may have an effect on self-esteem, particularly if that performance results in feedback that questions a student's self-efficacy or self-image.

Overall, self-efficacy is highly important in an academic setting because it can increase the student's self-esteem and motivation. In a study done by Bonsaken, Sadehgi, and Thorrisen (2017), they looked at the relationship between study habits and student self-efficacy as well as self-esteem. They found that self-efficacy was a predictor for how the student studied. High self-efficacy was related to more deep ($r = .20$) and strategic approaches ($r = .33$) to studying while

low self-efficacy levels used more of a surface approach to studying (Bonsaksen et al., 2017). Surface approaches to studying were negatively correlated with self-efficacy ($r = -.38$) and self-esteem ($r = -.35$). Additionally, the effect sizes for these variables fell within the medium range except for the correlation between self-efficacy and deep approaches which was in fact a small effect ($r^2 = .04$). Overall, the negative correlation between surface approaches to studying and self-efficacy suggest that student's with low self-efficacy may lose motivation and not study as thoroughly as those with high self-efficacy. Due to this, their academic performance may suffer, and it is possible that their low self-efficacy may have an effect on their self-esteem as well. Thus, it is also important to examine self-esteem in students and its relation to feedback.

Self-Esteem

One's self-esteem is how positively or negatively they evaluate themselves. Rosenberg (1965, p. 30) defined self-esteem as, "a positive or negative attitude toward a particular object, namely, the self," and Branden (1969, p. 114) defined self-esteem as "the disposition to experience oneself as being competent to cope with basic challenges of life and as being worthy of happiness." Rosenberg (1965) further expanded on his definition of self-esteem by defining both high and low self-esteem. According to Rosenberg (1965), high self-esteem was defined as an individual feeling that they are good enough, find themselves to be worthy, and indicates that they respect themselves. These individuals also strive to grow and improve any deficiencies they may have. In contrast, Rosenberg (1965) explained that having low self-esteem implies self-rejection, that the individual is dissatisfied with themselves, and has self-contempt. According to Akin and Radford (2018), self-esteem can be developed through an individual's associations, activities, or from what they hear from others concerning him or herself and that, "these processes result in an individual's overall feelings of self-worth" (Atkin & Radford, 2018, p. 16).

Relationships with peers, family, teachers, and society as a whole influence the development of students' self-esteem (Akin & Radford, 2018; Huebner, Tian, & Yang, 2007).

Throughout a person's development, their level of self-esteem shows changes in stability based on the period of life they are in. A meta-analysis of 86 published articles, a large cross-sectional study of participants aged 9 through 90 years old, and a longitudinal study of participants aged 25 through 96 years old were analyzed and summarized by Richard, Robins, and Trzesniewski (2005) in order to outline the development of self-esteem from childhood to old age, particularly its highs and lows. Richard et al. (2005) compared mean levels of self-esteem for males and females across the lifespan. Self-esteem scores of participants ranged from a value of 2.80 to 4.10. During childhood, young children often have relatively high self-esteem as they have unrealistically positive self-views. However, as they further develop cognitively they begin to self-evaluate based on external feedback and social comparisons and as, "they receive more negative feedback from teachers, parents, and peers... their self-evaluations correspondingly become more negative," (Richard et al., 2005, p. 159). Richard et al. (2005) indicated that from the ages of 9-12 years old the average self-esteem score was just below 3.80. However, by the time the individuals were between 18-22 years old, male scores had fallen to approximately 3.45 and female scores had fallen to 3.20.

During the adolescent phase, self-esteem tends to be on a downward trajectory as problems associated with puberty, abstract thinking about the future and the self, increased academic challenges, and social relationships. As a person moves into adulthood, self-esteem has been found to increase gradually, peaking when one is in their late 60s. This is in part a result of increasing maturity, adjustment, conscientiousness, and emotional stability. Once a person reaches old age, self-esteem begins to drop around the age of 70. Richard et al. (2005) explained

this decrease as potentially being due to the changes that occur in old age such as retirement, loss of a spouse, physical functioning, or a drop in socioeconomic status. Despite the fluctuations self-esteem goes through during one's lifespan, it is a variable that plays a key role in a person's self-concept, well-being, and performance. Overall, Richard et al. (2005) found that during early childhood the stability of self-esteem is relatively low, shows an increase throughout adolescence and early adulthood, and then the stability declines during midlife and old age. Additionally, they hypothesized that the lower trends of stability during childhood and old age could be due to, "dramatic life changes, shifting social circumstances, and relatively rapid maturational changes that characterize both the beginning and end of life," (p. 160). This shows that self-esteem can fluctuate during an individual's lifespan.

A particular period during an individual's lifespan that has changes in self-esteem is when an individual transitions from adolescence to adulthood. A study by Chung et al. (2014) looked at individuals within this age group who were attending college and found significant relationships between the slope of an individual's grade point average (GPA) and the slope of their self-esteem over four years of college, as well as the relationship between expected GPA and changes in self-esteem. The longitudinal study conducted by Chung et al. (2014) consisted of a subsample of 295 participants from longitudinal data of a previous study. Participants completed the Rosenberg Self-Esteem scale three times during their first year of college, and then again annually for the next three years. To assess their academic achievement, student GPA scores were recorded every semester over the course of four years. To determine the participants' expected academic achievement, participants were surveyed during their first week of college regarding their expected GPA scores. Results indicated a significant relationship between the participants' GPA slope and their self-esteem slope over their four years in college, which

demonstrated that increases in GPA were correlated with increases in self-esteem. As for expected GPA, Chung et al. (2014) found that participants who entered college with high expectations for their academic achievement and GPA tended to have high levels of self-esteem. However, expected GPA was negatively correlated with the four-year self-esteem slope, suggesting that those who entered college with high academic expectations experienced a drop in self-esteem over their four years of college. Chung et al. (2014) found there to be a significant decrease in the participants self-esteem in relation to their expected GPA when comparing its initial measurement at the beginning of college ($B = .52, SE B = .19, \beta = .18$) and the slope of their self-esteem over the four years of college ($B = -.11, SE B = .05, \beta = -.20$). Overall, results indicated that individuals who had unrealistic expectations for their academic performance declined in self-esteem when compared to those who had more realistic expectations of their achievement. These results also support the effect that academic performance has on an individual's self-esteem during four years of college.

A study conducted by Yang, Tian, and Huebner (2007), looked at the relationship between academic achievement, self-esteem, and subjective well-being in 807 elementary school students. Participants completed multi-measure questionnaires three times over an 18-month period. Yang et al. (2007) found that a student's level of academic achievement could positively predict later well-being in school and that there was a mediatory role of self-esteem for academic achievement. In a study conducted by Carter-Rogers et al. (2015), academic self-esteem was positively correlated with students' devaluation of their test results when they received corrective feedback. Across the three samples studied, test derogation was positively correlated with academic self-esteem ($r_1 = .24, r_2 = .34, r_3 = .23$). The researchers attributed this to the belief that, "when faced with a poor grade, students often attribute failure to external sources," because

“such performance threatens their generally positive academic self-worth” (Carter-Rogers et al., 2015, p. 123). The variables had small to medium effect sizes and the correlations indicated a weak positive linear relationship between academic self-esteem and student devaluation of their test results. Overall, Carter-Rogers et al. (2015) found that those with high self-esteem have a tendency to self-enhance, meaning that they tend to try and minimize their flaws and promote their more desirable traits, especially when these assertions are challenged or shown to be wrong. However, this self-enhancement functions as a “positive illusion” which, according to Carter-Rogers, Mackinnon, & Smith, (2015) promotes and maintains the mental health of the individual by preserving high self-esteem and self-concept. Although results indicate that there was a relationship between test derogation and self-esteem, this study could have benefitted from including either positive or neutral performance feedback in a control condition. This addition would further expand on the relationship between self-esteem and test derogation as well as showing how self-esteem is affected by neutral and positive feedback.

Unfortunately, individuals with high self-esteem may respond with denial if they receive corrective feedback rather than confirmatory feedback and are more likely to attribute faults to an external source. Those with high self-esteem expect to do well and may trivialize their test results when they do not meet their own expectations (Carter-Rogers et al., 2015). People tend to want to maintain a positive self-concept and threats to this self-concept will trigger attempts to minimize that threat. Threats may include when the individual’s beliefs are challenged or questioned (Carter-Rogers et al., 2015). To combat this, they felt that lessening the self-threat of the feedback may make it more effective. If the results do not challenge the individual’s self-perception as much, they may be more effective as the individual may be more likely to take the corrective feedback into consideration. A longitudinal study by Burke and Cast (2002) proposed

that self-esteem also plays a role mitigating the effects that an individual experiences regarding the threats, such as those from corrective feedback. They found that self-esteem works as a type of buffer that helps protect individuals from the negative feelings that come from disruptive or threatening experiences. This buffer allows the individual to find new ways to enforce their sense of self or to adjust their sense of self. However, this buffer has limits, and over time continued negative feelings prevent the individual from verifying their sense of self, and their self-esteem declines (Burke & Cast, 2002, p. 1059). Based on this, if a student does worse than their peers over a period of time, the social comparison will lead to negative emotions, and this occurring repeatedly can cause a decrease in an individual's self-esteem as their sense of self is challenged. According to a literature review by Hattie and Timperley (2007), feedback needs to be clear, purposeful, meaningful, and compatible with students' prior knowledge and to provide logical connections... and provide little threat to the person at the self-level" (Hattie & Timperley, 2007, p.104). Lowering the threat to the individual's self-esteem could involve changing the type of feedback received and the methods of delivering it. Feedback utilized in combination with peer comparison data, received through the use of electronic student response systems, could have a higher or lower threat level than individualized feedback.

According to Bandura (2006), the difference between self-efficacy and self-esteem is that self-efficacy, "is a judgement of capability; self-esteem is a judgement of self-worth" (Bandura, 2006, p. 309). In a study by Bonsaken, Sadehgi, and Thorrisen (2017), they examined the relationships between self-esteem, self-efficacy, and different approaches to studying by having 125 undergraduate students complete questionnaires measuring the previously stated topics. Regression analysis were used to analyze the relationships and they found that there was no relationship between studying and self-esteem. A study conducted by Kyprianou, Lane, and Lane

(2004) also looked at the relationship between self-esteem and self-efficacy of an undergraduate student population and found there to be a significant correlation between self-esteem and self-efficacy. They looked at three self-efficacy measures: self-efficacy to maintain motivation in the light of potential difficulties, self-efficacy to cope with intellectual demands, and self-efficacy to gain a passing grade at the end of the semester. Self-esteem was found to positively correlate with each of these ($r_1 = .28$, $r_2 = .31$, $r_3 = .37$). They also looked at the relationship between the two variables, concluded that self-esteem is likely influenced by perceived expectations of their abilities and not the reverse. They also found that self-esteem does not predict academic accomplishment. A study by Burke, Henderson, Lightsey, and Yee (2006) looked at the relationship between self-efficacy, self-esteem, negative affect, and performance changes. Findings from Burke et al. (2006, p. 77) discussed that while there is an association between changes in self-efficacy and performance changes, self-esteem is, “often is not related to functional status or behavior.” Thus, self-esteem may not affect student performance, but performance may have an effect on self-esteem, particularly if that performance results in feedback that questions a student’s self-efficacy or self-image.

Technology

Utilizing technologies such as electronic student response systems are one way that technology can be integrated into a classroom and increase the frequency of feedback on student performance. Student response systems include laptops, mobile phones, or clickers which are small wireless remote devices that allow students to respond to multiple-choice, true or false, and yes or no questions. According to DeJarnette and Moratelli (2014, p. 587), “Technology in the classroom can serve as an educational tool for both teachers and students. Technology can help make student performance easily assessable. Students can become self-regulated learners with

the immediate feedback the clicker technology offers. Teachers, on the other hand, have the opportunity to gather information regarding which students still need extra help and which can move on to new concepts.” Polling devices are coordinated with the teacher’s computer, and the questions are often presented using PowerPoint or an online polling site, and student responses are compiled and displayed on screen. The utilization of audience polling allows for data to be gathered and displayed easily, and this data can quickly provide information to the teacher regarding the students’ understanding.

DeJarnette and Moratelli (2014) found that when the clicker response data was displayed in the class, students were able to see which questions they got wrong and could identify material they needed to review for their test. Additionally, they found that the feedback the clickers provided allowed the teachers to identify what areas the students were struggling with and provide support to increase student success. DeJarnette and Moratelli (2014) also found that as the study progressed, students showed increased self-efficacy and confidence with continued use of the clickers. This change was measured through three different methods. The first was a comparison of average test scores prior to the use of clickers compared to the average scores with clicker use. The second method was a survey following the session asking the students to share their attitudes, opinions, and questions about the clickers. The final method utilized was a behavior checklist to rate student engagement. Overall, DeJarnette and Moratelli (2014) concluded that “if students believed the learning experience was fun and enjoyable, then they could become more easily engaged and ultimately increase their reading comprehension and literacy skills as presented here” (DeJarnette & Moratelli, 2014, p. 592). They also proposed that with the immediate feedback provided by using clickers, students become more motivated and

interested in learning as frequent positive feedback may increase the students' confidence and academic success.

Research Questions and Hypotheses

When students use polling devices to respond to classroom questions, the results of these questions are often displayed as a graph, allowing students to repeatedly compare their own performance to that of their peers. The present study examined if students' self-efficacy and self-esteem are affected by the visibility of peer responses on in-class polling questions. To do so, one class was provided a graph of student responses following each polling question and a second class was not shown how their peers performed. First, it was hypothesized that there would be a positive relationship between academic performance and self-efficacy regardless of group, as the instructor informed all students of the correct answer after they responded to the polling question. Second, because of the social comparison that would likely take place when data from the entire class were displayed after each question, the relationship between student performance and self-esteem would be stronger when the feedback was displayed than when the class results were not shown. Additionally, as data were collected from two separate classes, it should be noted that both classes had participated in in-class polling questions and had been previously exposed to comparison data for the majority of the semester prior to the study. Based on this, it was hypothesized that there would be a change in self-esteem only in the no-feedback group. Self-efficacy would not be expected to change because both groups would continue to be provided with corrective feedback from the instructor.

Method

Participants

Students enrolled in two spring semester undergraduate level psychology courses taught by the same teacher were the participants for this study ($N = 35$). The experimental condition was made up of 23 students in a Biological Psychology class and the control condition comprised 12 students in a Sensation and Perception class. These numbers do not include students who were removed for not completing the post surveys ($N = 4$). Within the experimental group, 5 participants identified as male and 18 identified as female, ($M_{age} = 22.17$, $SD = 4.94$). Of these participants, 21.7% identified as African American, 69.6% as White (Non-Hispanic), and 8.7% as Hispanic. Within the control group, 1 participant identified as male and 11 identified as female, ($M_{age} = 21.25$, $SD = .75$). Of these participants, 16.7% of students identified as African American, 58.3% as White (Non-Hispanic), 8.3% as Hispanic, and 16.7% identified as Two or More ethnicities.

Instruments

Self-Efficacy

Students' levels of self-efficacy were measured using the Self-Efficacy Formative Questionnaire (SEFQ) developed by Gaumer, Erickson, and Noonan (2018). This measure was developed following extensive review of research on self-efficacy and is designed to assess a student's perceived levels of proficiency in their ability to grow with effort and their belief in their ability as these are two essential components of self-efficacy (Gaumer, Erickson, McGurn, Noonan, & Soukup, 2018). This assessment is a 13-item survey with two subscales. The first subscale is made up of 5 items and assesses the individual's belief that ability grows with effort. The second subscale is made up of 8 items and these statements are about the individual's belief in their

personal ability (self-efficacy). Results from the two subscales were added together to produce the individual's self-efficacy rating. Participants read the statements and indicated on a Likert scale from 1 (Not very like me) to 5 (Very like me) what they believed fit best. The Self-Efficacy Formative Questionnaire was found to have adequate internal consistency ($\alpha = .894$), (Gaumer et al. 2018). Additionally, a literature review conducted by Bawdon (2019) reported the SEFQ to have both content and construct validity.

Self-Esteem

To assess levels of student self-esteem, the Rosenberg Self-Esteem Scale (RSES) (Rosenberg, 1965) was utilized. This scale is a 10-item assessment that measures state self-esteem based on responses regarding the individual's current feelings. Response options are on a 4-point Likert scale ranging from Strongly Agree (3 points) to Strongly Disagree (0 points), with half of the items being reverse scored. The higher the individual's score, the higher their self-esteem (Rosenberg, 1965). Rosenberg 1965 reported the internal consistency of the scale to be 0.77 and that the minimum coefficient of reproducibility was at least 0.90. The Cronbach's α was reported to range from .85 to .88 (Erol & Orth, 2011). A meta-analysis of four studies by Hendin, Robins, & Trzesniewski (2001) compared the RSES with the Single-Item Self-Esteem Scale (SISE) and looked at their reliability and validity with different populations. Overall, they found the two measures to have strong convergent validity for men and women, college students and community members, and for different ethnic groups. Additionally, the two measures had similar correlations across a range of criterion measures. In the first study that Hendin et al. (2001) evaluated, concurrent correlations between the two measures ranged from .72 to .76 over six assessments periods. Additionally, across the six administrations of the RSES they found it to be highly reliable with reliabilities ranging from .88 to .90. These trends continued through the four

studies and findings supported the contrast validity of the RSES (Hendin, Robins, & Trzesniewski, 2001).

Academic Performance

To assess students' academic performance, students were given in-class concept assessment questions based on lecture content. The questions were of comparative difficulty across the two classes. The questions were embedded in a PowerPoint presentation using TurningPoint polling software and students used their mobile devices to respond. The software program had the option to display or not display the histogram showing the distribution of responses after each question.

Procedure

Data collection occurred on 3 consecutive class periods in one week in April during the spring semester. Prior to the start of the study, both classes regularly answered in-class concept questions where comparative feedback data was presented for the majority of the semester, which began in January. Thus, in the control condition, students continued to be shown comparative data (i.e., the histogram of student responses) following their polling questions along with instructor feedback about the correct answers. In the experimental condition, the usual comparative feedback was withdrawn, but the instructor continued to provide feedback about the correct answer verbally. During the week, the control group was given daily concept questions using a student response system and, following each question on the quiz, class results were shown in the form of a graph displaying the percentage of students who select each answer, without showing student names. This feedback with comparison data was shown each day. The experimental group had in-class concept questions of similar difficulty, but were based on different content and were not provided with comparative data. On the last day at the end of

class, students in both groups completed the SEFQ and RSES. However, it should be noted that the day two concept assessment data were lost for the experimental group due to a software malfunction, so data from only the first and third day's concept assessments was utilized.

Statistical Analysis

Descriptive statistics and correlational analyses were calculated. In SPSS, a partial correlation was conducted to determine the direction and strength of the relationship between academic performance, as measured by performance on the in-class concept questions, and self-efficacy as well as the relationship between academic performance and self-esteem, controlling for baseline levels, respectively. For these comparisons, academic performance was calculated based on student performance on in-class concept questions. A Fisher Z Transformation was performed to determine if the correlation between academic performance and student's level of self-efficacy and self-esteem was stronger in the group that had comparative data than the group in which the comparison data was not present. A repeated-measures ANOVA was conducted to test the third hypothesis that self-esteem would change over time in only the experimental group. An alpha level of 0.05 was used for all statistical tests in this study.

Results

Raw score means, standard deviations, and additional statistics for each variable of the experimental condition are reported in Table 1 and for the control condition are reported in Table 2. The experimental and control groups had averages similar to each other on both their pre and post-tests of SEFQ and RSES.

Self-Efficacy

To test the first hypothesis that there would be a positive relationship between academic performance and self-efficacy, the partial correlation between academic performance and the

post self-efficacy scores was computed, controlling for baseline levels, but there was no significant relationship between the two variables in either the experimental group ($r = .10, p = .67$), the control group ($r = .17, p = .61$), or the combined groups ($r = .06, p = .73$). Pre and post self-efficacy scores were highly correlated ($r = .84, p < .001$) and did not change significantly over time, nor was there a significant interaction between group and time, ($F_s < 1, P_S > .05$).

Self-Esteem

The second hypothesis of this study predicted that the correlation between student academic performance and their level of self-esteem would be stronger with comparison data present than when the comparison data is not present. However, the partial correlation between the students' academic performance and post- self-esteem scale for the experimental group was not significant ($r = .17, p = .46$), and was identical to the partial correlation coefficient of the control group ($r = .17, p = .63$). Thus, the Fisher z transformation assessing the differences between the correlation between self-esteem and academic performance for each group was not significant, see Table 2.

Results from a repeated-measures ANOVA on RSES scores found that there was a main effect of time, with higher post RSES scores than pre RSES scores (see Table 1), $F(1, 33) = 9.14$ $p = .005$, but this change did not depend on group (interaction term $p > .05$). Thus, the third hypothesis that only the no-feedback condition (experimental group), would show a change in self-esteem scores was not supported as both groups showed a positive change in scores.

Discussion

The current study examined the effects of comparative feedback and performance on students' levels of self-efficacy and self-esteem using mobile device polling in the classroom. The first hypothesis was that there would be a positive correlation between academic

performance and self-efficacy regardless of group. However, results indicated that while there was a weak positive correlation between post self-efficacy score and academic performance, the results were not significant and self-efficacy did not change significantly over time.

This study also hypothesized that, because of the social comparison that would likely take place when data from the entire class is displayed after each question, the correlation between student performance and their level of self-esteem would be stronger than when the comparison data is not present. The second hypothesis was not supported as results showed that the correlation coefficients between student academic performance and post self-esteem score were identical for both the control and the experimental group. The third hypothesis predicted that there would be a change in self-esteem only in the no-feedback group. This hypothesis was also not supported as a positive change in self-esteem was seen in both groups, though this change was not significant. Therefore, none of the hypotheses of this study were supported. It is important to note that this study was not an experiment due to the non-equivalent groups. The groups had different numbers of participants, were different classes with different subject matter, and students were not randomly assigned to conditions. Additionally, the sample size for this study was extremely small resulting in the data being under powered. Further explanations for the findings follow.

Relationship Between Academic Performance and Self-Efficacy

The first hypothesis stated that there would be a positive correlation between academic performance and the post self-efficacy scores regardless of the participants' group as both groups were provided with the correct answers following the in-class concept questions. Additionally, this hypothesis was based on previous studies related to the relationship between academic performance and self-efficacy. A student's self-efficacy plays a crucial role in their academic

career. Brown et al. proposed in their study that individuals with a high level of self-efficacy tend to cope better with corrective feedback than their peers and that those with low self-efficacy tend to try and avoid further feedback, despite how constructive it may be (Brown et al., 2016). High self-efficacy has also been found to be correlated with good academic performance and that it is a predictor for a student's future performance (Kyprianou, Lane, and Lane, 2004). Additionally, studies have found that high levels of self-efficacy can increase student's self-esteem as well as their motivation, with studies showing that those with high self-efficacy put more effort into studying and preparing for their classes (Bonsaken, Sadeghi, & Thorrisen, 2017). Based on this, it was hypothesized that participants who did relatively well on the concept questions in class would have higher self-efficacy scores on their post measurements. Results indicate that the relationship between academic performance and post self-efficacy scores of participants was nonsignificant. As previous studies have found there to be a significant relationship between academic performance and self-efficacy, the lack of a significant relationship in the present study could be due to a variety of factors. The first factor is the small sample size of this study as this results in a lack of statistical power. With a larger sample size it is hypothesized that results would potentially be more significant based on the results of previous studies. Another factor that may account for the lack of a significant relationship between academic performance and self-efficacy could be the fact that participants self-selected their course enrollment. It is possible that they chose the class itself based on their belief that they could succeed in the class. Additionally, students already had several months of feedback before the study was conducted so they might already have an accurate assessment of their abilities, resulting in little to no change in their self-efficacy scores following the in-class concept questions.

Relationship Between Academic Performance and Self-Esteem

The second hypothesis stated that, due to the social comparison that would likely take place when data from the entire class was displayed after each question, the correlation between student performance and their level of self-esteem would be stronger than when the comparison data was not present. This hypothesis was based on studies showing the impact that academic performance has on self-esteem as well as how peer comparison effects self-esteem. In particular, the peer comparison that is a result of the polling question feedback could potentially threaten an individual's self-esteem as Carter-Rogers, Mackinnon, and Smith (2015) defined threats to self-esteem as when an individual's beliefs are challenged or questioned. If an individual answers a polling question in class and expects to do well, only to find that they did worse than their peers, this can threaten their self-perception and in turn, their self-esteem. Burke and Cast (2002) explored the role that self-esteem plays in mitigating the effects of threats that an individual experiences, and found that self-esteem works as a type of buffer that helps protect individuals from the negative feelings that come from these threats. This self-esteem buffer allows the individual to find new ways to enforce their sense of self or to adjust their sense of self. However, this buffer is limited and eventually persistent negative feelings prevent the individual from verifying their sense of self and their self-esteem declines (Burke & Cast, 2002, p. 1059). Based on this, if a student does worse than their peers over a period of time, the social comparison will lead to negative emotions, and this occurring repeatedly can cause a decrease in an individual's self-esteem as their sense of self is challenged. Due to this relationship between self-esteem and peer comparison when the "threat" of negative feedback and the feelings related to that feedback, it was hypothesized that the peer comparison following the concept questions would have an impact on the self-esteem of the participants. However, in the present study,

participants in neither group had a significant relationship between their academic performance and their post self-esteem scores. Additionally, both groups had identical and weak correlation coefficients ($r = .17$) for the relationship between academic performance and post self-esteem. This indicates that the presence of comparison feedback did not have an impact on the relationship between academic performance and self-esteem. Based on these results, the second hypothesis was not supported because neither group had a significant relationship between post self-esteem scores and academic performance.

The lack of a significant relationship between self-esteem scores and academic performance in the present study could be due to a variety of factors. As was the case for the relationship between self-efficacy and academic performance, the first factor is the small sample size of this study as which caused a lack of statistical power. However, the effect sizes for self-esteem in much of the reviewed literature were small as well. It is theorized that there are other variables other than academic performance that may cause changes in self-esteem within the classroom setting. Further research should be conducted to determine what alternative variables may have an impact on self-esteem scores.

Relationship Between Comparative Feedback and Ratings of Self-Esteem

As for the third hypothesis, it was predicted that there would be a change in self-esteem only in the no-feedback group as the other group would be accustomed to seeing the feedback already. However, this was not supported as both the experimental and the control conditions saw a slight increase in self-esteem between the pre and post surveys. It is possible that as participants grew more comfortable with the topics on the in-class concept questions over the week their self-esteem increased. Additionally, the participants had been exposed to comparative feedback for three months prior to the start of this study. Once the study was conducted in April

of that semester, the participants may have habituated to the presence of comparative feedback and may have become desensitized to the peer comparison. To determine if there was an influence on scores from alternative variables, further research should be conducted.

Limitations

There are a couple of limitations to note as a result of this study. One of the main limitations of this study was the small sample size. Unfortunately, not all members of the two classes took both the pre and the post tests, resulting in a further loss of participant numbers. Sample size is important because both confidence intervals and *p*-values depend on the size of the sample with larger samples generally resulting in narrower confidence intervals and smaller *p*-values, (Whitley & Ball, 2002). According to Whitley and Ball (2002), “often studies are reported that are simply too small to have adequate power to detect the hypothesized effect,” and that, “even when a difference exists in reality it may be that too few study subjects have been recruited.” This can be found in studies where the sample size is small, the *p*-values are high, and the confidence intervals are wide, and the conclusion is that there is no difference between the groups. Whitley and Ball (2002) summed this up as, “absence of evidence is not evidence of absence,” in which what seems to be an apparent null result signifying no difference between groups may be due to a lack of statistical power as a result of the sample size being too small, which in turn makes it unlikely that a true difference will be accurately identified. Consequently, this may lead to us accepting the null hypothesis and potentially making a Type II error. According to an a priori power analysis, the suggested sample size to create a medium effect size of .30 should have been 134 participants.

Another limitation of this study involved having only two classes participate that differed in course content. As the participation in either the control or experimental group was

determined by which class a student was enrolled in, this study was not a true experiment. Multiple classes would allow for greater randomization of the participants. Randomization is important in a study as it reduces bias and ensures that any confounding variables are distributed equally across conditions and groups. The different subject matter of the classes is important to take into consideration as well. One of the classes could be at a higher level or greater difficulty than the other which could in turn affect academic performance.

Another potential limitation of this study was the duration of the study. Data collection occurred over three class periods in one week. Having a longer study would allow for more data collection on the concept question scores and could create a more accurate representation of the participant's average performance as the particular lesson could have been harder for some students than others, or other variables could have been affecting students for that particular week. Additionally, another limitation of this study was that the two classes were different classes and taught different content. While the difficulty and format of the in-class concept questions were comparable, they were not identical. A fourth limitation is the fact that this was a correlational study and there could be other variables impacting the relationship. A potential variable that was not accounted for could be what the participants value, and to what extent those values influence their self-esteem and self-efficacy. In other words, it is possible that participants did not put academic success as a high-value factor for their self-identity, which in turn would cause poor academic performance not to have a great impact on their ratings of self-esteem and self-efficacy. Future studies should take these potential outside variables into consideration, especially the participants' personal views on the importance of academic performance. In this study, students chose the classes that they were taking at the beginning of the year. This choice

should also be taken into consideration as their motivations for participating in the class could influence their performance as well as their levels of self-esteem and self-efficacy.

Going forward another variable that should be taken into consideration is the age of the participants. Future studies should compare the use of classroom technologies and the peer comparison opportunities they provide in a variety of grade levels to see if the peer comparison has a greater impact at certain ages. If so, it could inform how to best use these technologies going forward. Additionally, by the time an individual is in college, they may have had so many years of schooling that their academic confidence may not be as easily impacted. Modifying and conducting this study with younger participants may result in different outcomes. However, if the study is replicated just with a different age range, age will continue to be a limitation as results cannot be generalized to different age ranges. Ideally, a longitudinal study could be conducted to determine the effects of peer comparison at a variety of ages.

Implications and Future Directions

The integration of mobile device polling in the classroom is becoming more prevalent in the school setting and it is important to stay updated on these developing technologies in order to best understand the potential impacts their use may have. The exponential growth of technology in school settings can especially be seen as students utilize technologies such as computers, mobile devices, the Internet, and interactive whiteboards. According to a survey conducted by Project Tomorrow in 2017, 60% of school principals report that their school is utilizing a 1:1 mobile device program for in-school use. This is an increase of 9% from Project Tomorrow's survey of schools in 2016 (Evans, 2018). Project Tomorrow also found that high school students with access to a 1:1 device such as a laptop were, "more likely to use those devices to personalize their learning process, to stay organized with their schoolwork and to leverage

technology for more enhanced learning experiences than their peers with no access or only sporadic access” (Evans, 2018 p. 4).

As the use of different technologies continues to grow, it is important to look at ways these technologies can be used to deliver student feedback and to explore the effects they may have on students. Going forward, it would be interesting to compare the feedback provided by technologies such as clickers to other methods, such as having a teacher call out answers following a quiz, or having peers grade work.

In conclusion, this study did not find there to be a significant relationship between academic performance and self-efficacy, or a significant relationship between academic performance and self-esteem when comparative feedback was not present. Additionally, results indicated that there was a slight positive increase of student self-esteem in both the experimental and the control conditions. Overall, little can be concluded based on the null results of this study. However, this study provides a groundwork for future studies that should be conducted with a much larger sample size and greater control over confounding variables.

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Tables

Table 1

Statistics of all Variables for Experimental Condition

Variable			Skewness		Kurtosis		95% Confidence Interval	
	<i>M</i>	<i>SD</i>	<i>Statistic</i>	<i>Std. Error</i>	<i>Statistic</i>	<i>Std. Error</i>	<i>Lower Bound</i>	<i>Upper Bound</i>
Pre Self-Efficacy	57.17	5.06	-.46	.48	.09	.94	55.00	59.35
Post Self-Efficacy	57.30	7.03	-1.11	.48	.35	.94	54.55	60.06
Pre Self-Esteem	19.74	5.97	-.09	.48	-1.02	.94	17.12	22.36
Post Self-Esteem	21.78	6.90	-.54	.48	-.45	.94	19.08	24.49
Total Concept Question Score	73.10	18.41	-.53	.48	-.55	.94	66.23	79.97

Note. N = 23

Table 2

Statistics of all Variables for Control Condition

Variable			Skewness		Kurtosis		95% Confidence Interval	
	<i>M</i>	<i>SD</i>	<i>Statistic</i>	<i>Std. Error</i>	<i>Statistic</i>	<i>Std. Error</i>	<i>Lower Bound</i>	<i>Upper Bound</i>
Pre Self-Efficacy	57.42	5.28	.07	.64	-2.05	1.23	54.40	60.43
Post Self-Efficacy	57.42	5.28	-.49	.64	-1.47	1.23	53.60	61.23
Pre Self-Esteem	19.33	6.58	-1.50	.64	2.64	1.23	15.70	22.96
Post Self-Esteem	22.92	5.18	-.16	.64	-1.56	1.23	19.17	26.66
Total Concept Question Score	67.06	20.15	-1.27	.64	.67	1.23	55.66	78.46

Note. N = 12

Table 3

Fisher's R-to-Z Transformation for Self-Esteem

Group				<i>P</i>
	<i>n</i>	<i>r</i>	<i>z</i>	<i>Two-tailed</i>
Experimental	23	.17		
			0	.05
Control	12	.17		

Appendix A
Permissions Form

CONSENT TO PARTICIPATE IN RESEARCH

Classroom self-efficacy and self-esteem

You are invited to participate in a research study conducted by Claire Schneider (and Dr. Stowell), from the Psychology Department at Eastern Illinois University. Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand, before deciding whether or not to participate. You have been asked to participate in this study because you are an undergraduate student enrolled in Dr. Stowell's psychology class.

- **PURPOSE OF THE STUDY**

The purpose of this study is to see how different methods of classroom assessment impact students' feelings about themselves.

- **PROCEDURES**

If you volunteer to participate in this study, you will be asked on two occasions to complete surveys regarding self-esteem and self-efficacy. You will also complete a demographics form, including information such as your TurningPoint ID number, ethnicity, gender, and age. Your TurningPoint ID number will be used to access your performance on in-class polling questions. Your identity will remain confidential. You will also continue to use TurningPoint to participate in class by responding to conceptual multiple choice questions related to course content. Each day there will be 5-10 in-class questions.

- **POTENTIAL RISKS AND DISCOMFORTS**

There are no significant perceived risks. There might be a mild negative emotional response when recognizing that your performance may differ from your peers. However, use of the TurningPoint software is already a familiar part of the course. Additionally, your responses remain anonymous in the classroom so other students will not know who does poorly.

- **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

You may become more aware of how you are performing in the class, and it may increase your confidence or inspire you to study more or work harder on the class material.

- **INCENTIVES FOR PARTICIPATION (*Optional*)**

You will receive a small amount of extra credit for participating (10 points). If you withdraw or miss some of the data collection, your extra credit will be prorated accordingly.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of storing all data on a password protected computer. TurningPoint responses, including names, will be accessible to the instructor. However, names will be removed from the data file before analysis. In analysis, participant data will be designated only by their confidential subject ID numbers.

- **PARTICIPATION AND WITHDRAWAL**

Participation in this research study is voluntary and not a requirement or a condition for being the recipient of benefits or services from Eastern Illinois University or any other organization sponsoring the research project. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are otherwise entitled.

There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled.

- **IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about this research, please contact:

Claire Schneider
Dr. Stowell

- **RIGHTS OF RESEARCH SUBJECTS**

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board
Eastern Illinois University
600 Lincoln Ave.
Charleston, IL 61920
Telephone: (217) 581-8576
E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I voluntarily agree to participate in this study. I understand that I am free to withdraw my consent and discontinue my participation at any time. I have been given a copy of this form.

Printed Name of Participant

Signature of Participant

Date

Appendix B

Self-Efficacy Formative Questionnaire

Please CIRCLE ONE response per question that best describes your abilities in this class.
Remember, you are only responding regarding how you feel about your abilities in **THIS CLASS**

- | | Not very
like me | —————→ | | | | Very
like me |
|---|---------------------|--------|---|---|---|-----------------|
| | 1 | 2 | 3 | 4 | 5 | |
| 1. I can learn what is being taught in class this year. | 1 | 2 | 3 | 4 | 5 | |
| 2. I can figure out anything if I try hard enough. | 1 | 2 | 3 | 4 | 5 | |
| 3. If I practiced every day, I could develop just about any skill. | 1 | 2 | 3 | 4 | 5 | |
| 4. Once I've decided to accomplish something that's important to me, I keep trying to accomplish it, even if it is harder than I thought. | 1 | 2 | 3 | 4 | 5 | |
| 5. I am confident that I will achieve the goals that I set for myself. | 1 | 2 | 3 | 4 | 5 | |
| 6. When I'm struggling to accomplish something difficult, I focus on my progress instead of feeling discouraged. | 1 | 2 | 3 | 4 | 5 | |
| 7. I will succeed in whatever career path I choose. | 1 | 2 | 3 | 4 | 5 | |
| 8. I will succeed in whatever college major I choose. | 1 | 2 | 3 | 4 | 5 | |
| 9. I believe hard work pays off. | 1 | 2 | 3 | 4 | 5 | |
| 10. My ability grows with effort. | 1 | 2 | 3 | 4 | 5 | |
| 11. I believe that the brain can be developed like a muscle. | 1 | 2 | 3 | 4 | 5 | |
| 12. I think that no matter who you are, you can significantly change your level of talent. | 1 | 2 | 3 | 4 | 5 | |
| 13. I can change my basic level of ability considerably. | 1 | 2 | 3 | 4 | 5 | |

Appendix C

Rosenberg Self-Esteem Scale (RSES)

Please CHECK ONE response per question that best describes you in this class. Remember, only respond regarding your feelings in **THIS CLASS**.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I feel that I am a person of worth, at least on an equal plane with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I feel that I have a number of good qualities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. All in all, I am inclined to feel that I am a failure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I am able to do things as well as most other people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. I feel I do not have much to be proud of.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I take a positive attitude toward myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. On the whole, I am satisfied with myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. I wish I could have more respect for myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I certainly feel useless at times.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. At times I think I am no good at all.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>