

### 2021 Provost's SOLER Seed Grants Proposal Template

Section 1: Project Summary								
Award Year:	2021-2022							
Title of Study:	Nudges informed by past student data to increase current students' engagement with course materials							
Principal Investigator (PI) Information								
PI #1 Name:	Samantha Garbers, PhD							
PI #1 Title:	Associate Professor							
PI #1 Department:	Heilbrunn Department of Population & Family Health Mailman School of Public Health							
PI #1 Email:	Svg2108@cumc.columbia.edu							
<b>Co-Investigator (CI) Information</b> Use an asterisk (*) to denote any CI who will serve as a Co-PI.								
CI #1 Name:	*Roxanne Russell	CI #2						
CI #1 Title:	Director of Online Education	CI #2 Title:						
CI #1 Department:	Mailman School of Public Health	CI #2 Department :						
CI #1 Email:	lrr2153@cumc.columbia.edu	CI #2 Email:						
CI #3 Name:		CI #4						
CI #3 Title:		CI #4 Title:						
CI #3 Department:		CI #4 Department :						
CI #3 Email:		CI #4 Email:						

405 Low Memorial Library

## COLUMBIA | SOLER Science of Learning Research Initiative

Abstract: Describe the project in non-technical language; articulate the project objective; specify what makes the project innovative; describe your assessment or evaluation plan to ascertain student impact or other insights. (Limit 250 words.)

This project will develop an evidence-based nudge strategy to make explicit to students the interconnection between course materials (lectures, readings, learning checks) and course assessments (homeworks, papers, group projects, tests). The objective of the intervention is to increase student engagement with course content, and in turn, increase and improve: 1) student experience with learning; 2) demonstration of achievement of learning outcomes on specific assignments, the course overall, and the entire Core; and perceived ability to demonstrate competencies; and 3) metacognition, specifically the awareness of links between course content and assessments. Using evidence of past course student behaviors to influence current course student behaviors is a novel approach to the application of actionable insights from learning analytics that is low-intensity, low-risk, and easily replicable in other courses. The impact of this intervention will be evaluated by comparing student engagement and learning outcomes between those who receive the nudge and those who do not.

Science of Learning Research Initiative

### Section 2: Project Description

Please complete each subsection taking into consideration the accompanying guidelines.

竝 Columbia | SOLER

Section 2a: Project Scope. (Limit 500 words.)

- Framing
  - State your overarching objective(s).
  - o Identify specific aims and explain how they align with the overarching objective(s).
  - Describe the overall methodology that will be used in this study, covering such factors as retrospective vs. prospective data collection, interventional vs. noninterventional, randomized vs. non-randomized, observational, experimental, etc.
- Participants
  - o Identify your target participants (e.g., students).
  - Specify how participants will be identified and contacted.
  - Estimate how many participants will be impacted during the grant period.
  - Briefly describe how the innovation will continue to benefit student cohorts beyond the PSSG duration (e.g., through curricular changes).

**Overarching objective**: to increase student engagement with course content, and in turn, improve: 1) <u>student experience</u> with learning; 2) demonstration of <u>achievement of learning</u> <u>outcomes</u> on specific assignments, the course overall, the entire Core, and perceived ability to demonstrate competencies; and 3) <u>metacognition</u> (awareness of links between course content and assessments).

**Specific Aims:** We will develop an evidence-based nudge intervention and assess the efficacy of the nudge intervention on these outcomes using a randomized study design:

**1.** Mine and analyze past course data to generate nudge messages presenting assignment-specific correlations between engagement and performance;

**2.** Deploy nudge messaging in an integrated public health Core curriculum course with more than 550 students organized in 4 cohorts; and

**3.** Conduct a <u>**prospective**</u>, <u>interventional</u> randomized controlled trial with 2 cohorts receiving the nudge intervention and 2 cohorts not receiving nudges (control condition), to test the following hypothesis: *nudges* [IV] will enhance student *performance* [DV] on associated assignments relative to the "no-nudge" condition by increasing *engagement* [mediator]. Secondary analyses will assess the impact of the nudge condition on student experience and metacognition outcomes.

### METHODS

**Aim 1 – Mapping & Mining:** We will identify assessments that map to course elements (lectures, readings) using recently-completed course mapping, and will export student-level learning management system (LMS) data from 2019-21. Using bivariate analyses (t-tests) we will compare student assessment grades between those who did and didn't complete required content. These analyses will provide quantitative information included in nudge messages.

### Aim 2 – Deploy Nudge Messaging:

Nudge messages informed by Aim 1 analyses will be implemented before assessments are due, to influence current student behaviors with sufficient time to engage with materials. These messages will be graphic images containing specific information about past student behaviors and placed in Canvas To-do lists in weekly modules. To-do lists become available each Friday to prepare students for the following week. Data about students who view these to-do lists are available through Canvas analytics.

Example:



### Aim 3 – Prospective Interventional RCT:

The RCT will compare the mediating, primary, and secondary outcomes between the intervention and control conditions using bivariate testing. To support analyses, we will download student engagement data and assessment data, and provide these files to the Office of Educational Initiatives to merge and de-identify Course Evaluation and Core Evaluation survey data. We will compare the mediating (engagement) and learning outcomes between those who receive the nudge intervention (2 cohorts) and those who do not (2 cohorts).

**Participants:** All candidates in the Masters of Public Health (MPH) program spend their first semester in an interdisciplinary Core curriculum designed to provide an interlocking foundation of public health knowledge. Public Health Interventions is one course in this Core curriculum.

Approximately 560 students from the school's six departments, in 4 cohorts, will complete the Core this fall.

This RCT will use cluster randomization, assigning 2 cohorts to receive the nudge intervention, and 2 cohorts to control (using prior years' data to maximize comparability). All students in each cohort will receive their assigned condition. We will apply for IRB designation of exemption (category 1).

**Benefits:** This project seeks to make explicit to students the interconnection between course materials and assessments; helping students make these connections may improve students' learning experience and outcomes. This intervention is low-intensity, low-risk, and easily replicable to other courses if shown to be efficacious.

Section 2b: Rationale and Literature Review. (Limit 500 words.)

- Describe how the project aligns with national and/or Columbia strategic initiatives.
- Highlight key findings of relevant educational research. Include citations as appropriate.
- Describe any prior work your team has done in this space.

This project aligns directly with the stated goals for Columbia's the Science of Learning Research seed grants by proposing an intervention that offers an opportunity to use learning analytics in the design of student learning experiences and features an experimental design with quantitative methods for measuring student outcomes and/or behaviors.

The endeavor of learning analytics has been defined as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising [sic] learning and the environments in which it occurs" (Long & Siemens, 2011, p. 33), and research on learning analytics produced in a learning management system (LMS) examines faculty and student behaviors through digital interactions such as clicks, views, downloads, submissions and communications. Following a line of research seeking to better define student engagement and identify relevant learning management system metrics that may serve as proxies for student engagement, Fincham et al. define academic engagement as "a student's time on task, credit accrual, and homework completion" and operationalize it through attention to analytics related to video watching, problem submissions and weeks active in the learning management system (2019). This nudge intervention will use learning analytics associated with academic engagement from two learning management system tools, Canvas and Panopto, as evidence of student behaviors.

According to Weijers et al. (2020), nudge theory is a framework from behavioral science and behavioral economics "which asserts that subtle and indirect changes in the environment are effective means to change people's behavior and decision-making" that shows promise in the educational context. The design rationale for this nudge intervention derives from learning analytics pulled from previous versions of this course: the selection of which course materials to target will be based on statistical analysis of the relationship between student LMS behaviors and assessment performance and the placement of the nudge on the Canvas To-

## COLUMBIA | SOLER Science of Learning Research Initiative

Do List page is supported by evidence that 83-95% of students viewed these pages in the latest run of the course.

**Samantha Garbers (Co-PI),** an Epidemiologist by training, has taught in the Core since 2015 as well as numerous departmental methods courses. She collaborated extensively with the OEI team to evaluate the process and outcomes of the Core, recently published (Garbers et al., 2021). Reflecting her commitment to innovating in the Core, she received the Core Excellence Award (2018) and the Innovation in Teaching Award (2021). She serves on the Core Advisory Committee with Roxanne Russell.

**Roxanne Russell (Co-PI)** has been designing and developing learning analytics protocols and solutions in higher education in collaboration with academic technology teams and faculty since 2014. She co-founded and helped facilitate Analytics for Learning at Emory from 2014 to 2018 and served as a member of Emory University's Canvas Analytics Exploratory Community of Practice from 2018-2019. She currently serves on Columbia University's Academic Technology Leadership Group's Sub-committee on Learning Analytics. Science of Learning Research Initiative

竝 Columbia | SOLER

Section 2c: Assessment and Evaluation Plan for Specific Aims. (Limit 250 words.)

- Describe novel or to-be-adapted measurement tools (e.g., surveys).
- Outline key comparisons and briefly describe data analysis procedures.

This project will integrate data from several sources, and compare course engagement (mediating outcome), primary learning outcomes, and secondary outcomes (metacognition, student experience) between the intervention and control arms. These outcomes, and their data sources, are outlined in Table 1.

We will be able to assess whether students receive the intervention. The nudge messaging will be displayed on the weekly "to-do list." We will be able to track whether students accessed the to-do list module (and saw the nudge message). We will use both an intent-to-treat approach for analyses (classifying all of the students in the intervention cohorts as having received the intervention) and an as-treated approach (only classifying as intervention students who saw the nudge messages).

We will use bivariate analyses (Chi-square tests, independent sample t-test) to compare the mediating, primary, and secondary outcomes between the arms. Because the characteristics of those in the intervention and control conditions may not be comparable in terms of age, department, or other characteristics, multivariable analyses (logistic regression, OLS regression) may be employed to adjust for any imbalances between the arms.

Outcome domain	Outcome	How operationalized	Data source
Course engagement (mediating outcome)	Students interact with specific course materials (readings, learning checks, online lectures) - overall, and for specific course elements that had intervention to increase engagement (e.g. nudge reminder)	Proportion of students who interact at least once with each course element	LMS analytics
Course engagement	Students interact with course material as a whole using LMS	Mean amount of time spent on LMS for the course	LMS analytics
Learning outcomes	Course grade	Numerical grade; successful completion (B- or better), y/n	LMS analytics
Learning outcomes	Grades on assessments that were adapted to increase engagement	Numerical grade	LMS analytics
Learning outcomes	Grade for the Core as a whole	Numerical grade; successful completion (B- or better), y/n	De-identified OEI data
Learning outcomes	Students feel prepared to demonstrate Course competencies	5-point scale, Strongly Agree to Strongly Disagree	Course evaluation
Student experience	Overall satisfaction with each concentration in the course	5-point scale, Excellent to Very Poor	Course evaluation
Metacognition	Course assessments reflected/tested the content from the course	4-point scale, Strongly Agree to Strongly Disagree	Course evaluation

#### Table 1. Outcomes, operationalization, and data sources for Aim 3 analyses

Section 2d: Role of Key Personnel. (Limit 150 words.)

- Specify the expectations and obligations of all project personnel.
- Outline expected needs for in-kind support from SOLER facilitators.

**Samantha Garbers,** Co-Principal Investigator, will lead statistical analysis for this project by identifying LMS data needed for analyses, statistical analyses to develop the nudges and to assess impact, and results reporting. Dr. Garbers will supervise a public health graduate student Research Assistant, who will conduct post-intervention data cleaning and analyses and participate in reporting activities.

**Roxanne Russell,** Co-Principal Investigator, will assist with LMS data and report collection and lead the design, development and implementation of the nudge intervention in the LMS.

**In-kind support requested from SOLER** facilitators includes technical assistance with export of data from the Canvas LMS, such as grading history, for the pre-intervention nudge development and the post-intervention impact assessment. We also seek to collaborate with SOLER in reporting out the findings from this project, and the replication of this intervention to other courses, as appropriate.

### **Section 3: Graphical Project Timeline**

Use a graphical timeline to depict the schedule for your project. The timeline should include start and finish dates for your project as well as the dates or periods during which various project tasks will occur. Indicate how you will monitor the effectiveness of the project as it evolves. All elements of the project should be completed within 12 months of receiving funds.

This one year project is planned to begin in July to allow for rapid turnaround of Aim 1 analyses for deployment in the first week of the Core, September 9<sup>th</sup>.

	July '21	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Мау	June '22
Identify analyses for nudges using course mapping												
Download 2019-20, 2020-21 LMS data (SOLER tech assist)												
Conduct analyses (mine prior data)												
Develop. pilot-test nudges (former Core students)												
Add nudges into Canvas pages												
Nudge intervention deployed												
IRB application for analysis phase												
Hiring/onboarding Research Assistant												
Download and clean post-intervention data												
Data analyses												
Write-up & reporting of findings												
Present findings to Core Leadership, CTL Leadership												

# We have established several benchmarks that we will use to measure the effectiveness of project activities:

### Aim 1:

Benchmark 1: At least 5 mapped linkages between course elements and assessment outcomes are identified.

COLUMBIA | SOLER Science of Learning Research Initiative

Benchmark 2: Assessments and course engagement are successfully downloaded and merged from LMS.

Benchmark 3: At least 4 quantitative analyses of mined data are completed and summarized in lay language.

### Aim 2:

Benchmark 1: At least 4 nudge messages are developed. Benchmark 2: At least 8 former students provide qualitative feedback on the resonance of draft nudge messaging.

### Aim 3:

Benchmark 1: IRB application submitted and designation (approval or exemption) received. Benchmark 2: Outcome data from the LMS are successfully downloaded and merged with the OEI data.

Benchmark 3: A minimum of one presentation of findings is made.

### Section 4: Budget Overview and Justification.

Provide a detailed budget and justification for funds. Funding can be used for expenses such as equipment, shipping, media development, compensation for study participants (typically students), compensation for research assistants, and conference registration. Please mention all other sources of funding, if any. The total budget requested should not exceed the maximum award amount of \$5,000.

### The total amount of support requested for this project is \$4808.

Personnel	
Samantha Garbers, Co-PI (5% in-kind) - Analysis lead	\$ -
Roxanne Russell, Co-PI (5% in-kind) - Nudge lead	\$ -
Research Assistant (analytic support, data cleaning) - 5 months [Jan-May 2022] @ 10 hours/week @ \$22/hour	\$ 4,400.00
SPSS (2 licenses at \$124)	\$ 248.00
Supplies for staff, faculty, and student meetings	\$ 160.00
TOTAL	\$ 4,808.00

### Personnel:

Both of the Co-PIs will dedicate 5% effort in kind to the project.

A Research Assistant, an MPH student in the Mailman School, will be hired to work 10 hours/ week with the Co-PIs for a 5 month term, January through May. The RA will be paid \$22/hour, standard pay for this work, to clean, merge, and analyze quantitative data to support Aim 3. This RA will also be involved in the interpretation and write up of analyses. Depending on the timing of funding notification, the time-allocation of the RA time may be adjusted, to move some effort to earlier months to assist with Aim 1 activities.

### OTPS:

Additional licenses for SPSS will be required for Russell and the RA. These licenses are purchased through CUIMC IT.

Supplies are requested for meetings of the team and others who are providing in-kind support to the project, including OEI staff involved in the export and merging of data, and former students providing qualitative feedback on the resonance of nudge messaging.

### **REFERENCES CITED**

Fincham, E., Whitelock-Wainwright, A., Kovanović, V., Joksimović, S., van Staalduinen, J., and Gašević, D. (2019). Counting Clicks is Not Enough: Validating a Theorized Model of Engagement in Learning Analytics. In Proceedings of the 9th International Conference on Learning Analytics & Knowledge (LAK19). Association for Computing Machinery, New York, NY, USA, 501–510. <u>https://doi.org/10.1145/3303772.3303775</u>



Science of Learning Research Initiative

Garbers, S., March, D., Kornfeld, J., et al. (2021). Columbia University Master of Public Health Core Curriculum: Implementation, Student Experience, and Learning Outcomes, 2013-2018. Public Health Reports, 0033354921999162.

Thaler, R. H., & Sunstein, C. R. (2008). Nudge: improving decisions about health, wealth, and happiness. London: Penguin.

Weijers, R.J., de Koning, B.B. & Paas, F. Nudging in education: from theory towards guidelines for successful implementation. Eur J Psychol Educ (2020). https://doi.org/10.1007/s10212-020-00495-0



Vice Dean of Education Mailman School of Public Health



June 17, 2021

Dear SOLER committee:

The Mailman School remains in a continuous improvement cycle for our Core curriculum, the strategically integrated, 6-course, 17-module experience in which all MPH students are engaged during their first fall semester that has been nationally recognized for its innovative and comprehensive approach to training the next generation of public health leaders. As part of this process, Core faculty regularly need to make evidence-based decisions to respond to student feedback and take action on insight provided by learning analytics data. Even faculty with deep experience using data for research in their own discipline may not be familiar with gleaning useful information about designing learning experiences from the data available about student behaviors in our learning management systems and integrations, like Canvas and Panopto.

With this in mind, in response to the Office of the Provost's request for proposals to SOLER that center around an innovative pedagogical intervention or learning analytics procedure, I am extremely pleased to support the following proposal to use course analytics to influence student engagement with course materials in the Public Health Interventions course of our Core Curriculum. This course is a key component of our MPH Core Curriculum providing students with an integrated approach to the theory and practice of designing, implementing, and evaluating interventions to improve health in the context of a complex real world. Student course evaluations from 2020, course faculty experience, and assessments of student learning have provided extensive data on challenges of the current model that could be addressed with attention to course analytics. For example, course evaluation feedback indicates that the number and timing of readings, assessments and assignments represent an unmanageable workload, and students are frustrated when it is perceived that engaging with course materials is not necessary to complete the assignments or assessments. A preliminary review of Canvas analytics data indicated that student engagement with some materials is low.

The overarching goal of this project is to use learning analytics to increase academic engagement and, in turn, academic outcomes, critical thinking, and meta-cognition of course competencies in the Public Health Interventions course. Learnings from this project in the Public Health Interventions course will also influence the Core continuous improvement process by modeling the use of course analytics to increase the level of engagement with critical course content.

This proposal is submitted as part of our continued commitment to a comprehensive learning strategy for the Mailman School. Digital learning tools afford new opportunities to leverage learning analytics dashboards and reports, and faculty and course designers seek guidelines and resources for gaining actionable insights from the data provided.

Please accept this proposal with my full support and enthusiasm.

Sincerely,

Michael Sept

Michael A. Joseph, PhD, MPH

**COLUMBIA UNIVERSITY MAILMAN SCHOOL OF PUBLIC HEALTH** 722 West 168<sup>th</sup> Street, 14 FL-1411A, New York, NY 10032 Telephone: 212.342.1576