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# The Impact of Positive Feedback on Student Outcomes and Perceptions

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# The Impact of Positive Feedback on Student Outcomes and Perceptions

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# The Impact of Positive Feedback on Student Outcomes and Perceptions

High quality feedback on assessments and deliverables is vital to student success. This pilot study sought to understand the impact of combining positive and performance-gap feedback in an immediate feedback scenario where students were provided multiple attempts to complete an assignment. 176 online undergraduate students were surveyed after completing a general inorganic chemistry course. Some students were provided performance-gap feedback, while others were provided performance-gap and positive feedback. The results suggest that type of feedback provided does not change students' perceptions and self-reported behaviors in the course. However, students who were provided both performance-gap and positive feedback received an average of an entire letter grade higher than the students who received only performance-gap feedback. These findings support the idea that a combination of feedback has a direct positive impact on students in an online setting.

Keywords: positive feedback; student perception; combined feedback; online feedback

## Introduction

Within the educational community, there is a long-established consensus on the importance of quality feedback on assessments and deliverables (Hattie and Timperley 2007, 81-112). In online courses, instructor feedback is an important aspect of instructional presence (Sheridan and Kelly 2010, 767-779). Many learning management systems (LMS) allow feedback to be automatically generated when assessments are submitted. While personalized feedback is important (Gallien and Oomen-Early 2008, 3-436), students perceive automatically provided feedback as constructive (Bayerlein 2014, 916-931).

Two major categories of feedback reported in the literature are performance-gap information and positive feedback (Hattie and Timperley 2007, 81-112; Lizzio and Wilson 2008, 263-275). Students report that feedback tends to focus on the negative aspects of their work (their performance gap) (Weaver 2006, 379-394), leading to negative emotions such as decreased academic confidence and self-esteem from negative feedback (K. Hyland 2000; Weaver 2006, 379-394). There is some evidence, however, to suggest that negative feedback is more powerful than positive feedback at confirming student self-perceptions (Brunot, Huguet, and Monteil 1999, 271-293). Students' emotions have been shown to influence their self-regulated learning and motivation, and thusly influence academic achievement (Mega, Ronconi, and De Beni 2014, 121-131). For constructive criticism to promote learning from failure, the feedback should be well-intentioned (perceived as rooted in care and respect), targeted appropriately according to the current quality of the work, and helpful (providing guidance for how the work can be improved) (Fong et al. 2018, 42-53).

As with performance-gap feedback, positive feedback should be specific (goal-referenced and tangible), timely, personal, supportive, and ongoing (Huba and Freed 1999; Hattie and

Timperley 2007, 81-112; Bayerlein 2014, 916-931). High-quality positive feedback is not simply praise or encouragement, but the identification of specific student strengths. Students can identify formulaic positive comments (F. Hyland and Hyland 2001, 185-212). Positive feedback effectiveness may be less impactful if used without a specific purpose or too frequently. Positive feedback can address student knowledge, effort, or goals. Research suggests that positive feedback recognizing the effort is preferable over recognizing the outcome or achievement (Lizzio and Wilson 2008, 263-275). High-quality positive feedback has also been correlated to a more positive opinion of the instructor (Plakht et al. 2013, 1264-1268).

The literature reports several benefits to positive feedback. High-quality positive feedback has been correlated to higher grades (Plakht et al. 2013, 1264-1268). Students reported that positive feedback boosted their confidence (Weaver 2006, 379-394), which not only reinforced correct responses but mitigated the negative emotions when receiving performance-gap feedback (Lizzio et al. 2003, 341-379). While positive feedback has been shown to increase student acceptance of critical feedback (F. Hyland and Hyland 2001, 185-212), this effect has been correlated to tasks students are motivated to do and is less evident for tasks students are not motivated to do (Van-Dijk and Kluger 2000). The effect of positive feedback on task persistence may correlate to student self-efficacy (Brockner, Derr, and Laing 1987, 318-333).

There are some potential drawbacks to positive feedback. While positive feedback may have emotional benefits, students report that developmental feedback (asking what “we” can do to improve) is the most effective feedback (Lizzio and Wilson 2008, 263-275). It is possible that inclusion of positive feedback may decrease student perceptions of usefulness or developmental value (Young 2000, 409-418). Furthermore, high-quality positive feedback may result in

students' over-self-evaluation while high quality negative feedback may result in more accurate self-evaluation (Plakht et al. 2013, 1264-1268).

Feedforward input is a way to focus on developing future achievement, rather than focusing on a student's past performance. Feedforward is achieved when students are provided feedback and subsequently receive an opportunity to apply it to close the performance gap, such as retaining a quiz (Koen, Bitzer, and Beets 2012, 231-242; Rodriguez-Gomez and Ibarra-Saiz 2015, 1-20; Dulama and Ilovan 2016, 827-848). This design increases the effectiveness of feedback (Higgins, Harley, and Skelton 2002, 53-64). Previous work in feedforward focused on performance-gap feedback, noting that students tended to take advantage of multiple attempts (Sancho-Vinuesa and Viladoms 2012, 241-260; E. Faulconer, Griffith, and Frank 2019), assessment scores tended to improve with multiple attempts (E. Faulconer et al. 2019)**,** and a lower withdrawal rate was seen with feedforward (Sancho-Vinuesa and Viladoms 2012, 241-260).

A connection between feedforward with multiple attempts and retention makes sense in light of Tinto's Model of Institutional Departure, which emphasizes the importance of academic experiences in student decisions to leave (Tinto 1987). A multiple attempts scenario, which turns feedback into feedforward, reinforces self-regulated learning strategies that support learning, with the potential to improve student outcomes (Clark 2012, 205-249). However, the literature does not yet explore the influence of both positive and performance-gap feedback in a multiple attempts-feedforward scenario. It is unclear how the presence of both positive and critical feedback will influence student use of or opinions on the feedback. It is also unclear if the presence of both positive and critical feedback will influence student outcomes. Despite the common opinion that a "feedback sandwich", which provides positive feedback before and after

constructive criticism is the correct feedback sequence, previous literature suggests that the sequence of feedback based on student performance on the assessment should not significantly influence the results (Henley and DiGennaro Reed 2015, 321-335).

The purpose of this study is to explore the combination of positive and performance-gap feedback in an immediate feedback scenario where students are given multiple attempts. Feedback in this research is viewed as fundamental to the teaching and learning process; assessment is viewed as a mechanism to enrich learning. This study explores the following alternate hypotheses:

(1) The presence of both positive and performance-gap feedback will influence student self-reported use of feedback relative to performance-gap feedback alone.
(2) The presence of both positive and performance-gap feedback will influence student opinions on feedback effectiveness relative to performance-gap feedback alone.
(3) The presence of both positive and performance-gap feedback will improve student confidence relative to performance-gap feedback alone.
(4) The presence of both positive and performance-gap feedback will increase the student use of multiple attempts on assessments relative to performance-gap feedback alone.
(5) The presence of positive feedback will correlate to an increase in student assessment scores.

## Methods

### *Participants*

The sample for this study was undergraduate students (n = 176) enrolled in an online general inorganic chemistry course at a medium-sized private university. The asynchronous online

course used a 9-week term. All sections are taught using streamlined content and learning outcomes. The data was gathered from sequential cohorts through the learning management system and end of course evaluations, with pre-intervention data collected from 6 sections held between May 2019 and January 2020 (n = 74) and post-intervention data collected from 6 sections held between February 2020 and May 2020 (n = 102).

Students enrolled in the studied sections were primarily non-traditional students, with 47% between the ages of 25 and 34 and 42% over the age of 35. Approximately 3% were 21 or younger. Enrollment reasons varied, with some students taking the course as a explicit degree requirement while others enrolled in the course as a general education elective option.

All data were aggregated with no individual identification of students, ensuring anonymity. Data were collected for several terms using only performance-gap feedback as the control. Data were collected post-intervention for several more terms, using both positive and performance-gap feedback. This work was reviewed by the institutional review board and deemed exempt.

### *The Assessments*

The students completed nine online summative assessments (quizzes) accounting for 40% of the overall course grade. Each quiz included a short paragraph explaining when feedback would be provided and how to apply this feedback to the multiple attempts format. The assessments were administered through the LMS, with each question pulled from a pool aligned with a specific module learning objective. Questions were closed format, presented one at a time. The assessment was timed, with one hour for completion, though students could pause progress and

resume any time before the due date. There was no penalty for stopping after the first attempt. Each student was permitted two attempts on the assessment, keeping the highest score.

The assessment was automatically graded by the LMS, immediately providing feedback to the student upon submission of the assessment, according to their selected answers. Correct answers were not provided at any time in the assessment process, though students could view what questions they answered incorrectly. All feedback was designed to meet the criteria of high-quality feedback, being specific, and actionable. In addition to the automatically-provided feedback, instructors could provide further feedback within the LMS, including personalized feedback and a reminder of the multiple-attempts format. Personalized feedback is specific to the student, task-focused with emphasis on next steps, and is growth mindset oriented (Koenka and Anderman 2019, 15-22). Only automatically-provided feedback was evaluated in this study.

Prior to the implementation of the combined performance-gap and positive feedback intervention in this study, only performance-gap feedback was provided for wrong answers in the course used to establish the population for this study. As a pilot study, the test group provided students positive feedback for challenging questions they answered correctly in addition to the performance-gap feedback for wrong answers. A pilot study approach was deemed appropriate as it was unclear if the combination feedback scheme might introduce undesirable outcomes like increased cognitive load, which could negatively impact student perspectives and use of the feedback or multiple attempts.

### *Measures and Data Analysis*

Student perceptions and self-reported behaviors were gathered from the anonymous end of course evaluation (EOCE) surveys (Table 1). These survey questions used a LIKERT scale from

strongly agree to strongly disagree, with a neutral option. The surveys were voluntary and participation was not incentivized. Hypotheses 4 and 5 were tested using multiple attempt data from the LMS. Because the LMS data was census data while the perspective data was collected through a voluntary survey, it is expected that the *n* will vary for the data types.

[Insert Table 1 here]

The first four hypotheses focused on student feedback and were evaluated using Chi Square ($\alpha = 0.05$) at the appropriate degrees of freedom. The last hypothesis was conducted using a t-Test for independent samples (assuming unequal variances) also evaluated at $\alpha = 0.05$ (Triola 2013).

**Results & Discussion**

***Student Use of Feedback***

We explored the influence of the combination of performance-gap feedback and positive feedback on student self-reported use of feedback compared to performance-gap feedback alone. The majority of students who received performance gap and positive feedback reported using the feedback on future attempts, $X^2$ (1, N = 77,) = 42.19, $p < 0.001$. Similarly, the majority of students who received only performance gap feedback also reported using the feedback on future attempts, $X^2$ (1, N = 50,) = 18.00, $p < 0.001$. However, when comparing the use of feedback between the two feedback schemes, there was not a statistically significant difference in the self-reported use of feedback. With $\alpha = 0.05$, we failed to reject the null hypothesis (Table 2). There is no discernable evidence to support the claim that the combined performance-gap and positive feedback scheme influences student use of multiple attempts more than feedback on performance gap alone.

[Insert Table 2 here]

***Student Perceptions of Feedback***

*Effectiveness*

We explored the influence of the combined feedback schemes on student opinions of feedback effectiveness. Within the group who received the combined feedback scheme, most students agreed that the feedback was useful, $X^2$ (1, N = 77) = 26.30, p <0.001. Similarly, students who received only performance-gap feedback tended to report that the feedback was useful, $X^2$ (1, N = 50) = 15.68, p < 0.001. However, as with the first hypothesis, perceptions were not statistically different when the two groups were compared with each other. With $\alpha = 0.05$, we failed to reject the null hypothesis (Table 2). The combined feedback scheme does not influence student opinions on feedback effectiveness when compared to performance-gap feedback alone. However, it is important to note that the combined feedback scheme does not damage student opinions on feedback effectiveness. This is important to document as increased feedback can increase cognitive load. Additionally, a more positive opinion was observed in the combined feedback scenario. External feedback has been shown to influence how students feel about themselves (Dweck 1999; Nicol and Macfarlane-Dick 2007, 199-218). Therefore, there may be more positive opinions about the combination feedback scenario due to how it made the students feel.

*Confidence*

We explored the influence of the combined feedback scheme on student confidence as well. Most students who received only performance-gap feedback agreed that the feedback improved their confidence, $X^2$ (1, N = 50) =13.52, p < 0.001. Students in the combined feedback scenario

felt similarly, $X^2$ (1, N = 77) = 10.92, p = 0.001. Therefore, when the two groups were compared with each other, perceptions were not significantly different. With $\alpha = 0.05$, we failed to reject the null hypothesis (Table 2). There is no evidence to support the claim that the combined performance-gap and positive feedback scheme influences student confidence beyond the level already attained by performance gap feedback alone.

***Student Performance with Feedback Schemes***

While the previous hypotheses explored student perspectives and self-reported behaviors, we also explored how the feedback schemes influenced student performance in several ways. First, we wanted to identify any influence of the feedback scheme on students' use of multiple attempts. We predicted that the combined feedback scheme would result in increased use of multiple attempts. We recognize that students who earned an A will have less motivation to invest time in a multiple attempt regardless of the feedback scheme, which was supported by data in this study. In the performance gap cohort, no students who earned 90% or higher made a second attempt. In the combined feedback cohort, 18% of students who earned an A tried again. For students who scored below 90%, 54% of those who received only performance gap feedback made multiple attempts and 45% in the combined feedback group made multiple attempts. Regardless of cohort, students who earned 90% or above on their first attempt made an additional attempt significantly less than students who initially scored below 90%; Performance gap only, $X^2$ (1, N = 607) = 119.4, p < .001; Combined feedback, $X^2$ (1, N = 916) = 61.85, p < .001. Therefore, we focused on student behaviors when the initial attempt was less than a 90% (an A on the grading scale) in both feedback scenarios. We also excluded students who did not attempt an assessment from this analysis (earned a 0%).

Within the group who received only performance gap feedback, there was not a significant difference in the number of students who attempted to retake quizzes and those who did not, $X^2$ (1, N = 478) = 2.42, p = .11. Within the group who also received positive feedback, significantly fewer students retook quizzes than those who did not, $X^2$ (1, N = 647) = 5.38, p < 0.02. With $\alpha = 0.05$, we failed to reject the null hypothesis due to the one tailed nature of the hypothesis illustrating that fewer students made a second attempt at an assessment in the performance gap only group than the combined feedback group (Table 3). In other words, rather than seeing the predicted trend of an increase in attempts in the combined feedback scenario, we saw a significant decrease in the number of attempts in the combined feedback scenario. Qualitative data are needed to further explore this interesting finding.

[Insert Table 3 here]

Although the Chi Square value was statistically significant, the null hypothesis was not rejected because a higher percentage of students who received feedback just on their performance gap retook a quiz (54%) compared to students who received messaging on their performance gap plus positive comments (45%).

We also investigated the influence of the combined feedback scheme on student performance relative to performance-feedback alone. Using a two-sample one-tailed t-test (Table 4), we reject the null hypothesis. There is evidence to support the claim that combined performance-gap and positive feedback scheme increases student assessment scores, with an improvement in the average assessment grades just under 11%, a full letter grade improvement. This aligns with previous research on the topic of multiple attempts, which demonstrates similar gains in student performance with use of multiple attempts (E. K. Faulconer, Griffith, and Frank

2019). Because positive feedback promotes the use multiple attempts, students see learning gains.

This also translates to an improvement in overall course grade, with a statistically significant increase in student performance. The final course grade for the combined feedback scheme cohort average was over 10% higher than the cohort who received performance-gap feedback alone. (The course score difference of over 10% constitutes at least one letter grade.) The end of course score comparison yielded the only null hypothesis rejection in the study. However, the statistical and practical significance of this finding show a direct positive impact to students who had feedback that included both performance gap and positive feedback comments.

[Insert Table 4 here]

***Limitations***

A sample-related issue for this study is nonresponse error. The perspective data was collected through a voluntary survey, which can introduce bias, with over-representation of strong positive and strong negative opinions. The response rate for the pre-intervention group was 70.0%, which results in a margin of error of 8%, given a 95% confidence level. The response rate for the post-intervention group was 86.4%, with a margin of error of 5%, given a 95% confidence level. The samples are reasonably representative of the population.

Though the sample size for this study is robust and covers multiple sections of a course, the data captured from the surveys were drawn from a university with a large non-traditional student population. Out of the students surveyed, 89% were 25 years old or older. The typical student at this university is in their mid-thirties and works full-time. This may have an effect on the results, though there is no research to support this as there are limited studies associated with

non-traditional students or adult learners (Martin and Chen 2016, 849-867). If anything, the combination of performance-gap and positive feedback would have more of a positive impact on non-traditional students as they can feel as though they have little support and are expected to be independent too early in their academic career (Leathwood and O'Connell 2003, 597-615; Read, Archer, and Leathwood 2003, 261-277). Indeed, feedforward and positive input is often better received by mature-aged learners and can reduce the impact of more judgmental feedback (Cramp 2012, 244).

Another limitation is that the term lengths were 9-weeks as compared to the more common 15- to 16-week semester. There is some evidence to suggest that students perform worse on academic calendars that run on quarters, potentially because the feedbacks and assessments do not have time to sink in in this accelerated format (Gordon 2016). However, as more higher education institutions have switched to a 15- or 16-week semester system, there is very little empirical evidence that show a link between academic calendars and student outcomes (Bostwick, Fischer, and Lang 2018).

The student set the surveys were collected from varied demographically. These moderating variables, such as gender, age, degree, and academic rank, were not studied. Future research will study how these moderating variables can strengthen or diminish the hypotheses in this pilot study. For example, it would be useful to know if positive feedback was perceived differently by student based on the gender identity of the student and faculty member. This would allow for a deeper analysis that will measure these potential moderating variables.

**Conclusion**

The addition of positive feedback to performance-gap feedback in this setting was correlated with an increase in student academic performance. In fact, students who were provided both performance-gap and positive feedback received an average of an entire letter grade higher than the students who received only performance-gap feedback.

While there was no improvement in student self-perceptions or in self-reported use of feedback it appears that there is no detrimental effect on these factors when using the combined feedback scenario. Specifically, there was no statistical difference between the two feedback scenarios on if the students used the feedback to prepare for a second attempt, whether they felt the feedback was useful, or if they felt it improved their confidence. Student use of multiple attempts did vary between groups, but qualitative studies are needed to further explore strategic behaviour that may have resulted in this finding.

Increased feedback can increase cognitive load (Moreno 2004, 99-113; Fyfe, DeCare, and Rittle-Johnson 2015, 73-91). Therefore, it is important to note that not only did the combined feedback scenario fail to negatively influence student opinions of feedback effectiveness, but the combined feedback scheme resulted in stronger student performance. It is possible that increased cognitive load is more visible in K-12 students or novice undergraduates, rather than mature-aged, non-traditional students.

These findings provide insight on the importance of feedback in an online setting and have important implications on student course outcomes. The positive results of this pilot study suggest that the combination feedback scenario is a suitable construct for a larger scale study in different contexts and with a larger sample size. Future work could also explore student self-judgement and self-reaction in the self-reflection phase of self-regulated learning to understand the influence of the feedback scheme on decisions to use multiple attempts.

**Disclosure Statement**

No potential competing interest was reported by the authors.

Bibliography


Bayerlein, L. 2014. "Students' Feedback Preferences: How do Students React to Timely and Automatically Generated Assessment Feedback?" *Assessment & Evaluation in Higher Education* 39 (8): 916-931. doi:10.1080/02602938.2013.870531.

Bostwick, V., S. Fischer, and M. Lang. 2018. *Semesters Or Quarters? the Effect of the Academic Calendar on Postsecondary Graduation Rates*. Washington, D.C.: Integrated PostSecondary Education Data System.

Brockner, J., W. R. Derr, and W. N. Laing. 1987. "Self-Esteem and Reactions to Negative Feedback: Toward Greater Generalizability." *Journal of Research in Personality* 21 (3): 318-333.

Brunot, S., P. Huguet, and J. M. Monteil. 1999. "Performance Feedback and Self-Focused Attention in the Classroom: When Past and Present Interact." *Social Psychology of Education: An International Journal* 3 (4): 271-293.

Clark, I. 2012. "Formative Assessment: Assessment is for Self-Regulated Learning." *Educational Psychology Review* 24: 205-249.

Cramp, A. 2012. "Empowering Non-Traditional Students in the UK: Feedback and the Hidden Curriculum." In *Social Inclusion in Higher Education*, edited by S. Tomlinson and T. N. Basit, 244: Bristol University Press.

Dulama, M. E. and O. Ilovan. 2016. "How Powerful is Feedforward in University Education? A Case Study in Romanian Geography Education on Increasing Learning Efficiency." *Kuram Ve Uygulamada Egitim Bilimleri* 16 (3): 827-848. doi:10.12738/estp.2016.3.0392.

Dweck, C. 1999. *Self-Theories: Their Role in Motivation, Personality, and Development*. Philadelphia, PA: Psychology Press.

Faulconer, E., J. Griffith, and H. Frank. 2019. "If at First You do Not Succeed: The Student Benefits of Multiple Trials on Summative Assessments." *Teaching in Higher Education*. doi:doi.org/10.1080/13562517.2019.1664454.

Faulconer, E. K., J. C. Griffith, and H. Frank. 2019. "If at First You do Not Succeed: Student Behavior when Provided Feedforward with Multiple Trials for Online Summative Assessments." *Teaching in Higher Education*.

Fong, C. J., D. L. Schallert, K. M. Williams, Z. H. Williamson, J. R. Warner, S. Lin, and Y. W. Kim. 2018. "When Feedback Signals Failure but Offers Hope for Improvement: A Process Model of Constructive Criticism." *Thinking Skills and Creativity* 30: 42-53.

Fyfe, E. R., M. S. DeCare, and B. Rittle-Johnson. 2015. "When Feedback is Cognitively Demanding: The Importance of Working Memory Capacity." *Instructional Science* 43 (1): 73-91.

Gallien, T. and J. Oomen-Early. 2008. "Personalized Versus Collective Instructor Feedback in the Online Courseroom: Does Type of Feedback Affect Student Satisfaction, Academic Performance, and Perceived Connectedness with the Instructor?" *International Journal on E-Learning* 7: 3-436.

Gordon, L. 2016. "Cal State Joins National Trend to Switch to 15-Week Semesters." *EdSource*, March 24.

Hattie, J. and H. Timperley. 2007. "The Power of Feedback." *Review of Educational Research* 77 (1): 81-112.

Henley, A. J. and F. D. DiGennaro Reed. 2015. "Should You Order the Feedback Sandwhich? Efficacy of Feedback Sequence and Timing." *Journal of Organizational Behavior Management* 35 (3-4): 321-335.

Higgins, R., P. Harley, and A. Skelton. 2002. "The Conscientious Consumer: Reconsidering the Role of Assessment Feedback in Student Learning." *Studies in Higher Education* 27 (1): 53-64.

Huba, M. E. and J. E. Freed. 1999. *Learner-Centered Assessments on College Campuses: Shifting the Focus from Teaching to Learning.* Needham Heights, MA: Allyn & Beacon.

Hyland, F. and K. Hyland. 2001. "Sugaring the Pill: Praise and Criticism in Written Feedback." *Journal of Second Language Writing* 10: 185-212.

Hyland, K. 2000. *Disciplinary Discourses: Social Interactions in Academic Writing*. London: Longman.

Koen, K., E. M. Bitzer, and P. A. D. Beets. 2012. "Feedback Or Feedforward? A Case Study in One Higher Education Classroom." *Journal of Social Sciences* 32 (3): 231-242. doi:10.1080/09718923.2012.11893068.

Koenka, A. C. and E. M. Anderman. 2019. "Personalized Feedback as a Strategy for Improving Motivation and Performance among Middle School Students." *Middle School Journal* 50 (5): 15-22.

Leathwood, C. and P. O'Connell. 2003. ""It's a Struggle": The Construction of the "New Student" in Higher Education." *Journal of Education Policy* 18: 597-615.

Lizzio, A. and K. Wilson. 2008. "Feedback on Assessment: Students' Perceptions of Quality and Effectiveness." *Assessment & Evaluation in Higher Education* 33 (3): 263-275.

Lizzio, A., K. Wilson, J. Gilchrist, and C. Gallois. 2003. "The Role of Gender in the Construction and Evaluation of Feedback Effectiveness." *Management Communication Quarterly* 16: 341-379.

Martin, A. and J. C. Chen. 2016. "Barriers to Sustainability in Mature-Age Adult Learners: Working Toward Identity Change." *Environmental Education Research* 22 (6): 849-867.

Mega, C., L. Ronconi, and R. De Beni. 2014. "What Makes a Good Student? how Emotions, Self-Regulated Learning, and Motivation Contribute to Academic Achievement." *Journal of Educational Psychology* 106 (1): 121-131.

Moreno, R. 2004. "Decreasing Cognitive Load for Novice Students: Effects of Explanatory Versus Corrective Feedback in Discovery-Based Multimedia." *Instructional Science* 32: 99-113.

Nicol, D. J. and D. Macfarlane-Dick. 2007. "Formative Assessment and Self-Regulated Learning: A Model and Seven Principles of Good Feedback Practice." *Studies in Higher Education* 31 (2): 199-218.

Plakht, Y., A. Shiyovich, L. Nusbaum, and H. Raizer. 2013. "The Association of Positive and Negative Feedback with Clinical Performance, Self-Evaluation and Practice Contribution of Nursing Students." *Nurse Education Today* 33 (10): 1264-1268.

Read, B., L. Archer, and C. Leathwood. 2003. "Challenging Cultures? Student Conceptions of "Belonging" and "Isolation" at a Post-1992 University." *Studies in Higher Education* 28: 261-277.

Rodriguez-Gomez, G. and M. S. Ibarra-Saiz. 2015. "Assessment of Learning and Empowerment: Towards Sustainable Learning in Higher Education." In *Sustainable Learning in Higher Education*, edited by M. Peris-Ortiz and J. Merigo Lindahl, 1-20. Cham: Springer. doi:10.1007/978-3-319-10804-9.

Sancho-Vinuesa, T. and N. E. Viladoms. 2012. "A Proposal for Formative Assessment with Automatic Feedback on an Online Mathematics Subject." *International Journal of Educational Technology in Higher Education* 9 (2): 241-260.

Sheridan, K. and M. A. Kelly. 2010. "The Indicators of Instructor Presence that are Important to Students in Online Courses." *MERLOT Journal of Online Learning and Teaching* 6 (4): 767-779.

Tinto, V. 1987. *Leaving College: Rethinking the Causes and Cures of Student Attrition*. Chicago, IL: The University of Chicago Press.

Triola, M. 2013. *Statdisk*. Vol. 12.0.2 Pearson Education Inc. http://www.statdisk.org/.

Van-Dijk, D. and A. N. Kluger. 2000. "Positive (Negative) Feedback: Encouragement Or Discouragement?".

Weaver, M. R. 2006. "Do Students Value Feedback? Student Perceptions of Tutor's Written Responses." *Assessment & Evaluation in Higher Education* 31 (3): 379-394.

Young, P. 2000. "'I might as Well Give Up': Self-Esteem and Mature Students' Feelings about Feedback on Assignments." *Journal of further and Higher Education* 24: 409-418.

Table 1. Alignment of EOCE Questions and hypotheses.

| Hypothesis | End of Course Evaluation Question |
|---|---|
| 1 | I used the feedback provided on my first quiz attempt to prepare for my second quiz attempt. |
| 2 | The feedback automatically provided after submitting my quiz was useful. |
| 3 | The quiz feedback improved my confidence. |
| 4 & 5 | N/A (Evaluated using multiple attempt data from the LMS) |

Table 2. Chi square goodness of fit for Hypotheses 1 (self-reported use of feedback), 2 (perceived feedback effectiveness), and 3 (self-reported improved confidence) ($\alpha = 0.05$).

| **Feedback Scenario** | ***n*** | **Agree** | **Disagree** | **DF** | **Value** | **p-value** |
|---|---|---|---|---|---|---|
| ***Hypothesis 1*** | | | | | | |
| Performance-Gap | 50 | 40 | 10 | 1 | 1.124 | 0.289 |
| Performance-Gap + Positive | 77 | 67 | 10 | | | |
| ***Hypothesis 2*** | | | | | | |
| Performance-Gap | 50 | 39 | 11 | 1 | 0.027 | 0.87 |
| Performance Gap + Positive | 77 | 61 | 16 | | | |
| ***Hypothesis 3*** | | | | | | |
| Performance-Gap | 50 | 38 | 12 | 1 | 0.767 | 0.381 |
| Performance Gap + Positive | 77 | 53 | 24 | | | |

Table 3. Chi square goodness of fit table for Hypothesis 4 (use of multiple attempts) ($\alpha = 0.05$).

| **Feedback Scenario** | ***n*** | **Retook at Least One Quiz** | **Did Not Retake Any Quizzes** | **DF** | **Value** | **p-value** |
|---|---|---|---|---|---|---|
| Performance-Gap | 478 | 256 (54%) | 222 (46%) | 1 | 7.25 | 0.007 |
| Performance Gap + Positive | 647 | 294 (45%) | 353 (55%) | | | |

Table 4. t-Test for Independent Samples for Hypothesis 5 (student performance) ($\alpha = 0.05$).

| **Feedback Scenario** | ***n*** | **Mean End of Course Score** | **Standard Deviation** | **DF** | **t Value** | **p-value** |
|---|---|---|---|---|---|---|
| Performance-Gap | 74 | 74.75 | 23.82 | 103 | 3.5 | <0.001* |
| Performance Gap + Positive | 102 | 85.41 | 12.73 | | | |

*Note*: Test assumed unequal variances between groups. The asterisk(*) denotes a statistically significant finding.

**Figure Captions**

Table 1. Alignment of EOCE Questions and hypotheses.

Table 2. Chi square goodness of fit for Hypotheses 1 (self-reported use of feedback), 2 (perceived feedback effectiveness), and 3 (self-reported improved confidence) ($\alpha = 0.05$).

Table 3. Chi square goodness of fit table for Hypothesis 4 (use of multiple attempts) ($\alpha = 0.05$).

Table 4. t-Test for Independent Samples for Hypothesis 5 (student performance) ($\alpha = 0.05$).