Modules to Increase Scientific Literacy in Ecampus Introductory Psychology Classes

Sponsoring Department: School of Psychological Science

Sponsoring College: College of Liberal Arts

ABSTRACT: Basic scientific literacy skills – including graph reading and understanding research design – are key skills for psychology majors, physicians, and all college students. Mastering these basic STEM skills is essential for college and career success, yet students arrive with uneven skills in this area. The aims of this project are to expand a current, NSF-funded project designed to develop modules to teach these key skills in Introductory Psychology, rigorously evaluate their effectiveness, and ultimately disseminate the modules widely and freely. We will use software like Microsoft PowerPoint Mix and Qualtrics to deliver the same high quality, active learning modules we are currently developing and testing on the OSU Corvallis campus, Willamette University and Chemeketa Community College to teach essential skills using psychology course material that is relevant to students' lives. By using active learning techniques and relevant course material from Introductory Psychology, we aim to teach all students the basic scientific literacy skills that will help them be successful in future psychology and other science classes, and also help them use data to make sound decisions in their personal lives as well. By leveraging a great deal of work that has already gone into the NSF-funded on-campus modules, we have a unique opportunity to bring truly effective, engaging educational modules to Ecampus students quickly and efficiently.

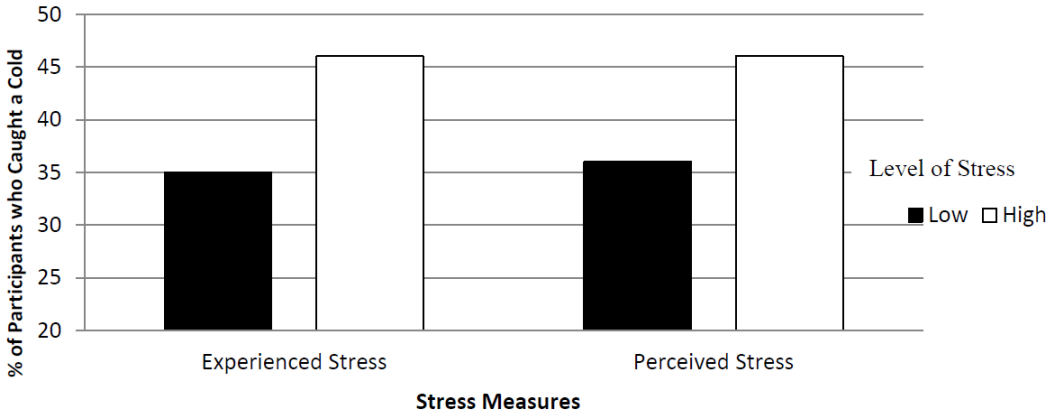
AIM: The goal of this project is to introduce new, NSF-supported scientific learning modules in Ecampus Introductory Psychology classes and rigorously evaluate their effectiveness.

STATEMENT OF PROBLEM: *Scientific literacy is a key skill that, when learned early in a college career, can open doors for students.* Introductory Psychology is a unique place to teach scientific literacy because 1) it is a Bacc Core course that is frequently taken during the first year of college, 2) it is among the most popular college courses, 3) although scientific literacy is a key skill for psychology majors, most incoming students do not know that and therefore approach the class with less dread and math anxiety as some other science courses, 4) the course material is inherently related to student's lives, and 5) psychology instructors tend to be more diverse than in some other sciences, which helps diverse students see that they belong in science.

As part of an NSF grant, on the Corvallis campus, Dr. Kathy Becker-Blease is working with colleagues at Willamette University and Chemeketa Community College to develop and evaluate a set of 8 learning modules to teach specific scientific skills centered around reading graphs and tables, understanding statistics, and understanding research design. These skills are tied to the new MCAT (medical admissions exam) that requires students to both learn the equivalent of the Intro Psych series, but also demonstrate high level scientific literacy skills in these domains. The project directly benefits future physicians, but the broader goals are to increase basic science skills that all students can apply to their everyday lives.

Modules focus on a passage and graph and/or table and research design. Typical in-class activities ask students involve activities that help students learn to answer questions like this:

When faced with a stressor, humans experience physiological changes including increased heart rate and blood pressure, and changes in hormone levels that affect the immune system. Physiological responses of the human body to psychological stressors, such as public speaking, resemble its responses to physical stressors, such as pain. In a study designed to examine the impact of psychological stress on the immune system, participants completed two self-report measures in order to assess experienced stress versus perceived stress. One measure obtained the number of stressful life events the participant had experienced over the last year. The second measure assessed the extent to which the participant perceived life events as stressful. After the participants gave their informed consent and the stress-related information was collected, participants were quarantined and exposed to the common cold virus and their symptoms were monitored. Figure 1 represents the findings from this study.



Additional studies have examined psychological factors that might influence the relationship between stress and the immune system. It has been demonstrated that individuals higher in optimism (optimists), are more likely than those lower in optimism to attribute their stressors to controllable causes, engage in a problem-focused coping style rather than an avoidant coping style, and have healthier lifestyles. Moreover, physiological measures have shown that optimists have lower levels of cortisol and a more responsive immune system.

96. Which of the following changes to the study would make it possible to investigate whether there is a causal link between stress, coping styles, and immune susceptibility?

A) Exposing participants to a stressor in the laboratory and collecting self-report data about perceived stress immediately after exposure.

B) Exposing participants to a stressor in the laboratory and then collecting self-report data about perceived stress over several months.

C) Randomly assigning participants to complete different questionnaires about their coping styles prior to exposing them to a stressor.

D) Randomly assigning participants to conditions in which they learn different coping styles prior to exposing them to a stressor.

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98. **Which of the following conclusions is NOT supported by Figure 1?**

A) Experiencing stressful events is positively associated with susceptibility to the cold virus.

B) Experiencing stressful events is negatively associated with immune functioning.

C) Perceived stress levels are negatively associated with immune functioning.

D) Perceived stress is positively associated with an increase in immune functioning.

Briefly, these modules were developed from a basis of cognitive and educational psychology. A previous Research Office supported grant allowed Kathy Becker-Blease to discover points of failure in answering these questions. The result suggested that students had difficult not with reading the graph or understanding specific words alone, but in combining information from multiple sources and making sense of patterns in graphs.

In our pilot work with on-campus students at Willamette University and OSU, we found that graph reading and research design skills are weak overall, and that our pilot modules successfully boosted these skills. Figure 1 is reproduced from a recent paper showing this effect.

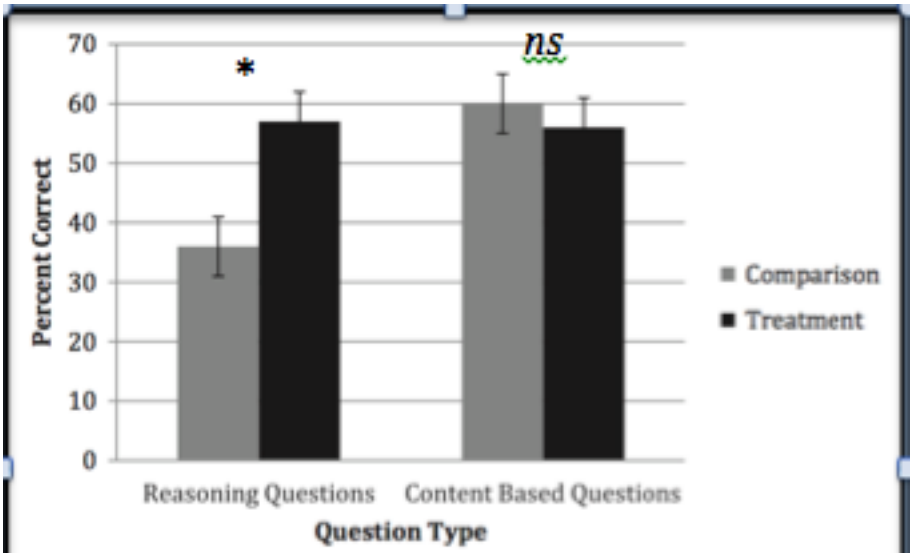

Fig 1 –Students receiving the scientific literacy module were more likely to answer scientific reasoning questions tapping research design and data-based reasoning correctly than students in the control classes. There were no differences between groups in content questions.
Figure reproduced from Stevens & Witkow (2014).

In an earlier version of the NSF grant, Dr. Becker-Blease and co-PIs intended to develop these modules for online use in Ecampus, hybrid, and web-enhanced on-campus classes. Along the way, the scope of the grant was scaled back to include only the 8 on-campus modules. This opens the door for a unique opportunity. Three experienced university professors across two campuses have spent several years developing modules – including images, questions, and activities – that are designed to work in both small seminars and large classes at a variety of on-campus sites. These materials are carefully designed to teach and assess key graph reading and research design skills using open source materials. We have also developed a common pre-/post-test that can easily be deployed online with norm scores for the on-campus students. Right now, these modules are being evaluated at several Oregon on-campus sites. The

opportunity now is to leverage NSF's funding for this work to bring these scientific literacy skills to Ecampus students.

PLANNED INTERVENTION

For each module, we will adapt our current materials so that they are effective and compelling for Ecampus students. We have looked into this some already, and would consult with Ecampus instructional designers if the grant were funded.

In a nutshell, we plan to use Microsoft PowerPoint Mix to turn our existing materials into interactive lessons with screenshot videos and mini-quizzes that deliver similar content as is delivered in classrooms. These videos will have identified chapters allowing students to easily navigate and re-watch relevant sections. In some cases, we collect data from students enrolled in a particular class to use for a lesson. We will use Qualtrics to do the same for Ecampus students. In classrooms, students complete handouts that encourage them to generate information (e.g. draw a graph, make a prediction). Students may use tablets and annotation software (such as Notability) or pen and paper. We anticipate supporting both options through Ecampus as well.

For example, one module focuses on the value of self-testing for learning academic material. The learning objectives include identifying the independent and dependent variable, generating a valid hypothesis, and interpreting a statistical interaction using a bar graph. In seminar classes, students discuss in large and small groups. In large lectures, students use a handout and work in small groups with the instructor using the document camera to give mini-lectures showing students' work and demonstrate how to think about the problems. In both cases, there is an emphasis on active learning focused on key learning goals. Powerpoint slides are minimal and visual based to encourage students and instructors to think and talk – and to avoid "Powerpoint karaoke" (where the instructor reads Powerpoint slides – a less than effective strategy on-campus or online).

If curious, reviewers are welcome to peek at four of the intervention materials currently being piloted in a LiNC classroom on the OSU campus: https://www.dropbox.com/sh/xdor3em14819b7p/AAC7RAdwxn0HY3ofbYjZQMeOa?dl=0 .

Every term, the School offers at least two sections of identical Introductory Psychology sections. Each pair of courses (see below table) will have randomly selected one experimental course and one control course. We anticipate working with the Registrar and/or online homework provider to ensure that students are randomly assigned to sections. The experimental course will receive an intervention that consists of three parts:

a) 14-question *pre*-test to assess students' scientific literacy in psychology *on the first week of the term*
b) Teaching of 8 scientific teaching modules spread throughout the term. Modules will be posted online and students will be prompted to view them.
c) 14-question *post*-test to assess students' scientific literacy in psychology *at the end of the term*

The control classes complete parts a) and c), and are assigned the typical course material.

As this work is already covered by an IRB protocol, we anticipate adding Ecampus sections will take only a fast minor revision rather than a completely new protocol.

Tentative courses for intervention:

Term	Course	Instructor	Control Paired Course	Instructor
Su 16	PSY 201.400	Frandrup, E.	PSY 201.401	Frandrup, E.
Su 16	PSY 202.400	Krieger, K.	PSY 202.401	Krieger, K.
F 16	PSY 201.400	Frandrup, E.	PSY 201.401	Frandrup, E.
F 16	PSY 202.400	Brunot, A.	PSY 202.401	Brunot, A.

PROJECT OUTCOMES:

Pre-/Post-test gains.

The operating definition for measuring learning will be the difference in scores between the pre-test and the post-test. Ideally, a two-sample paired t-test would examine if there was statistically a significant difference between pre-test and post-test across students in the experimental course compared to the control class.

Attitudes about Science.

As part of the NSF-funded on-campus study, we are piloting some measures of attitudes toward science. We hypothesize that students who get the modules will express a greater willingness to enage in scientific thinking, read journal articles, and use science to make decisions.

Student Evaluations of Teaching.

We will compare eSET scores for experimental and control classes to see if students prefer one class over another. In addition to the general eSET questions, we will add some additional, instructor-added questions to assess student perceptions of the modules themselves.

EVALUATION PLAN:

We propose a truly randomized control trial in which students are randomly assigned to the treatment-as-usual lessons or the usual class plus scientific literacy modules for Ecampus. While this is a strong design, it may take a little explanation to understand how to do it ethically. Kathy Becker-Blease has previously completed several IRB-approved, ethical randomized control trials in Introductory Psychology at OSU. Briefly, the keys are 1) we only *hypothesize* that the new homework is better. If we are wrong, they will still be struggling with the new style and actually earn lower grades and/or learn less over the term. If we knew the new homework was better and it was readily available, it would be unethical to withhold it from half of the students. That is not the case here. 2) if one group – experimental or control – outperforms the other, we can adjust the grading curve so that neither class is harmed. 3) professors try out different assignments, tests, and ways of teaching all the time. This is not "research" as the IRB defines it – it's just the basis of good, innovative teaching. When we want to disseminate that work at scientific meetings and in scientific journals, and it's feasible to get students' permission, we should get students' permission. Kathy Becker-Blease is has successfully obtained this permission in a number of

IRB-approved studies and that is how we would proceed with this study. By going through this careful work, we are able to know definitively whether the new way of teaching *caused* students to learn more. We can rule out, for example, differences in students themselves, like motivation or test-taking ability or prior knowledge. Randomized control trials are more easily published and disseminated, and more respected by peers. For example, the What Works Clearinghouse (http://ies.ed.gov/ncee/wwc/) publishes reviews of interventions just like this in higher education, but requires rigorous randomization to obtain the most favorable rating. It's more work to do a randomized control trial, but it's worth it.

A PLAN FOR SHARING the outcomes of the research with the OSU community and external audiences (i.e. intended journal or conference outlets) :

We are committed to sharing the outcomes of research with the OSU community through events such as the Ecampus Faculty Forum, the School of Psychological Science colloquium series, and the School of Psychological Sciences new GTA orientation.

We are also committed to sharing the outcomes with a wider audience, that might includes conference presentations at conferences like The Online Teaching Conference http://onlineteachingconference.org/ and the teaching conferences that precede the Society for Peronality and Social Psychology conference and the Association for Psychological Science conference (that we often already plan to attend).

The NSF on-campus modules will be deposited in an open educational resources depository (MERLOT or similar). If this grant were funded, we would plan to maximize exposure for all of our materials by depositing them together.

Kathy Becker-Blease is planning to resubmit an NSF grant related to this work in September, 2017. The grant, as currently planned, would not support the same work proposed here, but the grant Co-PIs requested that we leave open the possibility of using this data as pilot data for that resubmission. The focus of that grant is understanding the cognitive mechanisms that underlie reading complex graphs.

TIMELINE:

Task	Tentative Timeline
IRB proposal prep and approval	Winter 2016 term
Create web-based modules; Working with instructors to load modules into Canvas	Spring 2016 terms
Data collection *NSF grant submission related to this work*	Summer and Fall term 2016
Data analysis & Dissemination *Write white paper; SPSP conference*	Winter term 2017
Dissemination *Ecampus Faculty Forum, APS conference*	Spring term 2017

TEAM MEMBERS:

Introductory Psychology Instructor/Faculty Advisor: Kathryn Becker-Blease

Kathryn Becker-Blease earned a Ph.D. in developmental psychology from the University of Oregon in 2002. She regularly teaches Introductory Psychology on campus. She has taught online classes for Southern New Hampshire University, Washington State University, and Oregon State University. She serves on the School of Psychological Science Curriculum Committee and has reviewed 5 Ecampus courses using the Quality Matters rubric. She participated in the first Hybrid Faculty Learning Community where she developed a hybrid version of Introductory Psychology (PSY 202), and ran an evaluation of the effectiveness of the hybrid course relative to a well-matched control class. She teaches a graduate-level course *Psychological Science of Teaching and Learning.* Her research publications include articles on teaching about trauma, adaptive learning, and mindset interventions to boost students' performance in Introductory Psychology.

Introductory Psychology Coordinator: Ameer Almuaybid

Ameer Almuaybid is a graduate student in the M.A.I.S. program with a focus in social psychology. In addition to teaching Introductory Psychology, Ameer serves as the Introductory Psychology coordinator. Ameer assists with data collection, program assessment, test item analysis, textbook adoption and support, online homework supplement support, research participation credit, and a variety of other tasks related to Introductory Psychology. Ameer has taken a number of relevant courses, including Psychological Science of Teaching and Learning. This graduate level seminar included running an IRB-approved study of an educational intervention in an Engineering class. Ameer intends to defend his thesis this May. After that time, it is our plan to continue to employ Ameer, another student, or a new hire in the role of Introductory Psychology coordinator.

Ameer manages a research lab at the School of Psychological Science under Dr. Frank Bernieri. Not only is he CITI Ethics Training certified, but he also trains undergraduate research assistants in the lab. Ameer's expertise includes mentorship for research assistants to ensure ethical integrity of human subject research in lab. Ameer has written several IRB proposals and has taken multiple course in which an IRB proposal for a study was required.

In addition, as part of Ameer's Introductory Psychology Coordinator, Ameer is in charge of one of the biggest human subject pools on campus from all introductory psychology. Ameer's position gives him access to personal data which then allows him to pull data consented data out, de-identify it, and then work with it. In other words, Ameer ensures that research on the human subject pool at the School of Psychological Science has the highest levels of confidentiality and privacy to protect students.

Ecampus Instructors.

Our ecampus instructors are research Ph.D. psychologists and graduate students studying psychology who have expertise in research design, data collection, and IRB compliance. They both appreciate and have the skills to participate in carrying out an intervention in Ecampus classes. We have secured commitments from 2 potential instructors – Erika Frandrup and Katy Krieger – to assist with this project.

Relevant recent publications and presentations:

Becker-Blease[2], K. & Almuaybid[1], A. (2015.) *Transforming Text Selection: Improving Text Quality and Costs.* Talk presented at the 2015 Fall Center for Teaching and Learning Symposium.

Becker-Blease[2], K. & Bostwick[12], K. C. (Revised and resubmitted). Adaptive Quizzing in Introductory Psychology: Evidence of Limited Effectiveness. *Scholarship of Teaching and Learning in Psychology.*

Becker-Blease[2], K. (2013). *Student Achievement and Satisfaction in Introductory Psychology: No significant Differences Between Face-to-Face and Hybrid Sections.* LL Stewart Faculty Development grant final report. Available: http://oregonstate.edu/instruct/PP/ctla-files/docs/becker-blease-achievement.pdf

Becker-Blease[2], K., Stevens, C., Witkow, M, & Bostwick[12], K. C. (2014). *Multiple-Choice Testing to Teach Scientific Reasoning and Prepare Psychology Students for MCAT2015* . Poster presented at the 26th annual Association for Psychological Science convention. San Francisco, CA. Available: http://hdl.handle.net/1957/48329 .

1 = Current/Former graduate student 2 = Current/Former Ecampus instructor