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The Class is the Crowd

Exploring the Potential of Crowdsourcing in Large Classes

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ABSTRACT

Class sizes in higher education are increasing, with students today spending over 40% of their time in large classes, that is, those with over 40 students. While larger classes help university administrators balance growing enrollments with concurrent decreases in funding, they come at the cost of student academic achievement, satisfaction, and retention. Teaching practices such as collaborative and project-based learning are seen as too unwieldy to implement in large classes, and are sacrificed in favor of more manageable, but less successful, pedagogy, such as lectures and multiple-choice tests. In this thesis, I propose that the large number of students in a mass class represents a crowd, and outside of academia, crowds are not evils endured because of resource limitations; they are valued as intelligent forces that can achieve positive societal change and business growth. Drawing on industry crowdsourcing best practice, I designed, implemented, and tested a novel project that embraced, rather than struggled against, the vast quantity of students in a mass class. Moving between individual and collaborative phases, the so-called Crowd Project captured the wisdom of the crowd, while holding students accountable for their personal contribution. Using a quasi-experimental design, 81 students were randomly assigned to one of two conditions. Students in the Crowd Project shared findings from individual assignments with the entire class while students in a modified Group Project just shared their findings with their immediate group members. Results indicate that students in the Crowd Project were more engaged, performed better on course and module learning objectives, had higher grades, and developed more creative solutions, compared to students in the modified Group Project. Faculty involvement, however, was greater in the Crowd Project. A second quasi-experiment compared the Crowd Project to a Group+ Project, which aimed to equalize the degree of faculty involvement between conditions. Results find no significant difference between the Crowd and Group+ Project design, suggesting that faculty involvement is central to student success.

Keywords: design thinking, crowdsourcing, group project, pedagogy, large classes.

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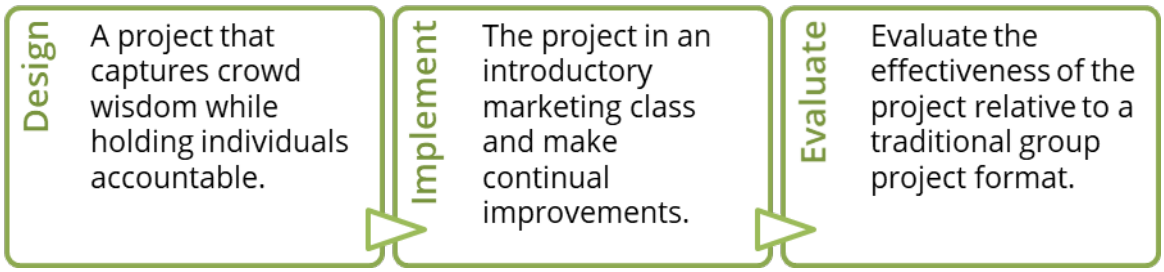
INTRODUCTION

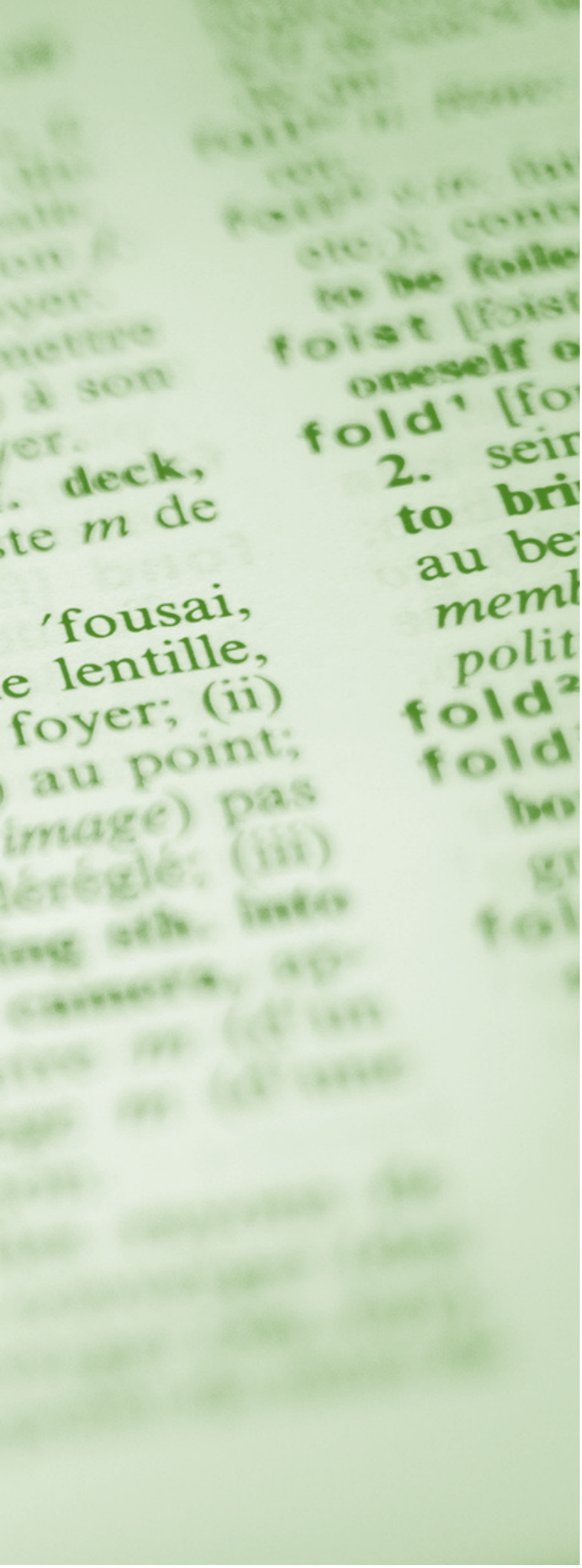
To produce graduates who are more than walking dictionaries, we need applied assignments that demand creative solutions to ambiguous, unstructured problems. In large classes (i.e., classes with 40 or more students), however, the workload to implement and grade such projects quickly becomes unfeasible. In this thesis, I reposition large classes as crowds, and outside of academia, crowds are not evils endured because of resource limitations; they are valued as intelligent forces that can achieve positive societal change and business growth. Crowdsourcing—any practice that involves distributing a project across a vast collection of users with different skills and abilities—is not simply a buzzword in industry. Over 90% of Fortune 500 companies use crowdsourcing to cut costs, increase brand loyalty, and deliver new product ideas (Garvey, 2018).

Academics are quick to study crowdsourcing but far slower to adopt it in the classroom. Typical uses include crowdsourcing content and crowdsourcing grading (Llorente & Morant, 2015; Prpic et al., 2015). However, neither of these applications operationalizes crowdsourcing the way it is typically used in industry. That is, the crowd is not being used to generate and evaluate creative solutions to ambiguous problems. Drawing on industry crowdsourcing best practice, as well as proven pedagogical techniques such as collaborative learning and project-based learning, this thesis seeks to design, implement, and test a "crowd project"—a novel problem-solving process that embraces, rather than struggles against, the vast quantity of students in a mass class. Moving between individual and collaborative phases, the Crowd Project captured the wisdom within the whole class, while holding students accountable for their personal contribution. Design thinking was used to:



The goal is to improve student engagement and performance in a large creative problem-solving class, while minimizing faculty course management and grading burden. Student engagement refers to the active participation in learning activities as measured by digital platform data analytics (e.g., time spent on the course learning management system [LMS]; quality and quantity of collaborative posts), as well as improvements in self-reported measures of course learning objectives. Student performance was measured by academic success on assignments, and creative success, as measured by self-reported improvements in creative confidence, as well as the quantity and quality of solutions generated in the applied project. Faculty burden was measured by the time to grade and provide feedback on active learning assignments in a mass class.

DEFINITION OF TERMS



APA PsychoInfo®
Database for citations in behavioral and social science research; accessed through Radford University library EBSCO.

Amazon Mechanical Turk (MTurk)
Crowdsourcing website to hire remotely located "crowd workers" to perform discrete tasks.

Association to Advance Collegiate Schools of Business (AACSB)
A global nonprofit organization that provides accreditation to schools of business.

Bloom's Taxonomy
Classification of educational learning objectives into levels of complexity and specificity.

Collaborative Learning
An instructional method in which students work together in small groups toward a common goal (Laal & Ghodsi, 2012).

Concept Poster
A presentation format illustrating main points of a new idea.

Crowd: A large group of people working towards a common goal (Lewicki, 2019).

Crowdlearning
Collaborative sourcing of material (e.g., class wikis), typically between students.

Crowdteaching
Collaborative sourcing of course material (e.g., syllabi, exam questions, and textbooks).

Empathy Map
A collaborative visualization of the end user's needs and desires.

D2L (Desire to Learn)
Cloud-based software used by Radford University to manage student learning.
EBSCO

Provider of research databases, e-journals, magazine subscriptions, e-books to libraries.

Education Research Complete
Database for research on all levels of education, from early childhood through higher education; accessed through Radford University library EBSCO.

Engagement
The extent of students' active participation in learning activities, often operationalized as time spent on a webpage or in a class.

ERIC Education Resources Information Center
Bibliographic database of education research and information; accessed through Radford University library EBSCO.

Free Riding
People in a group project who exert little to no effort and do not contribute to the final product.

Large Class
Classes with over 40 students.

Learning Management System (LMS)
A software application for the administration and delivery of educational courses.

Mass Class
Classes with over 40 students.

Persona Profile
A fictional character type representing real customer needs, feelings, and desires.

Platform
The system (typically online software) within which a crowdsourcing task is performed (Lewicki, 2019).

Project Based Learning (PBL)
A teaching method in which students learn by actively engaging in real-world projects.

Popular Press
Includes trade journals, newspapers, magazines, newspapers, and reports.

Quick Reference Guide
A short document summarizing key principles and elements of a desired solution.

SCAMPER
An ideation technique that encourages individuals to Substitute, Combine, Adapt, Minimize or Maximize, Put to other uses, Eliminate, and Rearrange features and processes to generate new ideas.

Social Loafing
The idea that people are prone to exert less effort on a task if they are in a group versus when they work alone.

Social Network Analysis (SNA)
The process of investigating social structures through the use of networks. It analyzes nodes (individual actors within the network) and the interactions between them.

STEM
Concerns the disciplines of Science, Technology, Engineering, and Mathematics.

Visual Notetaking
The recording of thoughts and observations through the use of illustrations, symbols, relationships, and text. This method of notetaking was popularized by Michael Rohde in *The Sketchbook Handbook* (2012); Peachpit Press.

Wisdom of the Crowd
The idea that the collective opinion of a group of individuals is superior to the answer from a single expert. Popularized in the book, *The Wisdom of Crowds*, (2004) by James Surowiecki.

Zotero
Open-source software used to manage bibliographic and research reference material.

LITERATURE REVIEW

TEACHING CREATIVITY

Definition and Value

Creativity is the ability to generate original and effective solutions to problems (Runco & Jaeger, 2012), or, put more simply, in the mantra I instill in my students: "creativity = novelty + value." The value delivered can be tangible (e.g., a Coke quenches your thirst) or intangible (e.g., looking at the frescos decorating the Sistine Chapel brings joy), but, in a business context at least, novelty alone is insufficient to characterize creativity. Creativity researchers distinguish between two levels: "Big C" and "Little c" creativity (Holm, 2016; Schlee & Harich, 2014). Big C creativity is that demonstrated by the proverbial creative genius (e.g., Michelangelo), while Little c creativity is that revealed by ordinary people solving everyday problems (e.g., substituting applesauce for butter in a recipe to make it healthier). According to this more democratic definition, all people can be creative in their work and personal life, even if they do not realize they are being creative (Homayoun & Henriksen, 2018). Importantly, from a pedagogical perspective, Little c creativity can be taught (Holm, 2016). Conceptualized as a process, rather than an innate trait, creativity is frequently likened to a muscle that, with regular practice, can improve (DaVia Rubenstein et al., 2018). Exercising associated underlying traits, such as a willingness to take risks, to think divergently, and keep a playful, open mind, can also improve creative problem solving skills (Adams et al., 2006; Al-Samarraie & Hurmuzan, 2018; Anderson, 2006; Costigan & Brink, 2015; Donnelly, 2004; Egan et al., 2017; Eisner, 2017; Forgeard & Kaufman, 2016; Holm, 2016; Murdock, 2003; Runco & Acar, 2012; Wang, 2001).

Creativity transcends professions and academic disciplines, and being able to creatively solve problems has never been more essential (Batey, 2012). In a survey of 1,500 Chief Executive Officers, creativity was identified as the single most important leadership competency of the future (*IBM Global CEO Study*, 2010). Since 2005, *The Boston Consulting Group* has surveyed and tracked the most innovative companies in the world. Executives in these organizations consistently rank creativity and innovation as the top strategic imperative, helping them deliver shareholder returns well above the global market (Ringel et al., 2020). A study by *Forrester Consulting* found that companies that embrace creativity outperform peers and competitors on key business performance indicators, including revenue growth, market share, and talent acquisition (*The Creative Dividend,* 2014). *Ernst and Young,* meanwhile, estimates that 50% of business revenue in 5 years' time must come from products and services that do not exist today, highlighting the urgency of constant innovation to survive (Pinelli, 2012). The World Economic Forum predicts creativity, innovation, and ideation will be key skills for the workforce of the future (*The Future of Jobs Report*, 2018), a finding confirmed by a recent LinkedIn survey of job postings (Petrone, 2019). Academic research supports these consulting firm reports: creative companies grow faster and are more competitive, more efficient, and more cost effective (Adams et al., 2006; Amabile & Khaire, 2008; Baer, 2006; Barrett et al., 2005; Batey, 2012; Gilson et al., 2005; Murwatiningsi et al., 2019; Weinzimmer et al., 2011).

It is no surprise, then, that business professionals and government leaders alike are calling for an increased emphasis on creativity in education to develop the next generation of creative leaders (Anderson, 2006; Beghetto, 2013; Dewett & Gruys, 2007; Holm, 2016; Homayoun & Henriksen, 2018; Lewis & Elaver, 2014; Mareque et al., 2019; Sundararajan, 2019; Tepper & Kuh, 2011). In business schools, the main accrediting body, the Association to Advance Collegiate Schools of Business (AACSB; https://www.aacsb.edu/) prescribes "thinking

creatively" as a desired student outcome (Puligadda, 2019; Schlee & Harich, 2014). Unfortunately, research suggests colleges are still not adequately incorporating creativity into the business curriculum (Ackerman et al., 2003; Chonko & Roberts, 1996; Costigan & Brink, 2015; Crittenden & Crittenden, 2006; Donnelly, 2004; Egan et al., 2017; Harwood & Liu, 2019; Holm, 2016; Hu, 2017; Lewis & Elaver, 2014; Machin, 2016; Rampersad & Zivotic-Kukuloj, 2019; Rampersad & Patel, 2014; Schlee & Harich, 2014; Tepper & Kuh, 2011). In particular, there is a need to depart from rote memorization of creativity theories in favor of activities that allow students to practice creative and critical thinking (Anderson, 2006; Chonko & Roberts, 1996; Costigan & Brink, 2015; Dewett & Gruys, 2007; Egan et al., 2017; Eisner, 2017; Lewis & Elaver, 2014; Machin, 2016; McCorkle et al., 2007; Ramocki, 2014; Robbins & Kegley, 2010; Schlee & Harich, 2014).

Creative Processes

The creative process refers to theories explaining how people approach and develop new and useful products, typically organized as a series of stages such as Osborn's Creative Problem Solving Model or Sawyers' Eight Stages of Creativity (DaVia Rubenstein et al., 2018). Design thinking is another process-oriented approach to creative problem solving (Brown, 2008; Liedtka, 2018). Uniquely suited to tackle socially complex, unstructured problems with no clear solutions (Buchanan, 1992), design thinking applies non-linear, human-centered practices that focus first on immersing oneself in the experiences of the focal population, brainstorming solutions, then rapidly developing, testing, and modifying prototypes (Armstrong, 2016; Brown, 2008; Kolko, 2015; Liedtka, 2018; Luma Institute, 2012; Olsen, 2015; Rowe, 1987). From food service giants Mars Wrigley (Berry, 2019), PepsiCo (Ignatius, 2015), and Starbucks (Design Council, 2007), to tech leaders Apple (Thomke & Feinberg, 2009) and Microsoft (Design Council, 2007), and companies as varied as Nike (Martin & Fifield, 2016), Proctor and Gamble (Leavy, 2010), Sony, and Lego (Design Council, 2007), design thinking methods are being rapidly adopted in industry not only to develop and market novel products and services (Schifferstein, 2016), but also to improve hiring processes (Martin & Fifield, 2016) and reduce manufacturing costs (Design Council, 2007; Leavy, 2010; Liedtka, 2014). For-profit companies are not the only ones adopting design thinking methods either. The U.S. Navy (K. Adams, 2016) and the National Health Service (Valentine et al., 2017) are just two examples of social innovators using design thinking (Brown & Wyatt, 2010).

Seen as an effective way to engage students with 21st century skills such as creative problem solving, business schools are starting to integrate design thinking into their curriculum (Beckman, 2020; Dunne & Martin, 2006; Garbuio et al., 2018; Hurni & Grösser, 2017; Knight et al., 2020; Matthews & Wrigley, 2017). Proposed benefits include helping business students think broadly about problems, develop multi-disciplinary perspectives, and improve their ability to think divergently (D'Ippolito, 2014; Knight et al., 2020; Kupp et al., 2017; Leavy, 2010; Lewrick & Link, 2015; Liedtka, 2018; Noweski et al., 2012; Pamfilie & Croitoru, 2018; Petruccelli, n.d.; Razzouk & Shute, 2012; Shively et al., 2018). Teaching design thinking, however, requires students to actively experience the process. As such, it tends to be implemented in small classes where the workload to grade multiple higher order learning activities is manageable. Effectively teaching this important creative problem-solving technique in larger classes without overwhelming the instructor remains problematic. Unfortunately, average class sizes in higher education are growing, discussed next.

MASS CLASSES

The Growth of Mass Classes

To survive expanding student enrollments with concurrent declines in university funding, class sizes in higher education are increasing (Cash et al., 2017; Estimated Class Sizes, 2019; Saiz, 2014; Umbricht & Stange, 2019). Over the last two decades, total undergraduate enrollment in degree-granting postsecondary institutions in the United States increased by 26% (The Condition of Education, 2020). Meanwhile, state funding for higher education has declined on average 13% per student, intensifying budget constraints (Mitchell et al., 2019). Enlarging class size is a relatively effortless way for university administrators to reduce instructional expenses and increase economic efficiencies (Mitchell et al., 2019; Pilli et al., 2018; Saiz, 2014).

One metric used to measure the increased prevalence of larger classes finds students spend 41% of their time in classes with over 40 students (Umbricht & Stange, 2019). However, class size increases are not distributed uniformly across academic discipline, course type, or class standing (E. Bettinger et al., 2017; Cash et al., 2017; Gibbs et al., 1996; Huxley et al., 2018; Kokkelenberg et al., 2008; Neumann, 2001; Taft et al., 2019; Vahala & Winston, 1994). In particular, 100-level foundational classes and general education courses are increasingly taught in mass sections (Ake-Little et al., 2020; Ballen et al., 2018; Beattie & Thiele, 2016; E. Bettinger et al., 2017; Gibbs et al., 1996; Lowenthal et al., 2019; Vahala & Winston, 1994).

Defining a Mass Class

Despite a wealth of research on the implications of larger class sizes, there is no well-accepted definition of what actually constitutes a mass, or large, class in higher education (Maringe & Sing, 2014). Characterizations vary across university, discipline, course type, and faculty and student perceptions. Several empirical studies classify large classes as those with more than 100 students (Heppner, 2007; Lowenthal et al., 2019; Maringe & Sing, 2014), but others consider sections with more than 30 (Burruss et al., 2009; Lowenthal et al., 2019), 40 (Taft et al., 2019), or 50 students as large (Ake-Little et al., 2020; *Estimated Class Sizes*, 2019; Exeter et al., 2010). Still others consider class size as a continuous variable and do not specify what constitutes a small versus large class size (e.g., Bandiera et al., 2010; Owuor, 2018).

Acknowledging the importance of student and faculty perceptions, other authors argue for a more qualitative definition of the large class. For example, Maringe and Sing (2014) defined a mass class as "any class where the numbers of students pose both perceived and real challenges in the delivery of quality and equal learning opportunities to all students" (p. 763), while Dean and Wright (2017) suggested that large classes are ones where "the number of students in the class limits the extent to which students can be physically or vocally active" (p. 653).

According to Radford University's Common Data Set, 5% of all class sections had more than 40 students in the 2019-2020 academic year, while less than 1% of classes had more than 100 students (see Table 1). In this thesis, a large class is classified as one with more than 40 students.

Class Size	2-19	20-49	50-99	100+
Section (#)	653	695	80	5
Section (%)	48.5%	46.5%	5.6%	0.3%

Table 1: Radford University Class Size Distribution

Problems with Large Classes

While larger classes help administrators manage their fiscal obligations, they come with difficult-to-quantify costs for students and faculty. Studies on the effects of class size at the postsecondary level have examined a wide range of outcomes, including grades, engagement, satisfaction, and retention. While some studies suggest that increasing class size has no effect on direct measures of student learning such as grades (Ballen et al., 2018; Bettinger et al., 2017; Gleason, 2012; Kokkelenberg et al., 2008), consensus appears to be emerging across a wide range of disciplines that large class sizes harm student academic achievement, both in terms of probability of passing exams and the grades obtained in those exams (Arias & Walker, 2004; Ballen et al., 2019; Becker & Powers, 2001; Diette & Raghav, 2015; Emerson et al., 2018; Gibbs et al., 1996; Johnson, 2010; Kara et al., 2020; Mandel & Süssmuth, 2011; Matta et al., 2015; Monks & Schmidt, 2011; Owuor, 2018; Paola & Scoppa, 2011; Saiz, 2014; Westerlund, 2007). Poorer performance is associated with higher drop-out rates and decreased retention (Bettinger & Long, 2016; Cash et al., 2017; Millea et al., 2018). Irrespective of actual academic success, student satisfaction dramatically decreases as class size increases (Emerson et al., 2018; Russell & Curtis, 2013; Sapelli & Illanes, 2016). Less frequent student-faculty interactions leave students feeling anonymous and isolated, which decreases engagement and motivation to participate (Burruss et al., 2009; Cash et al., 2017; Gleason, 2012). Faculty are no happier with mass classes, having to deal with both the increased workload administrating and managing a larger body of students, and the use of less satisfying and engaging instruction methods (Exeter et al., 2010; Orellana, 2006).

Importantly, the costs of increasing class size are not uniformly distributed (Ake-Little et al., 2020). Research shows, for example, that the negative effects of large classes are significantly worse for vulnerable student populations such as first-generation, freshmen, low-ability, minority, and low-income students (Beattie & Thiele, 2016; Diette & Raghav, 2015; Kara et al., 2020; Mathis, 2017). Large classes regularly hurt women more than men, especially in math and science courses (Ballen et al., 2019; Matz et al., 2017), though all students in science, technology, engineering, and mathematics (STEM) fields experience on average larger negative effects from increases in class sizes compared to students in non-STEM fields (Ballen et al., 2019; Kara et al., 2020; Matz et al., 2017; Toth & Montagna, 2002). While few performance differences are found in tests of lower order thinking skills in large classes, learning that requires higher order cognitive functions, such as the ability to apply, analyze, evaluate, and create, considered essential for today's graduate, is generally found to be inferior in larger classes (Bettinger & Long, 2016).

One reason for reduced performance in large classes concerns the necessary changes in pedagogy, from course design and assignments to instructional delivery (Ake-Little et al., 2020). In particular, instructors in larger classes typically engage with students less frequently and use fewer evidence-based teaching practices, such as active learning, in favor of more manageable, but less academically meaningful assignments (Ake-Little et al., 2020; Arias & Walker, 2004; Cash et al., 2017; Kokkelenberg et al., 2008; Mathis, 2017; Taft et al., 2019). Perceived barriers to using active learning activities such as case studies and simulations in large lectures are well-documented and include a lack of necessary class time and resource limitations (Wright et al., 2019). For these reasons, large classes are highly correlated with exclusive reliance on lectures and multiple-choice exams, which only test the lower order cognitive processes of Bloom's

taxonomy (e.g., remembering or understanding), fostering shallow learning strategies that minimize student engagement in the classroom (Becker & Powers, 2001; Wright et al., 2019). The aversive and inequitable consequences have led many researchers and policy makers to call for class size reductions (Millea et al., 2018; Orellana, 2006). However, if instructors could engage the majority of students in a large class through evidence-based teaching practices *without* increasing the faculty workload to implement and grade applied projects, reducing class size may not be a requirement for increasing student academic performance and class satisfaction. Recommendations to improve learning in large classes seek to adapt teaching techniques commonly associated with small classes (Exeter et al., 2010; Ludy, 1991; Maringe & Sing, 2014; Olson et al., 2011). In particular, *collaborative learning strategies* and *project-based learning (PBL)* have been proposed as ways to potentially mitigate the performance reductions seen in large classes, though more research is required (Cash et al., 2017; Emerson et al., 2018). In the next sections, best practices for project-based learning and collaborative learning are reviewed.

EFFECTIVE PEDAGOGY

Project-Based Learning

PBL advocates for more student-centered and experiential approaches to education that support higher order learning goals through active exploration of real-world problems (Condliffe, 2016; Junisbayeva, 2020; Kokotsaki et al., 2016). A recent review of the effectiveness of PBL indicates that project-based learning has a medium to large positive effect (overall mean weighted effect size was 0.71) on students' academic achievement compared with traditional instructional methods (Chen & Yang, 2019). Emerging from the progressive education movement in the middle part of the 20th century, the literature examining project-based learning is vast. Reviews reveal a remarkably consistent set of criteria for the successful implementation of PBL in the class room (Chen & Yang, 2019; Condliffe, 2016; DeFillippi, 2001; Junisbayeva, 2020; Keegan & Turner, 2001; Kokotsaki et al., 2016). First, the PBL approach must guide instruction of the entire course, not just an isolated activity. In other words, the best PBL requires sustained inquiry in which learners are engaged throughout the semester in searching for resources to find an appropriate solution. Second, the project must involve a challenging topic that the students can identify with and are motivated to work on. This can be accomplished by choosing a problem that authentically reflects students' real life or, even better, letting the student choose the topic area themselves, which brings the added motivation of ownership and control over their learning (Chen & Yang, 2019; Condliffe, 2016; DeFillippi, 2001; Junisbayeva, 2020; Keegan & Turner, 2001; Kokotsaki et al., 2016). Third, scaffolding activities are recommended, especially for students just beginning their higher education experience. Fourth, opportunities for student reflection and teacher feedback should be embedded within the course. This might be as simple as allowing time for self-assessment, reflection, and feedback (Condliffe, 2016), or can be more involved such as requiring students to keep a logbook or journal in which they record rough notes, ideas, and designs for the project as well as their own reflections on learning and project meetings (Junisbayeva, 2020). Finally, the project should lead to the creation of a final product that is presented to the class or an authentic public audience (Chen & Yang, 2019; Condliffe, 2016; DeFillippi, 2001; Junisbayeva, 2020; Keegan & Turner, 2001; Kokotsaki et al., 2016).

While effective, project-based learning has high costs. The workload to implement, manage, and grade multiple individual projects, versus, say, simple multiple-choice tests, quickly becomes unmanageable in large classes (Allen et al., 2009; Lawrie et al., 2010; Le et al., 2018; McKinney & Graham-Buxton, 1993). To reduce the workload, teachers frequently refashion individual tasks into group projects (Allen et al., 2009; Lawrie et al., 2010; Le et al., 2018; McKinney & Graham-Buxton, 1993). The benefits and disadvantages of group projects – a form of collaborative learning – are discussed next.

Collaborative Learning

Collaborative learning is an educational approach to teaching and learning that involves groups of students working together to solve a problem. It seeks to shift learning from a teacher-centered to a student-centered model (Lee et al., 2015). In comparison to competitive or individual learning, collaborative group methods in small classes have been shown to improve student performance and productivity when implemented well (Batra et al., 1997; Gokhale, 1995; Laal & Ghodsi, 2012; Liu & Beaujean, 2017; Tomcho & Foels, 2012). Students appear to enjoy the social support group work offers, though they consistently complain about unequal member contributions (Chang & Brickman, 2018; Le et al., 2018). To ensure learning in group projects, Slavin (1996), in an early review of the literature examining collaborative learning in small classes, identified group goals, individual responsibility, and group interaction as essential factors to enhancing learning. The theory is that while individual assessment methods are important, group performance scores are also necessary to motivate team members to ensure that everyone in the group understands the material. Group goals combined with individual accountability should motivate students to engage in behaviors such as peer tutoring and peer assessment that increase both individual and group achievement (Slavin, 1996). Subsequent reviews have reinforced the importance of positive team interdependence, shared learning goals, group accountability, and group rewards (Fu & Hwang, 2018; Heeg et al., 2020; Hmelo-Silver & Chinn, 2016; Le et al., 2018; Sharma & Arora, 2019; Sung et al., 2017; Tomcho & Foels, 2012). This research has also reviewed other factors that might contribute to collaborative learning success. Regarding team formation, irrespective of the segregation basis (e.g., demographics, knowledge, motivation, learning style), method (instructor-assigned, random, or organic), or composition (heterogenous or homogenous), there is little consensus regarding the ideal structure (Fu & Hwang, 2018; Heeg et al., 2020; Hmelo-Silver & Chinn, 2016; Le et al., 2018; Sharma & Arora, 2019; Sung et al., 2017; Tomcho & Foels, 2012). Smaller group sizes are more popular, with research demonstrating triads and tetrads outperforming larger groups (Fu & Hwang, 2018; Le et al., 2018; Lee et al., 2015; Slavin, 1996; Sung et al., 2017). Topic matters as well. Groups who perceive the project to be personally relevant are more motivated across all stages of collaboration (Fu & Hwang, 2018; Le et al., 2018; Sung et al., 2017). More recent research examining online collaborative learning has shown success. The use of mobile devices and Learning Management Systems (LMS) such as Desire to Learn (D2L) can facilitate information sharing and group interaction (Fu & Hwang, 2018; Olsen et al., 2019; Strauß & Rummel, 2020; Sung et al., 2017). Group size also appears to matter less in online collaborative learning as the virtual work appears to improve the efficiency and effectiveness of group interactions (Sung et al., 2017).

To truly leverage the potential of collaborative learning, however, faculty need to integrate collaborative learning into their course goals, and prioritize teaching collaborative skills throughout the semester. Simply inviting students to work together is not sufficient. To

avoid the "divide and conquer" group mentality, where teams distribute subtasks and solve them individually, careful instructional design that promotes productive interaction between students is necessary. This begins with the collaborative task itself. It should be sufficiently complex to require students to co-construct knowledge to solve it. Taking time to actively scaffold the task in a way that requires or promotes collaboration is critical. In general, scaffolding is any tool or technique that helps a learner to accomplish more difficult tasks than they otherwise are capable of completing on their own. Student-teacher interactions, peer counseling, project templates, and technology can all serve as scaffolds (Sung et al., 2017). In collaborative learning, teaching strategies such as Jigsaw, which divides a task such as gathering research from different fields between group members who then come together to complete the puzzle (Sung et al., 2017), can be effective. Other ways to divide assignments into productive collaborative tasks include distributing roles (e.g., discussant, notetaker, etc.) or to assign opposing perspectives on the topic between group members (Bailey et al., 2015; Fu & Hwang, 2018; Heeg et al., 2020; Le et al., 2018; Olsen et al., 2019). Such activities foster individual and collective self-efficacy, an important predictor of group success (Bailey et al., 2015; Fu & Hwang, 2018; Heeg et al., 2020; Le et al., 2018; Olsen et al., 2019). Teaching students specific collaborative skills, such as active listening, empathizing with opposing viewpoints, clarifying ideas with illustrative examples, and providing constructive feedback, helps them work more productively in their group (Le et al., 2018). Finally, teams that monitor and reflect on their own group processes and performance are more successful (Strauß & Rummel, 2020). Instructors can facilitate such introspective team metacognition by collecting collaboration data and visualizing it for the group (Strauß & Rummel, 2020; Wise, 2014). For example, the instructor can graphically portray the number of words contributed by each group member on a particular exercise and ask the group to discuss the results and make any necessary changes.

Faculty, arguing that group work is a necessary workplace skill, frequently split classes into teams to complete projects (Bailey et al., 2015; Baradi et al., 2018; Batra et al., 1997; Condliffe, 2016; Le et al., 2018; Lee et al., 2015; McCorkle et al., 1999). However, when group projects are implemented out of convenience, rather than pedagogical best practice, the learning benefits are less likely to emerge (Allen et al., 2009; Lawrie et al., 2010; Le et al., 2018; McKinney & Graham-Buxton, 1993). The task structure often does not lend itself to group work (Meyers, 1997), and the large team sizes required in mass classes (typically more than five students) reduce group performance (Fu & Hwang, 2018; Le et al., 2018; Tomcho & Foels, 2012). Known issues with group projects, such as member conflicts, social loafing, and inconsistent skill development, all increase with group size (Lawrie et al., 2010; Le et al., 2018; S. H. (Mark) Lee et al., 2016; Liu & Beaujean, 2017; McCorkle et al., 1999; Meyers, 1997; Tomcho & Foels, 2012). Poor project quality – or huge variances in quality between groups – is often the end result (Batra et al., 1997).

Moreover, collaborative learning that is only operationalized as small group work misses an opportunity: rather than resisting the large number of students in a mass class, why not embrace them? Mass classes are, effectively, crowds. Outside of academia, crowds are not evils endured because of resource limitations; they are valued as intelligent forces that can achieve positive societal change and business growth (Surowiecki, 2004). Drawing on crowdsourcing best practice, we designed a mass class where collaborative learning occurs at the crowd level, rather than a small group. Literature on the potential benefits of crowdsourcing is reviewed next.

CROWDSOURCING

Crowdsourcing refers to any practice that involves distributing a project across a vast collection of users with different skills and abilities (Estellés-Arolas & González-Ladrón-de-Guevara, 2012; Howe, 2006; Surowiecki, 2004). While not restricted to web-based activities, improvements in technology have undeniably accelerated the use of crowdsourcing in recent years (Estellés-Arolas & González-Ladrón-de-Guevara, 2012; Vianna et al., 2020). The broad theory behind the superior performance of crowd-generated solutions is that more people generate more ideas, while averaging a large number of responses cancels idiosyncratic errors associated with any individual judgement, ensuring more accurate judgements and decisions (Surowiecki, 2004). While not new – Aristotle is credited as the first person to write about the "wisdom of the crowd" (Landemore & Elster, 2012) – the idea of collective wisdom was popularized in James Surowiecki's 2004 book, *The Wisdom of Crowds,* which opens with an anecdote describing how the average of the crowd's guesses for an ox's weight at a county fair was closer than the estimates of any individual (Surowiecki, 2004).

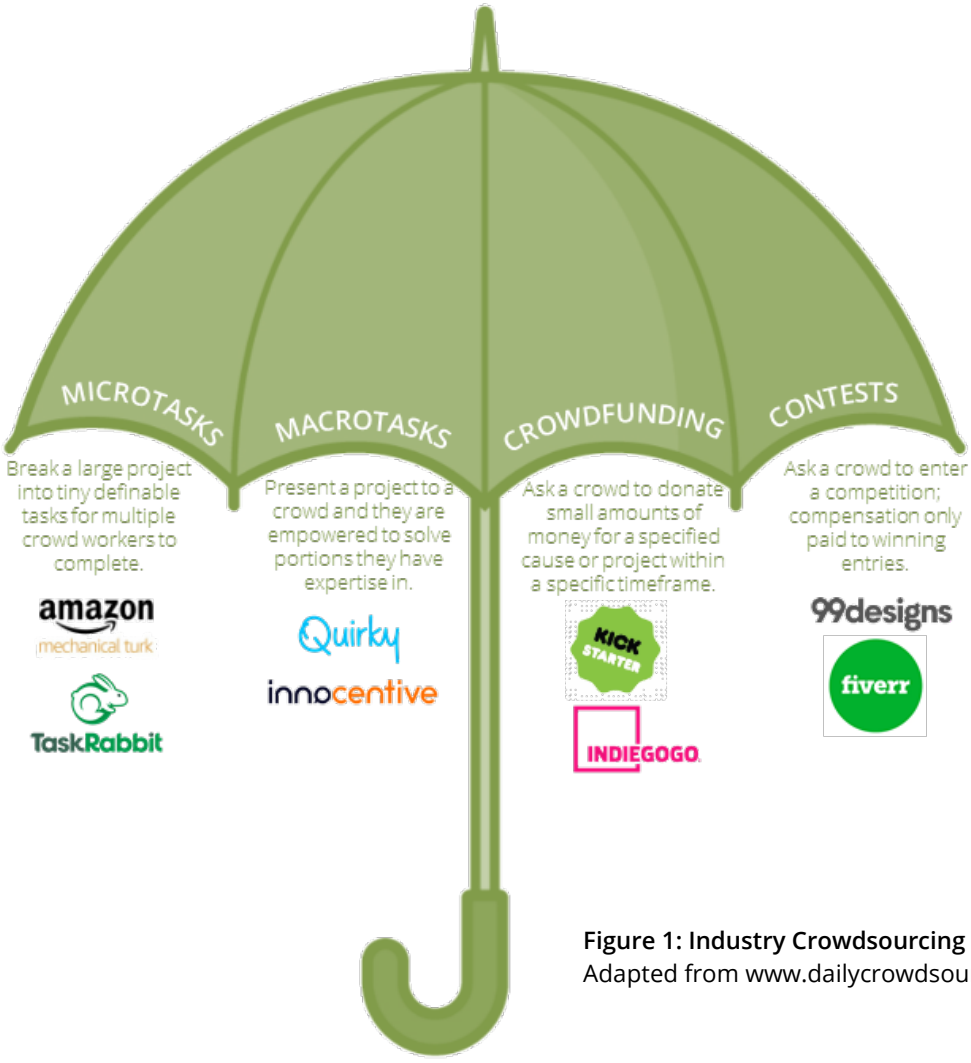


Figure 1: Industry Crowdsourcing Umbrella.
Adapted from www.dailycrowdsource.com.

Crowdsourcing in Industry

Crowdsourcing is not simply a buzzword in industry. It is a strategic model, proven to cut costs, minimize product development risks, increase brand loyalty, and deliver solutions that are superior in quality and quantity to those that traditional forms of business can provide (Brabham, 2017; Cappa et al., 2019; Chawla et al., 2019; Hammon & Hippner, 2012; Howe, 2006; Lewicki, 2019; Pilloni, 2018; Richter, 2015; Vianna et al., 2020; Wilson et al., 2016). When the term first appeared in *Wired* magazine, very few companies looked outside their own employees to creatively solve problems (Howe, 2006). Today, however, more and more companies broaden their base of resources by using a pool of external knowledge, ideas, and labor for innovative tasks (Hammon & Hippner, 2012). The world's most valuable brands have adopted crowdsourcing practices (Gatautis & Vitkauskaite, 2014; Ghezzi et al., 2018; Howe, 2006; Lewicki, 2019; Roth et al., 2015; Vianna et al., 2020), primarily for tasks such as new product or service development (Al-Ghamdi et al., 2018; Castro, 2019; Chawla et al., 2019; Evans et al., 2016; Forbes & Schaefer, 2018; Geise, 2017; Mehtälä et al., 2016; Pohulak-Żołędowska, 2019; Richter, 2015) and manufacturing (Caggiano, 2018; Jiang et al., 2018; Pilloni, 2018; Vianna et al., 2020), microtasks such as market research (Galdon-Salvador et al., 2016; Ghezzi et al., 2018; Goodman & Paolacci, 2017), and contests for marketing communications material (Derda, 2019; Roth et al., 2015). Entrepreneurs can also benefit from crowdfunding sites such as Kickstarter (Negrão & Brito, 2021; Patil et al., 2021; Tian, 2021), which has raised over $5.4 billion[1] to successfully launch new projects. Figure 1 provides an overview of the different types of crowdsourcing that dominate business applications.

Industries from healthcare (Ghosh & Sen, 2019; Seidenwurm, 2018; St John-Matthews et al., 2019; Wazny, 2018) to food (Castro, 2019; Dunford & Neal, 2017; Hultberg, 2016), transportation (Kafle et al., 2017; Klumpp, 2017; Kumar et al., 2018) to construction (Pilloni, 2018; Vianna et al., 2020), engineering (Evans et al., 2016; Mao et al., 2017) to hospitality (Ćwiklińska, 2014; Galdon-Salvador et al., 2016; Jiménez-Crespo, 2018; Richard et al., 2016; Way et al., 2011) and fashion (Hultberg, 2016; Mehtälä et al., 2016; Nasta & Pirolo, 2020) to publishing (Mustafa & Mohd Adnan, 2017) have all invested in crowdsourcing capabilities over the last decade. Ben & Jerry's, Dunkin' Donuts, and McDonald's use crowds to invent new flavors, for example (Cao, 2017; Quigley, 2010). LEGO encourages consumers to modify product designs (Yoo, 2017), Doritos has generated several successful Super Bowl commercials using the crowd (Plante, 2016), and Netflix awarded a million-dollar prize to collaboratively develop a better movie recommendation algorithm (Johnston, 2012).

Crowdsourcing in Education

Within education, crowdsourcing focuses on capturing the resources of the crowd in three areas (Llorente & Morant, 2015; Prpic et al., 2015). First is the crowdsourcing of educational resources, also known as crowd-teaching when course material such as syllabi and exam questions are shared between instructors (Donlon et al., 2020; Prester et al., 2019; Prpic et al., 2015; Solemon et al., 2013) or between faculty and students (Heffernan et al., 2016; Jiang et al., 2018; Khosravi et al., 2019; Penciner, 2015), or crowd-learning, when educational resources are shared *between students* (e.g., class wikis for lecture notes or social learning sites such as Duolingo; Jiang et al., 2018; Molnár

[1] www.statista.com

& Szűts, 2018; Prester et al., 2019; Suhonjić et al., 2019; Workman, 2008). Many of these crowdsourcing platforms share revenues with the creators though free open educational resources are growing rapidly (Porcello & Hsi, 2013; Zdravkova, 2020). The second application is the use of crowdsourcing for assessment purposes, where student peers collaboratively review and grade assignments (ArchMiller et al., 2017; Duverger & Steffes, 2012; Hall & Griffy-Brown, 2016; Luther et al., 2014; Maletić et al., 2019; Prester et al., 2019; Prpic et al., 2015; St John-Matthews et al., 2019). The third area concerns the crowdfunding of classroom materials from sites like DonorsChoose, which direct millions of dollars each year to schools across the country (Wolff & Carlson, 2021). Importantly, none of these applications operationalizes crowd-sourcing the way it is typically used in industry. That is, the crowd is not being used to generate and evaluate creative solutions to a specific business or social problem. The closest is a paper by Dow et al. (2013) that used crowds *external to the classroom* to develop and evaluate student ideas, rather than using the student crowd to creatively develop solutions to complex societal and business problems.

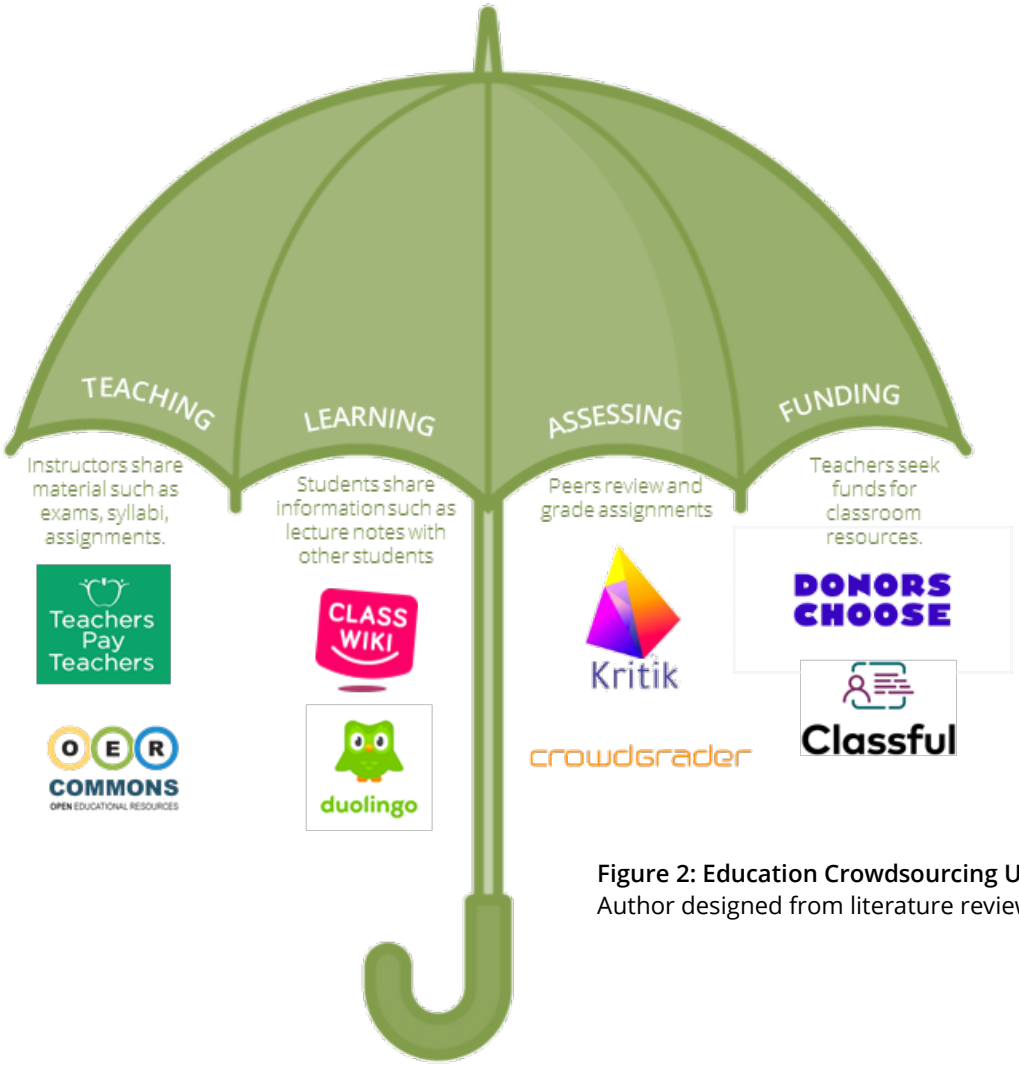


Figure 2: Education Crowdsourcing Umbrella. Author designed from literature review.

Crowdsourcing Best Practices

Crowdsourcing solutions to problems is not always feasible, appropriate, or successful. Horror stories abound of the crowd sending organizations in unwanted directions. For example, the British public chose "Boaty McBoatface" in a crowdsourced campaign to name a new $300 million government research vessel. Internet trolls can quickly monopolize and derail a crowdsourcing campaign. Other issues include a lack of quality control and concerns for security and idea ownership (Wazny, 2017). Unsurprisingly, then, a large management literature investigates crowdsourcing best practices (Estellés-Arolas & González-Ladrón-de-Guevara, 2012; Hosseini et al., 2014; Lewicki, 2019). Reviews identify four pillars for the successful implementation of a crowdsourced marketing or innovation project. First, *the crowd itself needs to be clearly defined,* considering factors such as the size of the crowd, whether participants know each other or not, suitability for the task, and diversity of age, gender, expertise, and race. While there is no single correct answer, some combinations work better for certain tasks than others. For example, Lewicki (2019) suggested that large internal crowds who know each other and have some domain expertise may be better for the development of novel products, but a diverse external crowd might be better for marketing research. Some level of vetting of the crowdsourcing community is also recommended. Second, the *crowdsourcer (the person or organization who seeks the wisdom of the crowd) needs to be clearly identified*. In particular, the crowdsourcer must specify the incentives for participation (e.g., financial reward or social capital), and the measures to maintain privacy and protect the crowd. Third, *the task or activity in which the crowd participates must be clearly outlined*. This includes the degree of task complexity, solvability, skills required, and contribution type (individual or collaborative). Task instructions are also important, with some research suggesting that detailed instructions with attributes to either improve (suggestive instructions) or avoid (prohibitive instructions) generate more ideas than tasks without detailed instructions (Gillier et al., 2018). Finally, *the crowdsourcing platform must be established* prior to beginning the project. Platforms typically use software such as the propriety OpenIdeo.com digital collaboration program. There are many factors to consider when choosing a platform, including the ability to manage project tasks such as crowd enrollment, authentication, feedback, and reporting, as well as ease of use and, of course, cost. Other researchers add to this list *platform flexibility* to allow multiple iterations of ideas and feedback (Forbes & Schaefer, 2018; Qin et al., 2016; Saldanha et al., 2014).

LITERATURE SUMMARY

To survive expanding student enrollments with concurrent declines in university funding, higher education class sizes will continue to grow in the coming years. Currently, educators view mass classes as an evil to be endured, requiring a switch to less effective pedagogical techniques in order to minimize instructor burden (Becker & Powers, 2001; Wright et al., 2019). Drawing on crowdsourcing best practices, we challenged such perceptions by designing a course that realizes the potential benefits of a large class size. Mass classes are, effectively, crowds, and in industry, crowds are valued as an intelligent resource that can improve performance. Unlike existing crowdsourcing practices in education, the collaborative wisdom of the entire class will be used to creatively develop solutions to complex problems.

DESIGN

Design thinking was used to develop, implement, and evaluate a crowd project assignment in an introductory marketing class focused on creativity and innovation. While many versions of the design thinking process exist (e.g., Beckman, 2020; Liedtka, 2014), they share many commonalities that can be broadly conceptualized in two primary phases: understanding problems, then designing solutions (Brown, 2008; IDEO, 2012; Luma Institute, 2012). Initially, research to empathize with key stakeholders and better understand the problem was conducted.

A prototype of a crowd project was developed, then implemented and tested during the Fall semester. A quasi-experimental design was used to compare the crowd project with a more traditional group project. Analysis of student performance, engagement, and faculty effort in both conditions led to improvements that were implemented and tested the following Spring semester. In this section, each stage of the design thinking process is described, identifying the specific design tools used at each stage (see Figure 3).

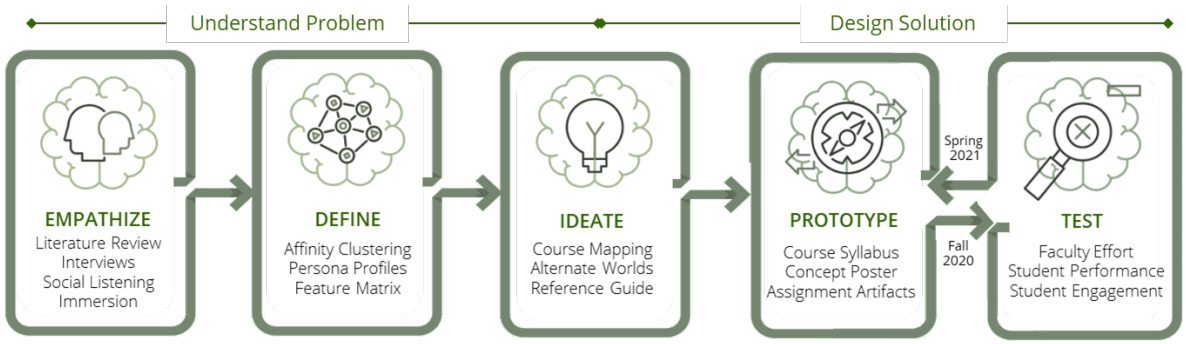


Figure 3: Overview of Design Thinking Process

Empathize

The first stage of the design thinking process requires the development of *empathy* with key stakeholders in the project. Four design methods were used to better understand the learning issues faced by students in a mass class, as well as the instructional needs of professors teaching a large number of students (see first box in Figure 3). First, an extensive review of the academic literature on pedagogy helped to identify best practices for teaching mass classes in general, and teaching creativity and innovation more specifically. Systematic literature reviews summarize and synthesize findings from existing papers on the topic (Palmatier et al., 2018). Recommended guidelines were followed to ensure depth and rigor of the reviews conducted (Linnenluecke et al., 2020; Palmatier et al., 2018; Snyder, 2019). The process described below for a review of the literature on large class pedagogy in higher education was repeated three additional times for reviews on crowdsourcing, creativity and innovation pedagogy, and teaching higher order learning skills. Table 2 provides a summary of the four literature reviews conducted.

Design: Scholarly articles that referenced teaching large classes in all higher education domains (i.e., not just those in marketing or business) were included. Different instructional formats including online and in-person classes were reviewed. Synonyms for higher education

(e.g., college, university) and large class (e.g., mass class) were searched for in the articles' title, abstract, or identifier fields in three EBSCO databases (ERIC, APA PsychInfo, and Education Research Complete). Forward citation search identified additional articles that cited the original paper. Articles prior to 1990 were excluded due to significant changes in technology since that time.

Conduct: All possible combinations of the keywords were searched for in the article title, abstract, or identifier fields. Resulting papers were saved using Zotero software and duplicate publications were removed.

Analysis: Papers were read by the author and sorted into broad themes, such as best practices, issues, growth, etc. Grounded theory and emergent coding (Glaser & Strauss, 1967) was used to identify related patterns of information. Papers from multiple perspectives, including university administration, students, and faculty, were considered.

Reporting: Findings were organized into affinity clusters and integrated with key insights from the remaining empathize methods. Many of the findings were reported earlier in the literature review section of this thesis.

Review Step:	Design	Conduct	Data Analysis	Reporting
Step Description	**Define inclusion and exclusion criteria; sampling unit, keywords & databases**	**Search and store articles meeting inclusion criteria**	**Identify trends and relationships in the data**	**Results interpreted to deepen understanding**
Review 1: Understand issues and benefits of **teaching large classes**	Large classes in higher education; all domains; students, administration & faculty; (large class, mass class) + (higher education, university, college); scholarly journals only in EBSCO (ERIC, APA PsychInfo, Education Research Complete)	Keyword presence in the article title, abstract or identifier fields; citing articles reviewed; results stored in Zotero.	Definitions; growth trends; issues for students; faculty concerns; benefits for university administrators.	Findings were summarized in affinity clusters reported in the Define stage and also discussed in the *Literature Review.*
Review 2: Understand issues and benefits of **crowdsourcing** material	Crowdsourcing in industry and K-12 and higher education; (crowdsourcing, crowdfunding, crowd) + (industry, business, education, school, university); scholarly journals and popular press in EBSCO and ProQuest (ABI/INFORM)	Keywords were searched for in all text fields; citing articles reviewed; results were stored in Zotero.	Definitions; uses in academia and industry; issues, benefits and best practices.	Findings were summarized in affinity clusters reported in the Define stage and also discussed in the *Literature Review.*
Review 3: Understand best practices when **teaching creativity** and innovation	Teaching creativity and innovation in higher education; (creativity, innovation) + (higher education, university, college); scholarly journals only in EBSCO (ERIC, APA PsychInfo, Education Research Complete)	Keyword presence in the article title, abstract or identifier fields; citing articles reviewed; results stored in Zotero.	Benefits to students of learning creative problem solving; best practices in teaching creative problem solving.	Findings were summarized in affinity clusters reported in the Define stage and also discussed in the *Literature Review.*
Review 4: Understand best practices in **teaching higher order skills**	Best pedagogical practices when teaching higher order thinking skills in K-12 and higher education; (higher order thinking; analyze, evaluate, create, apply, Bloom's Taxonomy) + (effective, best practice, success) scholarly journals only in EBSCO (ERIC, APA PsychInfo, Education Research Complete)	Keyword presence in the article title, abstract or identifier fields; citing articles reviewed; results stored in Zotero.	Identified two key teaching techniques: collaborative learning and project- based learning.	Findings were summarized in affinity clusters reported in the Define stage and also discussed in the *Literature Review.*

Table 2: Literature Review Process

Second, empathy interviews were conducted with experts in pedagogy to understand best practices. Three Instructional Designers and one Information Technology Specialist were interviewed. All were personally known through my experience teaching at Virginia Tech and Radford University. Combined, these staff members have over 50 years of experience designing effective higher education courses. Participants were given an opportunity to review the consent form and ask questions. Where necessary, supervisor support was secured for participants to spend the time giving the interview. Interviews lasted approximately one hour and covered best practices in course design, digital teaching tools, collaborative learning, project-based learning, and student engagement in all class sizes. The interview guide can be found in Appendix E. Interviews were conducted via Zoom or in person in my office at a time of the participant's choosing. Interviews were not recorded but visual notes were taken to capture key insights and relationships (Rohde, 2012).

To gain a deeper understanding of student perspectives about MKTG 101: Creativity and Innovation, the large class in which I intended to implement a crowd-based assignment, informal 30-minute interviews were conducted with three former students who had already taken the class, as well as two graduate students who had assisted teaching and grading the course in prior semesters. The interviews took place either via Zoom or in person in my office. The goal was to clarify learning objectives and identify areas for improvement, particularly regarding the existing group project requirement in the course. The interview guide can be found in Appendix D.

Immersion in the lived experience of the population for whom the project is being designed is an extremely valuable method to improve empathy. To achieve this, I participated in three classes to better understand the student perspective. First, I took an online instructional design class organized by Radford University's Center for Innovation in Teaching and Learning called *Rapid Online Course Kit SU2020*. Designed to take 10 days over 2 weeks in Summer 2020, the course taught backward course design principles through the Desire to Learn learning management system. Topics included setting learning objectives, effective assessment techniques, designing inspiring presentations and videos in an online environment, and D2L tools to engage users. Second, I took three online courses: *Get Creative with People to Solve Problems*, organized by the University of Leeds and hosted on FutureLearn; *Analytics in Course Design: Leveraging Canvas Data*, organized by Dartmouth University and hosted on Canvas Network; and *Social Network Analysis*, offered by UC Davis and hosted on Coursera. The courses were useful from two perspectives: first, the content helped to directly identify best pedagogical practices for teaching mass classes in general, and teaching creativity and innovation more specifically. Perhaps more importantly, however, the courses immersed me in the student experience. To encounter situations that frustrate me as an educator from a student perspective was unbelievably insightful. Notes on the course content were taken in Microsoft PowerPoint and a journal was kept in which reflections on the education experience were recorded.

Finally, to help identify the possible online tool(s) to support collaborative learning in a large class, I engaged in social listening of reviews of digital whiteboarding and crowdsourcing platforms. Social listening is a research method used to follow conversations related to a chosen topic on digital and social media platforms (Li & Bernoff, 2011). Searches for terms including "collaboration software," "digital whiteboards," "digital collaboration," "innovation platforms," and "crowdsourcing platforms" identified multiple potential platforms. The names of the most frequently occurring sites were then entered with qualifying words such as "issues"

and “love” on individual social media sites (e.g., Twitter, LinkedIn, and Reddit), social media aggregator sites (e.g., Boardreader.com), and digital review sites (e.g., Techradar, CNET). Data from the social listening exercise was supplemented by my own immersion in each platform to assess firsthand the pros and cons. This proved invaluable in understanding how each platform functioned and helped in the ideation phase to determine how both the group and the crowd project might be implemented. I also recruited one of the instructional designers I had interviewed to enroll in each site as a participant to better understand the experience from a student perspective (see Figure 4).

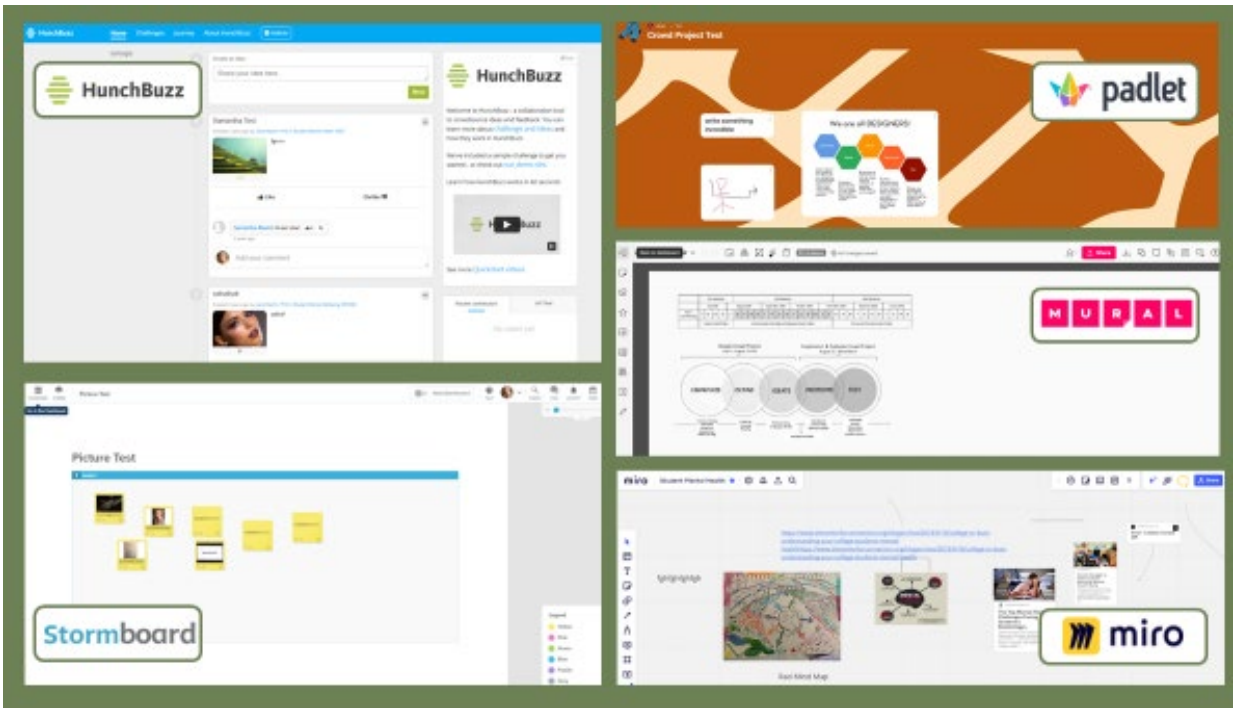
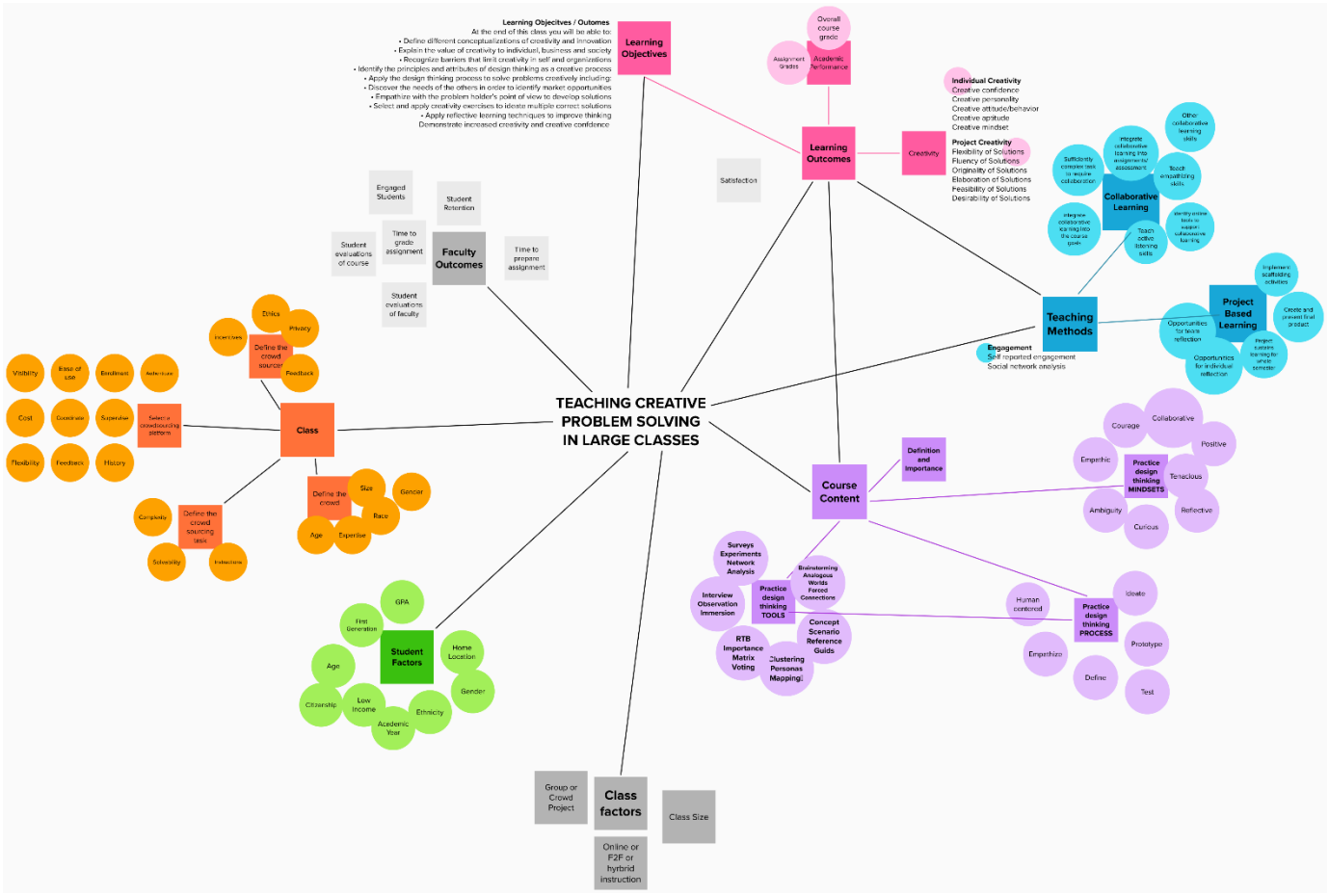


Figure 4: Immersion in Digital Collaboration Platforms

Define

Content analysis was used to explore data collected from the empathize research activities (Glaser & Strauss, 1967; Stemler, 2015). This qualitative research approach is appropriate for generating depth and breadth of understanding (Glaser & Strauss, 1967). Using the constant comparative method (Glaser & Strauss, 1967), findings were examined to identify common themes, then compared with earlier findings. Similar concepts that emerged were integrated and generalized to maximize parsimony and scope, while remaining true to the data. Negative cases and alternative understandings were explicitly sought out to improve reliability of conclusions (Strauss & Corbin, 2008). Three design thinking methods were used to represent the findings. First, key insights from the literature reviews, the interviews, the immersion experiences, and student evaluations were sorted graphically into similar themes in Mural.co, a digital whiteboarding platform, using a technique called Affinity Clustering (see Figure 5).



Key to Clusters

- Industry Crowd Sourcing
- Effective Learning Outcomes
- Effective Pedagogical Methods
- Faculty / Class Success Factors
- Creativity Course Content
- Student Success Factors

Figure 5: Affinity Cluster of Key Themes

A Persona Profile is another technique used to help define the research problem. A fictional characterization of a key student stakeholder, Robyn Bynum, was created to describe the needs of a typical student in MKTG 101: Creativity and Innovation. The profile also provided a reference point when evaluating features in the course design (see Figure 6). The empathy researched revealed intense frustration with group projects, especially when students prioritized success differently. Some students are satisfied with passing the class, which infuriates students who are aiming for an A letter grade. Demographically, the student persona represents a typical student in MKTG 101. They are likely first-generation students who have completed some of their general education requirements at a local community college before transferring to Radford University. They enter as an academic Junior, meaning that it is their first year at Radford University, but they have sufficient credits to graduate within 2 years. As a transfer student, they often do not know anyone in the classes they are taking because they have not had time to establish relationships. This makes it difficult to find partners to work with if the professor allows the teams to form themselves, rather than assigning members. Different schedules and social lives make meeting with group members outside of class time difficult.

Figure 6: Student Persona Profile

Information collected from the social listening exercise of, and immersion in, the different digital collaboration platforms was organized into a Feature Matrix (see Table 3). Five potential platforms were identified in the research as potentially suitable to support group and class collaboration. Criteria such as the number of users, privacy, cost, ease of use, reporting, and D2L integration were considered in the evaluation.

Many sites charged a fee, either when users went above a trial number (between 10 and 30 members) or for full site functionality. Since I did not want to charge my students to use the software, and to better compare sites on an equal footing, I successfully negotiated with salespeople from those websites to either increase the number of participants allowed with their academic licenses or to make their regular product available free to faculty.

Crowdsourcing Platform Review	HunchBuzz	miro	MURAL	Stormboard	padlet
Overall Assessment	☺ Reports See DT flow ☹ No templates Not normally free	☺ Easy to connect ideas ☹ No reports! No email service	☺ Ease of use Multiple templates ☹ No reports! Not normally free	☺ Good reports ☹ Limited storage Limited templates	☺ Reports Structured better ☹ Limited templates Adding users harder
Cost	Free (by special permission)	Free (by special permission)	Free (by special permission)	Free (till Jun 2021)	Free (students); $100 (faculty
Design	By Challenges	By Board	By Board	By Board	By Padlet
Integration	OneDrive; Slack	OneDrive; Slack	OneDrive; Slack	OneDrive; Slack	D2L; websites
Ease of Use	****	*****	****	*****	*****
Mobile App	Y	Y	Y	Y	Y
Customer Help	Help Center; online form; email	Q&A, community, tickets	email super quick	Email, community, Q&A	Email, message, Reddit, Q&A
Learning Tools	Videos	Videos,	Introduction boards & videos	Introduction videos	Video tutorials
# Boards	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Reporting	Y	N	N	Y (all to Excel)	Y (main posts to Excel)
Directions	Embed in board	Embed in board	Embed in board	Embed in board	Embed in board
Colors	Full color spectrum for stages	Limited	Limited	Limited	Limited
Content Tools	Tag, Search, Sort	Tag, Search, Sort, Export	Tag, Search, Sort, Export	Search, Export	Limited tag, search; export
Website links	**** (when create new idea)	**** (copy and paste most)	***** (copy and paste)	* (URL text only)	***** (search within post)
Pictures	Yes (need to upload)	Y (Drag or search)	**** (drag or search)	* (limited space)	Y (drag or search)
Connectors	N	*****	***	N	N
Other Tools	Titles, keywords	Tags, emojis icons, title	Icons, titles, copy	Titles, draw, text2sticky	Titles, draw, copy
Navigation	Y	Y	Y	Y	N
Upload Docs	Y	Y	Y	Y	Y
DT Process	See overall DT flow	N	N	N	Y
Templates	N (upload pictures or URL link)	*****	*****	***	Limited
Edit entries	Y	Y	Y	Y	Y
Flexibility	Very structured	Floating	Floating	Floating	Mixed
# Users	100 (by special permission)	100 (by special permission)	100 (by special permission)	100	Unlimited students
Enrollment	Multiple emails at once	Multiple emails at once	Multiple emails at once	Multiple emails at once	Multiple emails at once
Groups	Y (effortful)	Y (separate boards)	Separate Rooms	Y (Separate boards)	Y (separate Padlets)
Privacy	No RU authentication	Y	Y	Y	RU authentication
Voting	Comments; voting; reviews	Live voting	Anonymous live voting	Yes	Comments, grades, votes
Communication	blogging tool; polls	Chat, notes	Chat, comments, outline	Chat, comments	Separate chat board
User Tracking	Yes		In activity log only	Yes	Yes to original posts only

Table 3: Feature Matrix of Digital Collaboration Platforms

Ideate

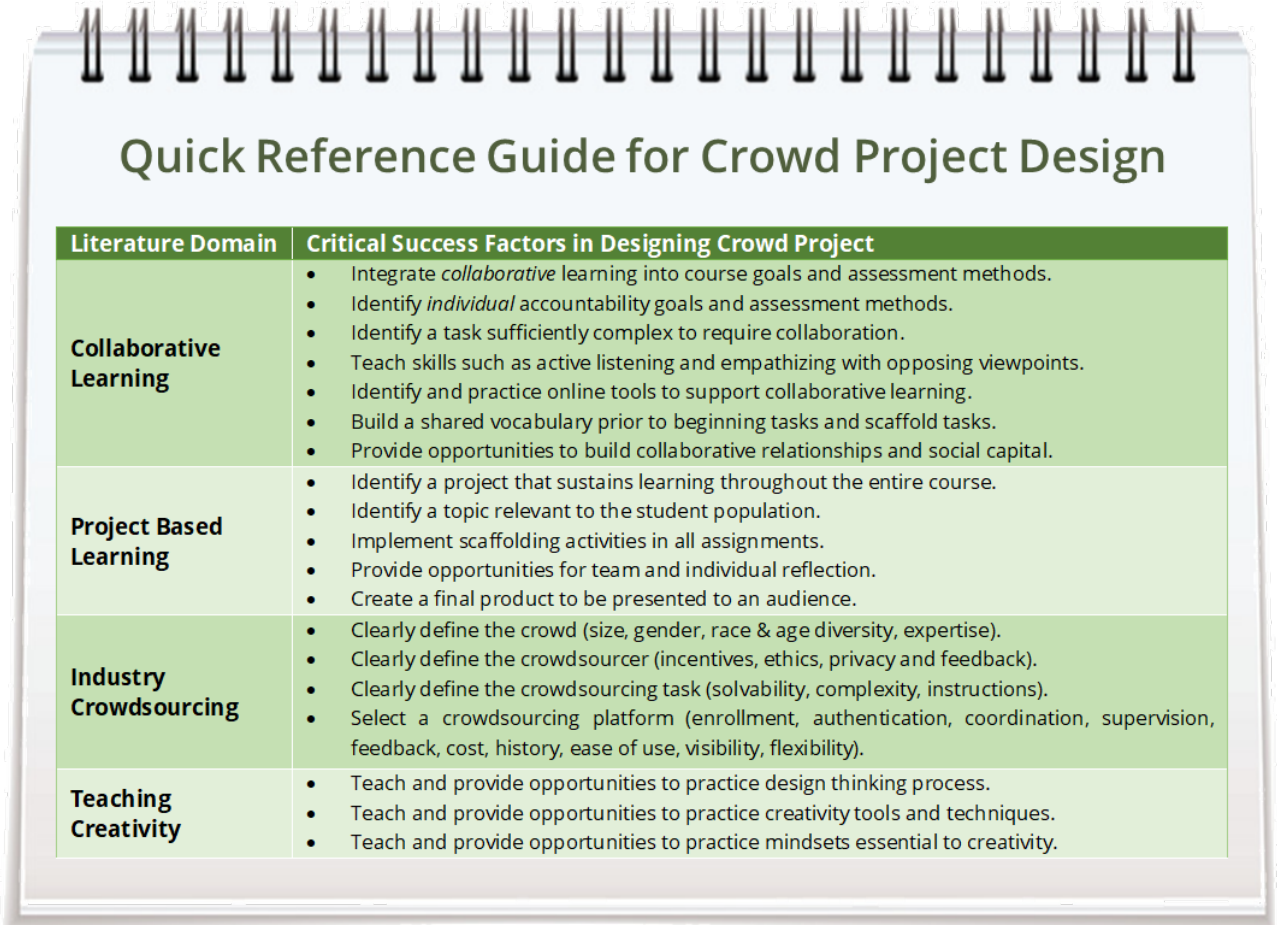
Guided by the insights generated in the first two stages, possible ways to introduce a project in a mass class that capitalized on the wisdom of the student crowd were brainstormed. The crowd project was to take place in MKTG 101: Creativity and Innovation, a freshmen level business course that teaches design thinking.

First, the alternative world of industry crowdsourcing was used to identify best practice when designing a crowdsourced project in education. Four key steps were identified. First, it is necessary to clearly define the crowd-sourcer, in this case myself. This involves designing a project that ensures the students' privacy is protected, that they are treated ethically, are appropriately incentivized for participation, and are given opportunities for feedback. The second step is to select an appropriate crowdsourcing platform. In addition to the features necessary for success in industry crowdsourcing, it was also important to have a way to track student participation. This proved to be a key determinant in selecting the digital whiteboarding platform. Many collaboration or crowdsourcing platforms are not designed with pedagogy in mind. For example, several only offer anonymous posting options to ensure the confidentiality of participants. Obviously this would not allow an instructor to monitor student progress and engagement with the project. Others allow for user authentication but do not provide an easy means of accessing participation data. Stormboard was ultimately selected. Stormboard performed on points of parity, such as ease of use, availability of templates, the ability to upload multiple student emails at once, to add pictures, draw, post sticky notes in a variety of colors, and had a chat and comments feature. From a faculty perspective, Stormboard offered historical reports on individual participation that were downloadable to Excel.

The third step is to clearly define the crowd. Understanding the demographics, size, experience, and needs of the target audience ensures the smooth implementation of the crowdsourced project. The Persona Profile developed in the Define phase helped here, combined with instructor knowledge of previous student body composition in the class. The majority of students tend to come from marketing because the course is required for the major. However, the course is open to the entire campus without prerequisites. There are typically a handful of sports management, communication, and design majors in the class most semesters, as well as students from other business disciplines. Given the diversity in major and class year, no prior experience of creativity and innovation can be presumed. There are usually between 80 and 120 students each semester in the class, meaning it is a mass class.

Finally, the crowdsourced task needs careful consideration. Business crowd sourcing best practice recommends problems that are sufficiently complex to prevent simple solutions, but that are not so complex as to be unsolvable, given the knowledge and experience of the intended crowd. Clear instructions are also vital. In addition to crowdsourcing best practice, the empathize phase identified other factors necessary for successful collaborative project-based learning. Of particular note was the need to ensure collaborative learning was integrated into the learning objectives and assignments so that students were incentivized for collaborating with their peers. Also important was the need to identify a project that was sufficiently complex to require collaboration and sufficiently interesting to sustain student interest for an entire semester. These findings were summarized in a Quick Reference Guide (see Figure 7) and used to guide the development of the academic crowd project.

Figure 7: Quick Reference Guide

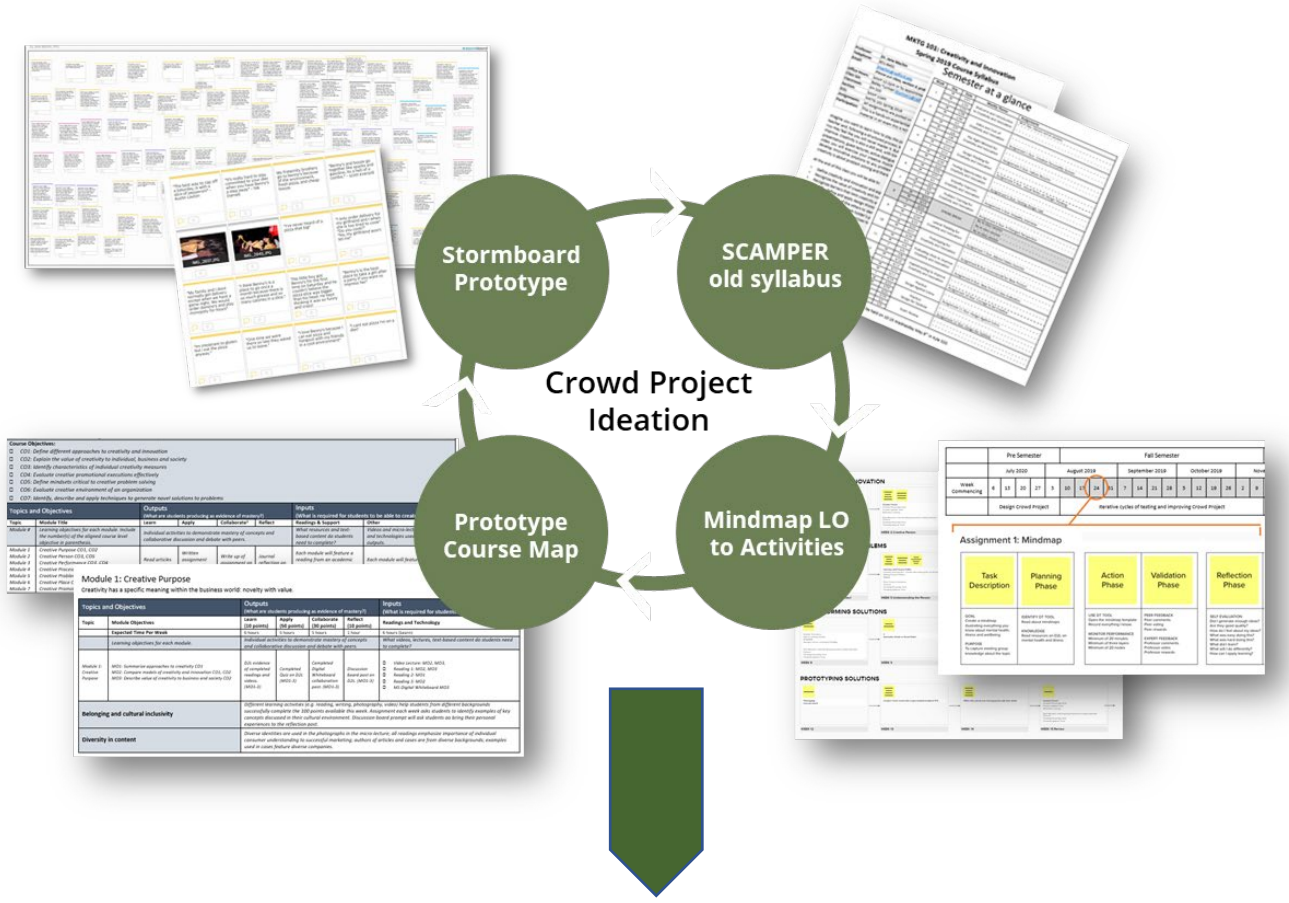


Quick Reference Guide for Crowd Project Design

Literature Domain	Critical Success Factors in Designing Crowd Project
Collaborative Learning	• Integrate *collaborative* learning into course goals and assessment methods. • Identify *individual* accountability goals and assessment methods. • Identify a task sufficiently complex to require collaboration. • Teach skills such as active listening and empathizing with opposing viewpoints. • Identify and practice online tools to support collaborative learning. • Build a shared vocabulary prior to beginning tasks and scaffold tasks. • Provide opportunities to build collaborative relationships and social capital.
Project Based Learning	• Identify a project that sustains learning throughout the entire course. • Identify a topic relevant to the student population. • Implement scaffolding activities in all assignments. • Provide opportunities for team and individual reflection. • Create a final product to be presented to an audience.
Industry Crowdsourcing	• Clearly define the crowd (size, gender, race & age diversity, expertise). • Clearly define the crowdsourcer (incentives, ethics, privacy and feedback). • Clearly define the crowdsourcing task (solvability, complexity, instructions). • Select a crowdsourcing platform (enrollment, authentication, coordination, supervision, feedback, cost, history, ease of use, visibility, flexibility).
Teaching Creativity	• Teach and provide opportunities to practice design thinking process. • Teach and provide opportunities to practice creativity tools and techniques. • Teach and provide opportunities to practice mindsets essential to creativity.

Once the critical success criteria had been established, I began to ideate potential crowd project designs. Initially I tried adapting traditional group project activities into class-wide activities. It quickly became clear that this was not sufficient. Using the criteria in the Quick Reference Guide required an overhaul of the entire course, not just one single project. Figure 8 outlines some of the activities I undertook to redesign the course. I began using the SCAMPER ideation technique (Withell, 2016) to identify areas in previous syllabi and course outlines that I could substitute, combine, adapt, minimize or maximize, put to other uses, eliminate, or rearrange in the revised course.

I then plotted key learning objectives against class and homework activities on a mindmap and developed a course map that explicitly linked weekly content to course and module learning objectives. Since I was new to using digital collaboration software in the classroom, I also experimented with Stormboard in a small online summer class. Students expressed enjoyment with the method both as a way to get to know their fellow classmates in a virtual environment and also to break up the monotony of the LMS and typical online course textbooks. All this learning was integrated to produce a course outline for Fall 2021. Each week students had to complete five activities, described next.



Stage	1. Understand	2. Plan	3. Act	4. Collaborate	5. Reflect
Action	Attend lecture and take notes	Read material and ask questions	Implement directions	Post and discuss output of action	Reflect on action
Format					
Type	Individual	Individual	Individual	Collaborative	Individual
Location	Kyle 340	D2L Content	D2L Assignments	Stormboard	D2L Discussions
Deadline	2 pm Monday	Midnight Wednesday	Midnight Friday	Midnight Sunday	Midnight Sunday
Points	5	5	50	30	10
Validation	Attendance register & class participation	Digital record of access & time spent	Upload process documentation	Digital record of collaboration	Post responses on discussion board
Time	**75-min in person**	**105-min asynchronous**	**240-min action**	**90-min online**	**30-min online**
	3-hours of instruction each week		**6-hours of homework each week**		

Figure 8: Ideating the Crowd Project

Structured activities to scaffold the project began with the weekly in person lecture (see "Understand" in second column of table in Figure 8) where key course concepts and skills were presented and practiced. In "Plan," students read a popular press article to deepen their understanding of that week's topic. Key to the success of this project was the completion of an individual assignment to practice the particular design thinking task for that week ("Act"). Consistent with collaborative project best practices, the revised course included for the first time a graded collaborative component ("Collaborate"). Every week, students were required to post findings from their own research onto a shared whiteboard and to also respond to at least one other post from their peers. Students concluded the week with a structured reflection on the activity ("Reflect"). One hundred points were available to be earned each week. The full syllabus is in Appendix H.

Once the course structure was finalized, I turned my attention to designing the collaborative portion of the class. The idea was very simple. Students in this class go through the design thinking process and are required to do various assignments to practice design thinking methods. For example, they conduct an empathy interview and learn how to record insights onto an empathy map. In a traditional group project, the group is responsible as a whole for each task and only one assignment is uploaded. There is little individual accountability, unless the instructor offers a peer review at the end of the semester, allowing members to reward hardworking students and penalize social loafers. Prior experience has also shown that students tend to distribute the workload between them so not every student practices every method.

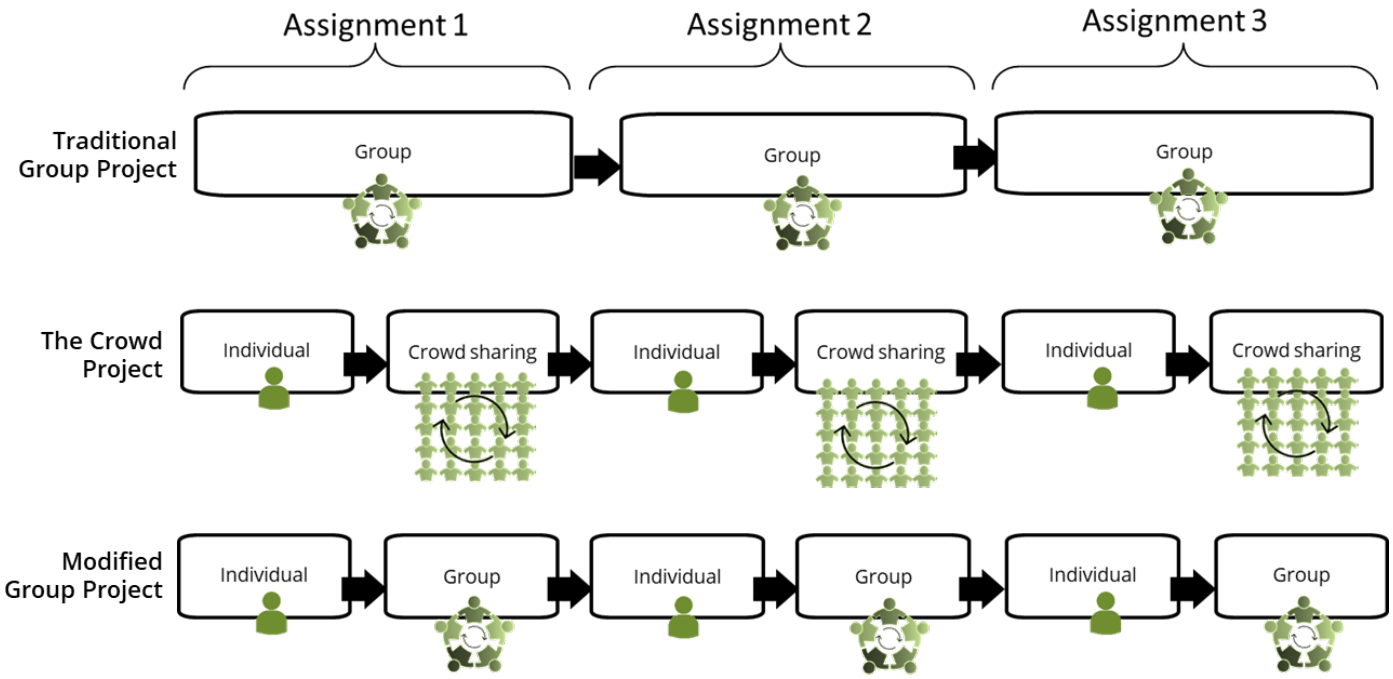


Figure 9: Example Project Flow Comparing Traditional Group, Modified Group Project, and Crowd Project

In a Crowd Project, the idea was for students to individually complete assignments (e.g., an empathy interview) and then to share their findings with the entire class. In this way, individuals are held accountable for completing the assignment, but benefit from exposure to insights from multiple other students. In theory, this should deepen their understanding of both the subject matter and the method, because they can see how other students have completed the assignment. Figure 9 compares a traditional group project with a Crowd Project. The illustration highlights two key differences. First, idea sharing within a traditional group project is limited to the group members, while in a Crowd Project, insights from the whole class can be reviewed, accessing the so-called "wisdom of the crowd." Secondly, the two-stage process of individual work combined with collaborative sharing means students are engaged with the project potentially more times than in a traditional group project, depending on how frequently the team members meet. Given that the goal of this thesis is to identify ways of improving the group project, it did not seem ethically correct to implement a traditional group project. Instead, a revised version of the group project was implemented that attempted to capture some of the potential benefits of the crowd project, namely individual accountability.

The only task remaining was to identify a project that was sufficiently complex to require collaborative problem solving and would engage the diverse student population that enrolls in this class for the entire semester. The problem had to have no clear solution and be sufficiently broad to allow for students to tackle aspects of it that they personally found most motivating. Given that this is a business class, the problem also had to have potential for the development of entrepreneurial solutions that were at least self-sustaining if not profit-making ventures. Marketing scholars have recently begun to tackle the United Nations Sustainable Development Goals (Voola et al., 2022). Goal 3, focused on good health and well-being, seemed particularly appropriate, given the number of students in higher education experiencing mental health problems (Barkham et al., 2019; Medicine et al., 2021; Usher, 2020), exacerbated recently by the COVID-19 pandemic (Fried et al., 2021; Fruehwirth et al., 2021). Improving student mental health was thus the broad problem area the students tackled.

IMPLEMENT

Fall 2020 provided a novel opportunity to test the Crowd Project and compare it against the modified group project. Social distancing rules in place at Radford University at the time meant that the 81 students enrolled in the class could not all meet in the same room. To that end, the class was divided into two sections, and each section served as a natural experimental condition to compare the two project types. Students were randomly assigned to meet in person either on Mondays or Wednesdays, where they received a lecture explaining the core concepts for the week. The remainder of the work was completed asynchronously online, subject to posted deadlines. The class was divided into four modules each lasting approximately 4 weeks. The first module introduced key creativity concepts while modules two to four were dedicated to practicing design thinking in the context of the mental health project. Students completed weekly assignments individually and then, depending on their assigned condition (Group or Crowd), shared their results with either their group members or the rest of their section. There was a quiz at the end of each module to check understanding of course concepts. A detailed flow is presented in Figure 10 and a table showing all the weekly assignments is presented in Table 4.

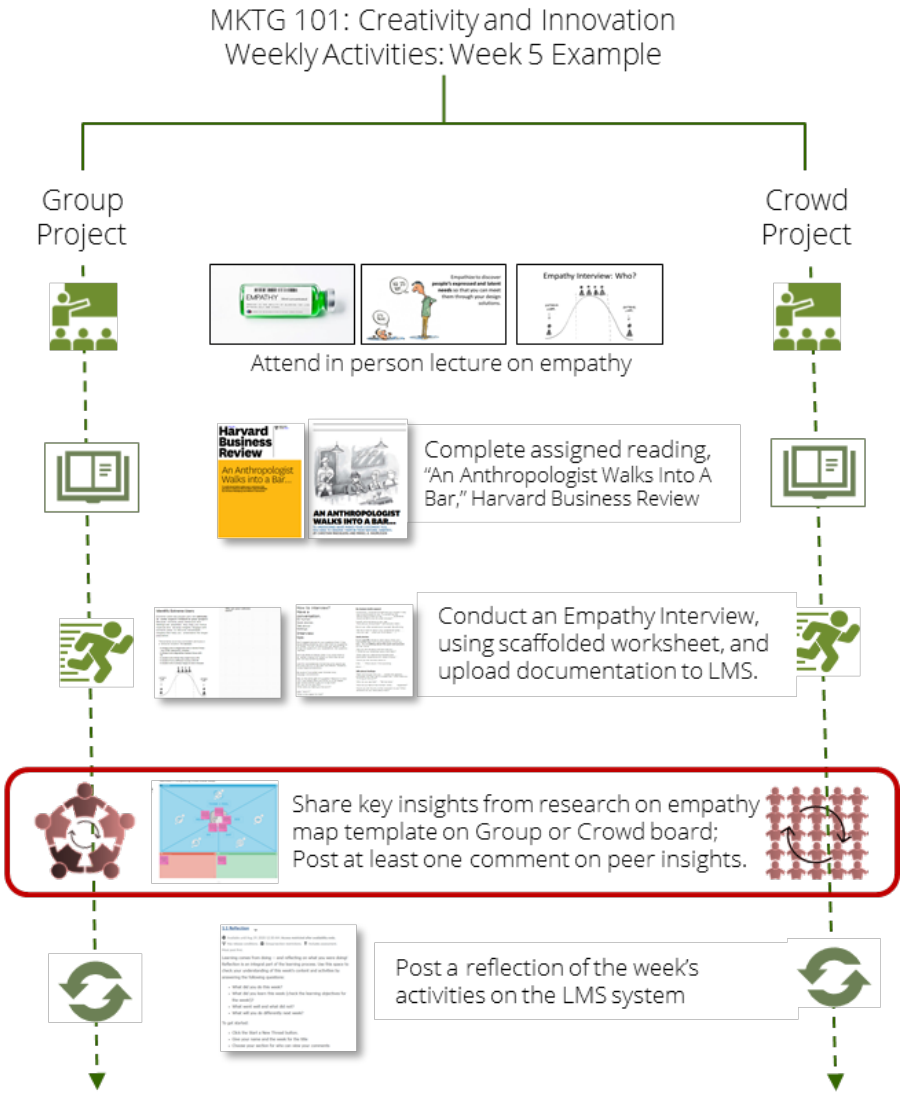


Figure 10: Week 5 Activity Flow

	MKTG 101: Creativity and Innovation Fall 2019		
	In Class	Act Assignment	Collaborate Assignment
Week 1	Course Introduction	Take Syllabus Quiz	Crowdsource questions for clarification.
Week 2	Creativity Concepts	Introductory Survey	Crowdsource music playlist.
Week 3	The Creative Person	Personality Quizzes	Post creativity skill to focus on and improvement plan.
Week 4	The Creative Process	Wallet Design	Post final wallet and comment on others' wallets.
Week 5	Knowing People: Empathy	Empathy Interview	Post key insights to develop a shared Persona Profile.
Week 6	Knowing Process: Field Visit	Field Visit	Post and label photos; comment on others' photos.
Week 7	Knowing Products	Social Listening	Post key insights and organize into clusters.
Week 8	(Re)Framing Problems	HMW Questions	Post favorite HMW questions and comment on others.
Week 9	Ideation: Creative Matrix	Creative Matrix	Post favorite ideas and give feedback on others.
Week 10	Ideation: Alternative Worlds	Alternative Worlds	Post favorite ideas and give feedback on others.
Week 11	Ideation: SCAMPER	SCAMPER	Post favorite ideas and give feedback on others.
Week 12	Ideation Selection	Feasibility Grid	Plot your ideas on a feasibility grid. Check others.
Week 13	Prototyping 1	Concept Sketch	Post your concept sketch and give feedback.
Week 14	Prototyping 2	3D Model or Storyboard	Post your revised prototype and give feedback.

Table 4: Weekly Class Topics, Individual Assignments, and Collaborate Directions

As much as possible in a quasi-experimental design, everything was kept the same between the two conditions except for the group or crowd project manipulation. Students heard the same lecture, did the same reading, completed the same scaffolded individual Act assignments, and posted a reflection based on the same directions. The only controlled difference between the conditions was in how students posted the insights they uncovered each week in the individual Act assignment. In the Crowd Project, students posted on a collaboration board that was shared with all other students in that condition. In the Group Project, however, students were randomly assigned to teams and only saw their teammates' collaboration board posts each week.

Students in both conditions could access the collaboration board prior to posting, or even completing their individual assignment. Students struggling with the assignment directions therefore could learn from what peers might have already posted. Since they were required to complete the assignment individually, however, they could not abuse the system and just post ideas copied from their colleagues. (When grading, if a student had not completed the individual assignment, they were not given credit for any collaborative posts they might have made that week.)

Due to space constraints with so many people posting, students in the Crowd condition accessed a new digital collaboration board each week, though they could easily access any previous week's boards. Students in the Group condition saw all their posts in one place (see Figure 11). Being able to have a bird's eye view of the total design thinking process may have provided an advantage, although this format prevented the use of design templates. Each blue-headed square in Figure 11 represents the area to post ideas for that particular week. In the bottom right-hand corner, students were assigned a color to post with to facilitate tracking of individual contributions. Students also shared their contact information in this section. The penultimate square was reserved for "random ideas" to finish out the four by three grid layout.

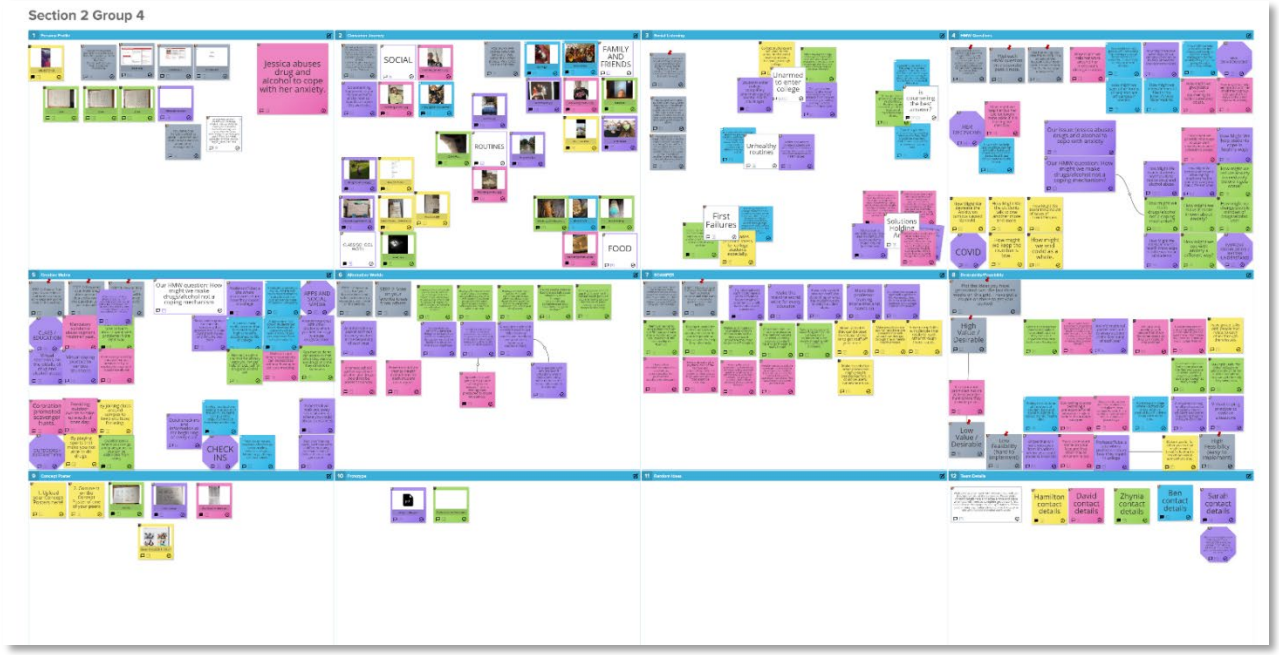


Figure 11: Example of Completed Group Project Collaboration Board

The first few weeks of implementation were treated as a prototype and student responses were closely monitored to quickly address any emerging issues. Some issues were easily handled. For example, analysis of the early scaffolded individual process documentation revealed that students were not completing them fully. There was confusion between which pages were directions and which pages required student input. Future individual assignments, therefore, were redesigned to be two-toned: a gray background meant it was a direction page while a white background indicated that students needed to complete it with their own work. Another issue emerged with the reflections. Students were initially asked to answer four questions ("what did you do?"; "what did you learn?"; "what went well?"; and "what will you do differently next week?"). Early responses were very shallow and literal (e.g., "I read an article") and did not show any actual reflection of the material covered in the week. The directions were updated for subsequent reflections to better explain the purpose of doing the reflection in the first place and to be more specific:

Learning comes from doing -- and **reflecting** on what you did! Reflection is an integral part of the learning process. Use this space to check your understanding of this week's content and activities by answering the following questions:

Identify 2 challenging or memorable or **experiences** from the class and the assignments due this week.

For **both moments** answer the questions below:

- Give the moment a brief **name** or title.
- Describe the **context** in which the moment occurred
- Describe the **content** of the moment or experience in detail.
    - Why did this moment or experience occur?
    - How did the moment challenge you or change you?
    - What **insight** into you or creativity did you gain?
- Describe 1 specific way you can apply your insights to **uplift other students** in MKTG 101. How can you help your peers gain the same insight you had?
- Describe the **learning objectives** the moment relates to.
- Describe 1 specific way you can apply what you learned to marketing

Two unexpected adverse events occurred in quick succession, which were more complicated to manage and required a rapid design pivot to ensure the Crowd Project experiment was not a complete disaster! Test posts on Stormboard in the Crowd condition prior to beginning the mental health project had progressed without issue. For example, in week two, students practiced using Stormboard by posting one of their favorite songs, which I then compiled into a Spotify Playlist and shared with the class. However, in week four, students were required to post pictures of their wallet designs from that week's individual assignment. We quickly ran into storage limits with Stormboard, and students who attempted to post pictures closer to the deadline were unable to. Then in the following week, when students were required to post insights from their empathy interviews, Stormboard quickly became unmanageable. In the space of a week, students in the Crowd Project posted almost 250 ideas (individual virtual "sticky notes") on the blank empathy map canvas, or about six ideas on average per student. The result was nothing short of a hot mess (see Figure 12). Any potential benefit from sharing ideas with a larger crowd was quickly lost in the chaos on the board. Students were posting on top of each other and the Empathy Map template soon disappeared.

It was clear that Stormboard could not handle the goals of the Crowd Project. Students could not upload images, and the boards were not infinitely expandable, resulting in posts on top of posts. After testing the earlier-identified alterative boards with regard to these two needs specifically, I decided to pivot to Mural. Student feedback about Mural was uniformly positive. They found it a cleaner, more inviting, and intuitive platform, though of course this could be because they had already climbed the digital whiteboard learning curve with Stormboard. Students liked the ability to see all the Murals clearly on one screen, like their peers in the Group Project (see Figure 13).

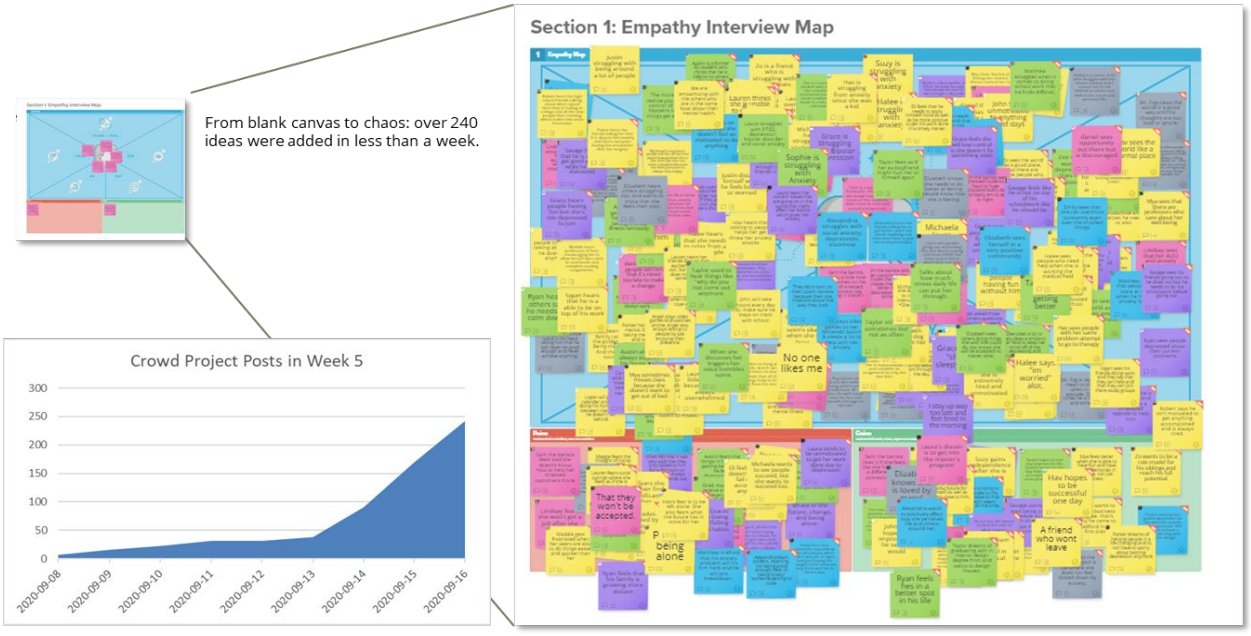


Figure 12: Week 5 Crowd Project Stormboard Insights from Empathy Interviews

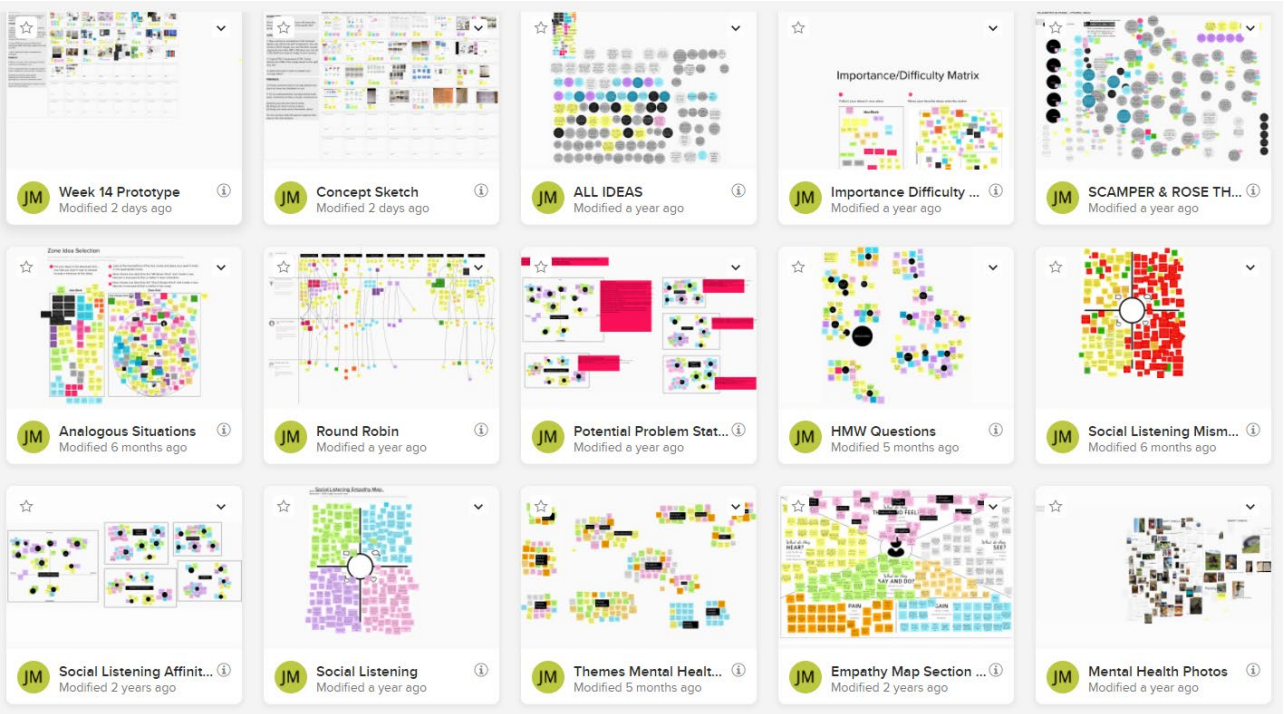


Figure 13: Mural Home Room of all Fall 2020 Crowd Project Murals

The experiment continued with students in the Crowd Project sharing ideas on Mural while students in the Group Project remained with Stormboard. Obviously this introduces a rather substantial confound in the experimental design. Should any changes emerge between the two conditions, it cannot be ruled out that they are due to the different platforms, rather than the structure of the project (Group or Crowd collaboration). Mural, for example, has many more templates that were used to help students better grasp design thinking methods. In hindsight, it would have been better to also move students in the Group condition to Mural as well. Three reasons prevented me from making this move at the time. First, the student groups had already become accustomed to having their own group Stormboard and going to the same location for each assignment.

Students in the Crowd condition were already used to visiting a new Stormboard for each assignment, so the change was less intimidating. Second, Mural's organizational structure would have required multiple "Rooms" to be set up (one for each group), which is problematic both from an administrative perspective but also because Mural limits the number of "Rooms" available under its free education plan.

Most importantly, however, was that Stormboard still had the key advantage over Mural in the comprehensive reports it produced to assist grading. Each week, I downloaded an Excel sheet from Stormboard that listed separately all ideas, comments, photos, and votes posted by each group member. These reports were used to quickly record grades in D2L, the Learning Management System at

Radford University. For example, if the assignment required a minimum of six photos to be posted, students only received full points for the Collaborate part of the weekly grade if they posted six photos. Points decreased commensurately. For example, if only three photos were posted, only half the points were awarded. Most weeks required participants to provide feedback on each other's posts as part of the assignment grade. This information was easily accessible in Stormboard's Excel report.

Calculating individual student participation in Mural, however, was far more time consuming. Mural is not designed for educational use and prioritizes anonymous collaboration options. As such, it does not provide any reports of participation. The only way to identify individual contributors is to click on a toolbar at the top that brings up all Activity on the board since it was created (see Figure 14). Then the instructor can scroll down the long list of activity and take note of who has participated that week.

Unfortunately, it allows anyone with access to the link (which was always posted on the LMS) to post on the board without registering. This caused some issues when the Crowd students first switched to Mural. As can be seen in the top panel of Figure 14, anonymous visitors are assigned a random name (e.g., Visiting Horse) and icon making it impossible to identify the post's author. As a short-term solution, I asked students to self-identify on the post. In later weeks, I asked students to create an account and to log in before posting, ensuring their names appeared on the Activity list (see lower panel). Participants received a different color circle with their initials, which helped speed up identification over time. The Activity panel does also differentiate between original ideas and comments.

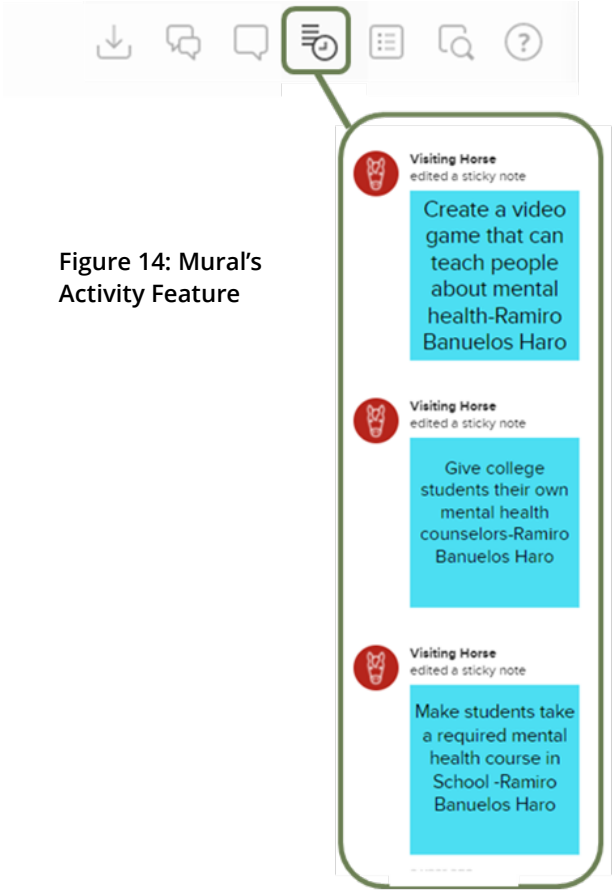
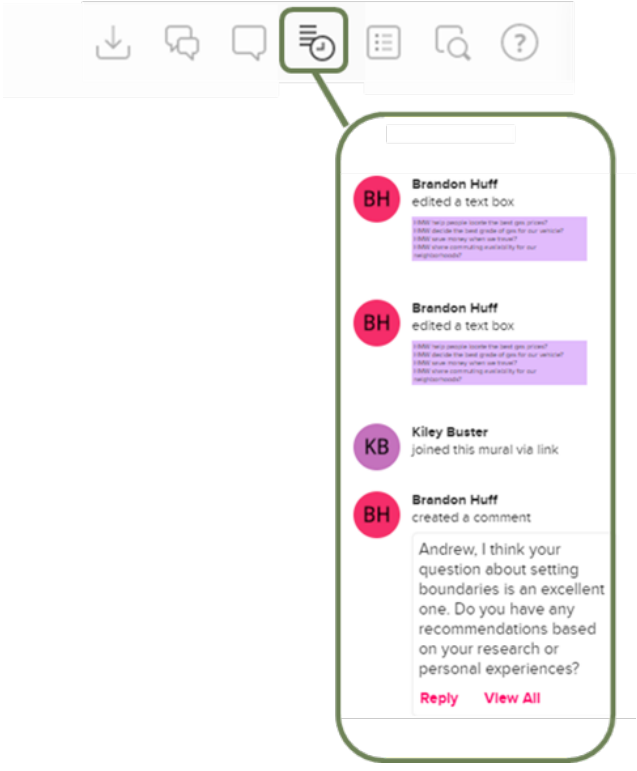


Figure 14: Mural's Activity Feature



EVALUATE

The goal of the Crowd Project was to improve student engagement and performance in a large creative problem-solving class, while minimizing faculty course management and grading burden. In this section, the two project conditions (Crowd and Group) are compared to determine how well they fared. Any significant differences will be discussed at the end.

Summary Statistics

Students were randomly assigned to one of the two conditions. A chi-square test of independence was performed to examine the relation between student demographics and condition. As expected, there was no significant relationship between any of the demographic characteristics and condition (all $p > 0.14$). Table 5 presents summary demographic statistics.

	Crowd	Group	TOTAL
	n = 39 (48.1%)	n = 42 (51.8%)	n = 81 (100%)
Gender	Percent	Percent	Percent
Female	38.5	45.2	42.0
Male	61.5	54.8	58.0
Major College	Percent	Percent	Percent
ACST	2.6	0.0	1.2
CEHD	7.7	7.14	7.4
CHBS	10.3	7.14	8.6
CVPA	2.6	0.0	1.2
DCOBE	66.7	78.6	72.8
Undecided	10.3	7.1	8.7
Race	Percent	Percent	Percent
Black	15.4	19.5	17.5
Hispanic	5.1	2.4	3.75
White	79.5	78.1	78.8
Academic Year	Percent	Percent	Percent
Freshman	20.5	41.5	31.3
Sophomore	41.0	26.8	18.8
Junior	17.9	19.5	16.3
Senior	21.5	12.2	33.8
Age	Mean	Mean	Mean
Average	19.7	19.5	19.6

Table 5: Summary Demographic Statistics

[2] Act assignments were graded by a graduate student blind to the experimental conditions.

Student Engagement

Student engagement was measured in multiple ways. First, time spent on the LMS was examined as a proxy for course participation. D2L provides data on the number of days students accessed the course website. There was no significant difference in the number of days students visited the LMS site, $t(80) = 0.58$, $p = 0.57$, between the Crowd ($M = 53.79$, $SD = 14.86$) and Group conditions ($M = 51.98$, $SD = 13.51$).

Quantity and quality of the collaboration posts is another way to measure student engagement with the process. A collaboration score was calculated by summing the weekly collaboration points earned over the semester. Collaboration points were awarded based simply on whether the student and contributed (15 points) and responded to another post (15 points). There was no assessment of contribution quality. An independent *t*-test finds a significant effect of project condition, $t(80) = 2.08$, $p = .04$, such that the collaboration score was significantly higher for students in the Crowd condition ($M = 322.46$ $SD = 98.67$) compared to students in the Group condition ($M = 275.05$, $SD = 102.99$), a small to medium effect size, $d = 0.31$, 95% CI [.14-.76].

Quality of participation in the weekly Act assignments is another way to understand student engagement with the course material[2]. An assignment quality score was calculated by summing all the Act points. An independent *t*-test finds a significant effect of project condition, $t(80) = 1.96$, $p = .05$, such that students in the Crowd condition performed significantly better on the individual assignments throughout the semester ($M = 567.62$, $SD = 118.87$) compared to students in the Group condition ($M = 509.83$, $SD = 145.41$); a medium effect size, $d = 0.43$, 95% CI [.01-.87].

Students completed a self-assessment of their proficiency with course and module learning objectives at the beginning and end of the semester. Competence on 20 learning objectives, such as "Define different approaches to creativity" and "Reframe a problem into an HMW question," was self-reported on a scale of 1 (extremely incompetent) to 7 (extremely competent). A change score was calculated for each learning objective by subtracting the pre-evaluation from the post evaluation. This controls for any potential differences in scores at the start of the semester and reports individual level changes in self-perceived competence.

A positive number indicates an improvement in self-reported proficiency with the learning objective. Average change scores were positive for both conditions on all items. The largest changes in perceived competence occurred for ideation and prototyping related learning objectives. Improvement in learning objectives was greatest for students in the Crowd Project overall, though not all individual items were statistically significant. See Table 6 for detailed presentation of means by condition. LO14 to LO16, concerning ideation techniques, were among the largest differences between the Crowd and Group project.

	Learning Objective	Crowd Change	Group Change	p value
LO1	Define different approaches to creativity	1.76 (0.29)	1.59 (0.30)	n.s.
LO2	Explain the value of creativity	1.52 (0.31)	0.80 (0.32)	0.11
LO3	Identify measures of individual creativity	1.89 (0.27)	1.21 (0.289)	0.08
LO4	Define mindsets critical to creativity	1.97 (0.30)	1.96 (0.32)	n.s.
LO5	Explain the design thinking process model	2.61 (0.30)	2.00 (0.31)	0.16
LO6	Recognize key design thinking principles	2.68 (0.27)	1.97 (0.27)	0.07
LO7	Implement the design thinking process	2.61 (0.32)	1.53 (0.34)	0.02
LO8	Design a plan to empathize with people	1.86 (0.32)	0.94 (0.33)	0.05
LO9	Design a plan to understand problem	1.34 (0.28)	0.88 (0.30)	n.s.
LO10	Design a plan to identify existing solutions	1.78 (0.29)	0.77 (0.30)	0.02
LO11	Summarize, evaluate & present data visually	1.43 (0.31)	0.76 (0.32)	0.14
LO12	Identify causes and consequences of problem	1.11 (0.30)	0.77 (0.31)	n.s.
LO13	Reframe problem into a HMW question	3.22 (0.34)	2.39 (0.6)	0.09
LO14	Describe at least one ideation technique	3.13 (0.34)	2.09 (0.36)	0.04
LO15	Implement at least one ideation technique	3.24 (0.32)	1.85 (0.33)	0.00
LO16	Identify methods to select the best ideas	1.97 (0.29)	1.05 (0.31)	0.03
LO17	Describe at least one prototyping technique	3.08 (0.32)	2.32 (0.34)	0.11
LO18	Implement at least one prototyping technique	2.62 (0.33)	2.21 (0.35)	n.s.
LO19	Describe value of collaboration to creativity	1.70 (0.32)	1.11 (0.32)	n.s.
LO20	Describe value of reflection to creativity	2.03 (0.32)	1.26 (0.33)	0.09

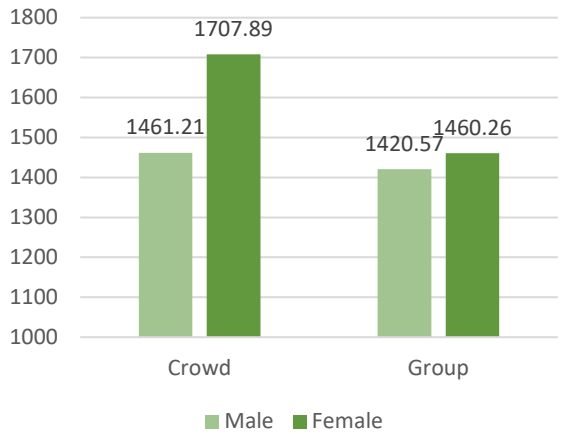
Average scores in green are significantly different at $p < 0.05$; (SD) in parentheses

Table 6: Means by Condition for Change in Learning Objective

Student Performance

Student performance was examined in multiple ways. First student performance on the final total score was estimated by condition. An independent one-sided *t*-test finds a marginally significant effect of project condition, *t*(80) = .59, *p* = .06, in the direction hypothesized: students in the Crowd condition scored significantly higher (*M* = 1556.09, *SD* = 301.28) compared to students from the Group Project (*M* = 1438.53, *SD* = 361.99) a small to medium effect size, *d* = .35, 95% CI [.08-.79]. Although a priori, I had not predicted any differences by gender, anecdotal evidence over the course of the semester led me to believe that women might prefer the Crowd Project format. A post-hoc two-way analysis of variance with gender (male or female) and condition (crowd or group) and their interaction as the predictor variables and final numerical score as the dependent variable revealed a marginally significant effect for condition, F(1,79) = 3.79, *p* = 0.06 and a marginally significant effect for gender, F(1,79) = 3.75, *p* = 0.06, such that female students scored higher (*M* = 1569.51, *SD* = 56.51) than male students (*M* = 1441.32, *SD* = 47.74). While the interaction did not reach significance (*p* = 0.17), directionally the pattern of means is interesting. A post hoc contrast comparing male and female scores within the Crowd condition is significant, F(1,77) = 5.25, *p* = 0.02.

Figure 15: Mean Final Numerical Score



Next, student performance in the each of the four module quizzes was estimated. Independent *t*-tests found no significant difference between conditions on Modules 1, 2, and 4 quiz scores, but did reveal a significant difference between Module 3 test scores (*t*(80) = 3.12, *p* < 0.01), such that students from the Crowd Project performed better (*M* = 79.89, *SD* = 8.86) compared to students from the Group Project (*M* = 65.47, *SD* = 28.53), a relatively large effect size, d = .67, 95% CI [.22-1.11}. Module 3 introduced three ideation techniques (Creative Matrix, Alternative Worlds, and SCAMPER) and methods to evaluate and select high potential ideas. This is consistent with the earlier finding that students in the Crowd condition reported increased efficacy with the learning objectives concerning ideation methods. Students in the Crowd condition appear to better understand ideation techniques in particular.

In addition to academic success, student performance can be assessed by changes in self-reported beliefs about their own creative capabilities. To assess this, the Creative Self Efficacy Inventory (Abbott, 2010) was administered to students at the beginning and at the end of the semester. The scale consists of 27 items that have been shown to measure creative self-efficacy. Each item is scored on a scale of 0 to 100 where 0 = not confident at all in their ability to perform the task described and 100 = highly confident. Confidence ratings are averaged to give a summary score. See Appendix G for the full battery of items included. A *t*-test on the change score from the beginning to the end of the semester revealed a significant effect of condition, t(80) = 2.23, p = 0.03, such that students in the Crowd condition experienced a greater increase in their pre-post confidence (*M* = 13.14, *SD* = 23.45) compared to those in the Group condition (*M* = 0.05, *SD* = 25.86), a medium effect size, d = .53, 95% CI [.06-1.00].

Evaluation of Solutions

The final way of evaluating student performance is to consider the quantity and quality of the solutions they generated. Since Mural does not provide a count of individual ideas by week, it was not possible to compare quantity of ideas generated by condition at an individual level. As a proxy, the total number of ideas generated per week in the Group and Crowd conditions was tabulated and analyzed. Table 7 provides the total unique posts (ideas and comments) written on each collaboration board by week. The total quantity of ideas is a sum of all posts over the semester in each condition. The average count divides this total by the average number of group members (in the Group condition) or the total number of students assigned to the Crowd condition. While it is not possible to run any statistical tests comparing the average or total quantity of ideas per semester because the data is aggregate, it is clear that students in the Crowd Project posted more ideas and comments both in total and on a per-student basis compared to students in the Group Project. This pattern is true for every week with the notable exception of 2 weeks in the problem understanding phase, when students in the Group Project posted more photos and HMW questions on their shared platform. This is likely because I provided a suggested number of photos and questions in the Crowd condition to manage the content effectively.

			Understand the Problem				Ideate Solutions				Prototype and Test	
	Average Quantity of Ideas	Total Quantity of Ideas	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
			Empathy	Photo	Social	HMW	Matrix	Alt Worlds	SCAMPER	Evaluate	Prototype 1	Prototype 2
Crowd	53.67	2093	230	193	230	175	283	278	222	164	148	170
Group	45.26	1728	159	370	131	329	221	138	202	36	88	54

Table 7: Count of All Posts (Ideas and Comments) by Week by Condition

All students produced two prototypes. The first, a simple Concept Poster, was used to gather feedback. Students then revised their prototype based on the feedback. Students were given flexibility when designing the second prototype depending on what their solution needed. Some students did a Cover Story Mock-Up while others did Storyboards of services or Schematic Diagrams of mobile applications. A dataset was created that categorized each prototype into one of four potential solutions: events, services, products, or mobile applications. A chi-square test of independence revealed a marginally significant difference between the type of prototype from the Crowd and those from the Group (ChiSq = 6.53, $p = 0.08$; see Figure 16). It is worth noting, however, that the Crowd project generated more prototypes overall because students in the Group condition were allowed at this point to combine ideas into one prototype and submit it as a team if they desired.

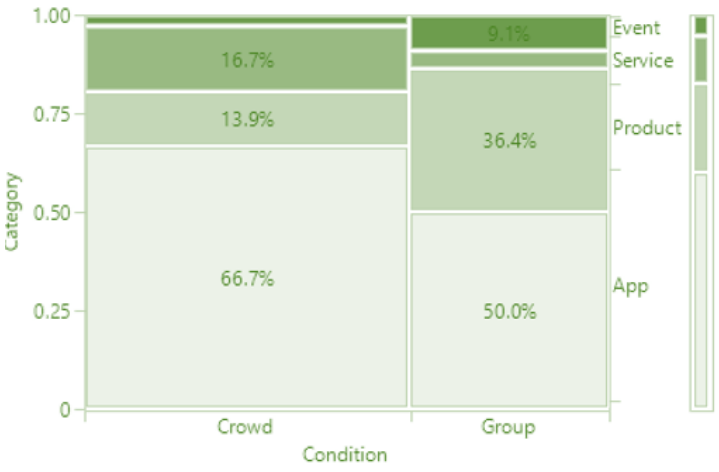


Figure 16: Prototype Category by Condition

To analyze final prototype quality, students in a subsequent section of MKTG 101 were asked to rate the prototypes on eight different criteria using a simple 5-star scale (see Appendix I). Students were blind to the experimental conditions. Two criteria addressed clarity of the problem to be solved and target audience. Two criteria focused on the quality of the prototype. The remaining four criteria assessed the novelty, desirability, feasibility, and viability of the proposed solution. Students were also asked to estimate how much they would be willing to pay to purchase the solution if it were produced. Directionally, the Crowd Project prototypes performed better on all rating categories, but not all differences were significant. Independent one-sided *t*-tests with each rating as the dependent variable and condition as the independent variable revealed a significant effect of condition for prototype design, and solution novelty, desirability, feasibility, and viability, each with medium to large effect sizes (see Table 8). Aside from willingness to pay, where the variance between responses was huge, all effect sizes are above .35.

	Problem Clarity	Audience Clarity	Prototype Design	Prototype Fidelity	Solution Novelty	Solution Desirability	Solution Feasibility	Solution Viability	WTP
Crowd	4.08 (1.11)	4.22 (1.12)	3.89 (1.16)	3.83 (1.32)	3.44 (1.23)	3.64 (1.13)	3.75 (1.11)	2.89 (1.55)	$4.49 (8.92)
Group	3.56 (1.47)	3.74 (1.55)	2.74 (1.41)	3.26 (1.43)	2.74 (1.54)	2.67 (1.28)	2.82 (1.52)	2.14 (1.36)	$4.42 (14.84)
t-test *p*	0.08	0.11	0.00	0.07	0.04	0.00	0.00	0.03	0.49
Cohen *d*	0.42	0.37	0.91	0.42	0.52	0.82	0.73	0.51	0.01

Average scores in green are significantly different at p < 0.05

Table 8: Average Rating of Prototypes by Condition

Faculty Burden

The final criteria to examine is the burden on faculty to grade and provide feedback on the assignments in the mass class. This analysis focuses only on the grading of the collaboration aspect of the project because all other assignments were identical between the two conditions. In lieu of hard data, I present a reflection of my experience during the semester. There is no doubt that grading the Group Project, which used Stormboard, took less time. Each week I downloaded the Excel sheet for each group and identified the new posts by sorting the columns according to recency and checked that each student in that group had contributed the minimum number of ideas and commented on at least one other post. This was extremely formulaic and could easily be automated or handled by a graduate teaching assistant. Transferring the grades to D2L took some time because the site had to be refreshed manually to enter data for each new group. The process could be made quicker if Stormboard allowed downloads of multiple boards with one click from the home page. Instead, it was necessary to enter each board separately and download the Excel sheet. Stormboard is not user friendly. Opening a new group storm requires going back to the home page. While other boards can be accessed from within a particular storm, they are ordered randomly and are difficult to scroll through. In total, I estimate that it took approximately one hour per week to record the Group collaboration posts.

By contrast, determining who had participated in the Mural board was far more labor intensive. As noted earlier, it was necessary to scroll through the (very long) Activity list to see who had posted. That said, it definitely became quicker with practice. I began to associate certain circle colors with the poster, making it possible to scan the Activity list for color patterns rather than individual names. As shown in Figure

14, comments appeared in the list in white, making it easy to identify whether someone had provided feedback in addition to making their own post. Some short cuts were possible. For example, clicking on the Members icon at the top of the Mural board showed students who were a member of the room but had never accessed the particular board being graded. I estimate it took about 2 hours to grade the Mural Crowd collaboration posts in the beginning, which reduced to about 90 minutes by the end of the semester. This is still 50% more time than with Stormboard.

Grading posts was not the only time intensive task in the Crowd Project, however. Once the Stormboard master template was set up, with directions for each week, I engaged very little with the group members within the board. In Mural, however, the sheer volume of posts required much more hand holding. I estimate I spent at least an hour each week helping to organize findings into themes so students did not get overwhelmed by the amount of information available to them. On the other hand, it was much easier to post photographs on Mural (they can be copied directly onto the whiteboard without embedding them in a sticky note, as is required in Stormboard). Mural also has many different templates that made setting the boards up in the first place extremely easy. Mural boards are infinitely extendable, meaning that I could organically grow the board as more posts were entered. Mural also has some automated sorting features that were helpful in quickly untangling overlapping posts. Moreover, the color of large groups of sticky notes can be changed with one click, helping with the organization (see Figure 17).

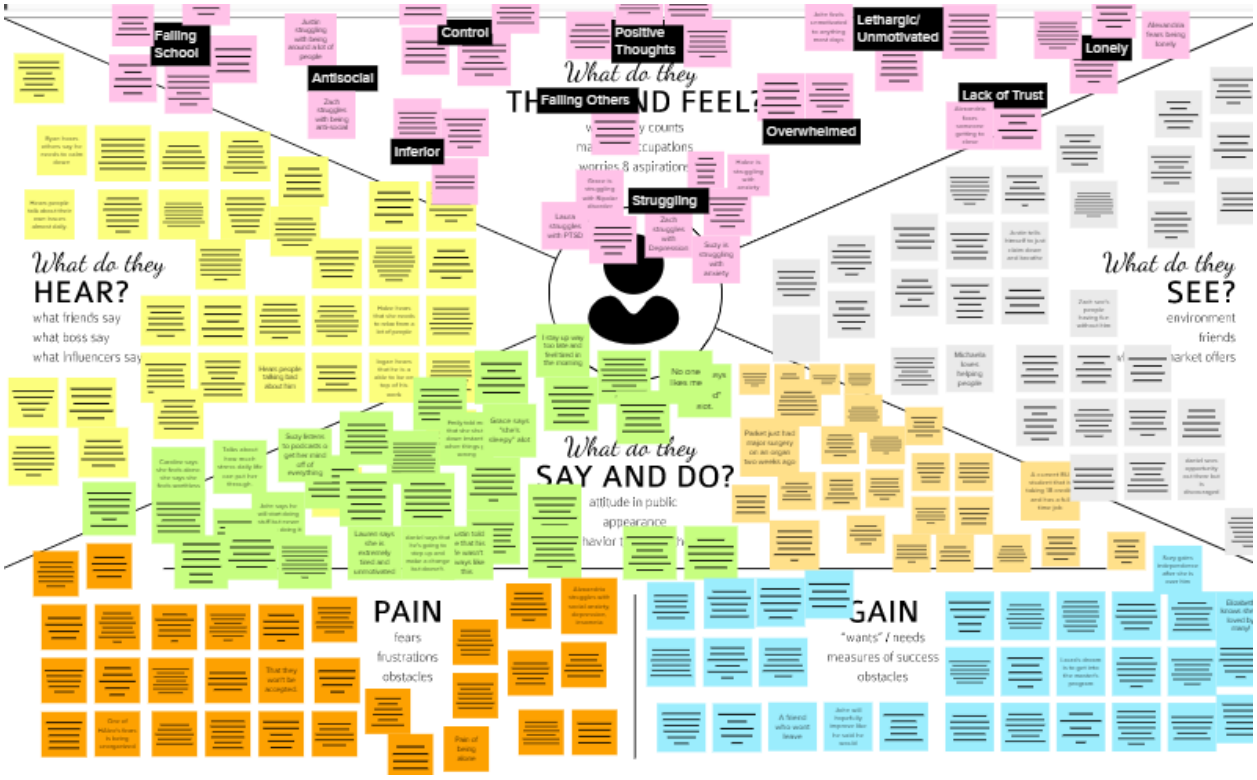


Figure 17: Example Mural Board

Summary

In this thesis, I report on the design, implementation, and evaluation of a novel assignment, called the Crowd Project, comparing it to a modified Group Project. On the positive side, the data paint a pretty clear picture that a Crowd Project, which capitalizes on the wisdom of the crowd while maintaining individual accountability, increased student engagement and performance. Students in the Crowd Project scored higher on both the collaborative and individual portions of the project. While all students saw increases in self-rated competence on each learning objective, students in the Crowd Project demonstrated a significantly higher increase on many, particular in the domain of ideation. Crowd Project participants' confidence in their creative problem-solving abilities increased significantly compared to their peers in the Group Project. Students in the Crowd Project generated a greater quantity of ideas in total, and more ideas per student, compared to those in the Group Project, while the prototypes produced by the Crowd Project participants were uniformly rated higher compared to those in the Group Project.

It is worth noting that this improved performance came when compared to a likely more effective Group Project, which still held individual students accountable, unlike typical team projects. One unexpected finding was the interaction between gender and condition. It seems that women might be more receptive to the Crowd Project, which was reflected in their significantly higher final grade. The Crowd Project, however, required greater faculty intervention and took more time to grade. Some faculty may consider this a small price to pay for improved performance, but the additional time and effort was not inconsequential. Of course, this was a quasi-experimental design and other things differed between the two conditions besides the collaborative project. Three alternative explanations stand out. First, each condition met in person on different days. The Group Project met in person on Mondays while the Crowd Project met in person on Wednesdays. It is possible that the different timing of the in-person class, and how it related to assignment due dates and recreational activities, may have influenced performance. Second, as noted in the Implementation section, the two conditions used different digital collaboration platforms. It is possible that there was something inherently more motivating about Mural (used in the Crowd Project) compared to Stormboard (used by the Group Project) that stimulated higher quality collaboration. Certainly, Mural has a more sophisticated interface, more templates, and a more intuitive user experience. Furthermore, students in the Group condition completed all their assignments on a single board, while the Crowd students accessed a new board for each weekly collaboration, though it is unclear which condition might be advantaged by this difference. Finally, instructor bias cannot be ruled out. It is possible that I taught more clearly on Wednesdays, having presented material already earlier in the week, though this seems unlikely because which group was "in the lead" varied each week depending on the speed with which we covered material in class. More likely is the simple fact that the instructor engaged more frequently with the Crowd Project. Having a visible presence inside the Mural collaboration boards could have been motivating to students in the Crowd Condition.

To address these limitations, the entire experiment was run again the following Spring with some changes, discussed next.


ITERATE

The revised project design aimed to unconfound the effects of collaboration style from alternative explanations. Specifically, if the degree of faculty involvement is driving differences in performance between the two conditions, then a third collaboration style – call it Group+ – that features an increased amount of faculty presence on the digital whiteboard should help the Group Project achieve the success of the Crowd Project. Importantly, Mural was still used for the Crowd Project and Stormboard was maintained for the Group+ Project. The Group+ section still met in person on Mondays and the Crowd section on Wednesdays. Thus, if Group Project performance improved with the increased faculty attention, it helps to rule out time of class meeting and collaboration board format as explanations for the success of the Crowd Project in the first semester. What does an increased faculty participation in the Group+ project look like? As described earlier, a greater instructor presence was required in the Crowd Project simply to prevent the large number of posts from overwhelming students. The main task was sorting posts into meaningful themes. For the Group+ Project then, everything remained the same, but I spent more time on each group's private Stormboard helping them recognize patterns in their data, especially in the first few weeks of the design thinking project. Figure 18, for example, shows a cluster from Fall 2020 where the posts remain in the original color-coded order in which the posters placed them (i.e., no thematic categorization between posters was conducted). In Spring 2021, I arranged the posts by themes, irrespective of the original poster.

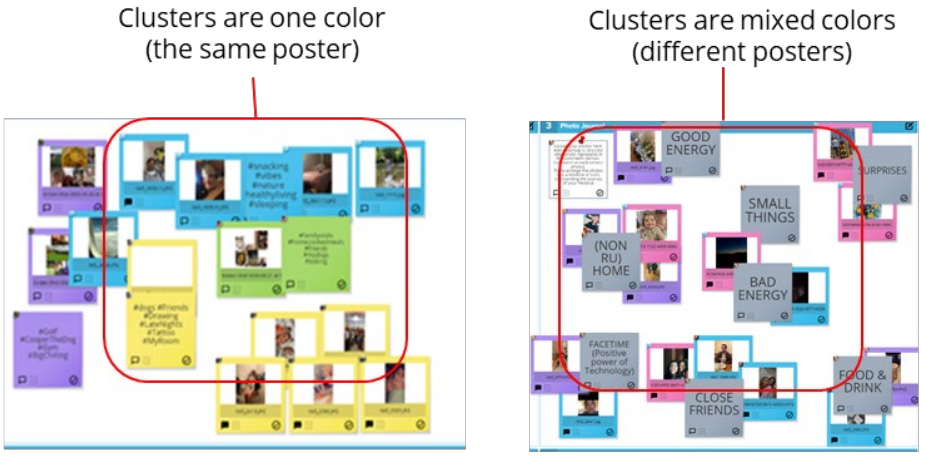


Figure 18:
Group Project clusters Fall 2020 versus Spring 2021

Some other changes were made to the overall course design that were not specific to either the Crowd or Group Project. For example, the staggered deadlines used in Fall 2020 were eliminated in favor of a simpler system with just one deadline each week for all material. The SCAMPER ideation session was eliminated because students found it difficult to apply when designing completely new products or services. Instead, a week on mental health was added earlier in the semester to help prime students about the topic and the variety of directions they could consider. A stakeholder mapping assignment was also introduced as the first task in the design thinking process, which helped to broaden students' perspectives about where solutions (or problems) might originate.

Evaluation

The evaluation of the revised project focused on understanding whether the Group+ Project increased student performance relative to the previous semester. To this end, two-way analysis of variance with Semester (Fall 2020 or Spring 2021) and Project (Crowd or Group) as the independent variables was conducted on all previously described dependent variables. Only statistically significant results are reported in the interests of brevity.

With regard to student engagement, student collaboration scores increased significantly in the Group+ project in Spring 2021 (see Figure 19), while student final numerical grades in the Group+ condition also increased significantly relative to Fall 2020 (see Figure 20). As shown in Table 9, the Group Project improved performance on almost all learning objectives, either bringing it into line with the Fall 2021 Crowd condition results or bettering them. There were no significant differences on any measure between the Crowd and Group+ Project conditions *within* Spring 2021. Contrasts between the Crowd conditions in each semester revealed no significant differences.

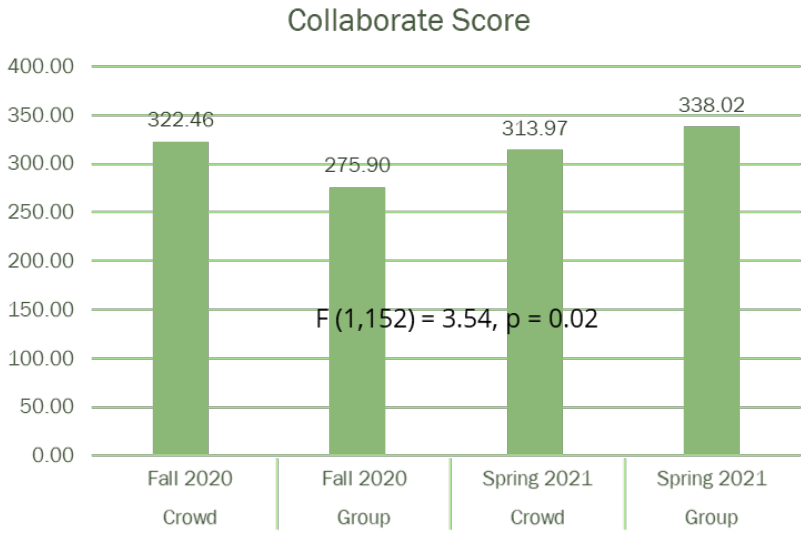


Figure 19: Collaborate Average Score by Semester and Condition

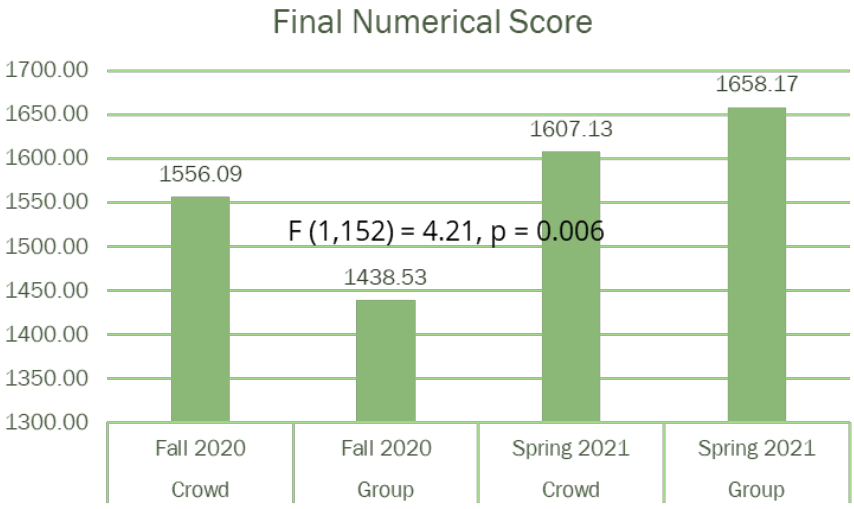


Figure 20: Final Numerical Average Score by Semester and Condition

Table 9 Learning Objective Change by Project and Year

	Learning Objective	Semester x Project Interaction p value	Fall 2020		Spring 2021	
			Crowd	Group	Crowd	Group+
LO1	Define different approaches to creativity	ns	1.76	1.59	1.29	1.73
LO2	Explain the value of creativity	0.07	1.53	0.80	1.07	1.54
LO3	Identify measures of individual creativity	0.02	1.89	1.21	1.04	1.79
LO4	Define mindsets critical to creativity	ns	1.74	1.97	1.44	1.67
LO5	Explain the design thinking process model	0.05	2.61	2.00	2.04	2.71
LO6	Recognize key design thinking principles	0.09	2.68	1.97	1.69	2.05
LO7	Implement the design thinking process	0.02	2.61	1.53	2.04	2.62
LO8	Design a plan to empathize with people	0	1.87	0.94	0.46	1.73
LO9	Design a plan to understand problem	0.05	1.34	0.88	0.44	1.12
LO10	Design a plan to identify existing solutions	0.03	1.78	0.77	0.96	1.24
LO11	Summarize, evaluate & present data visually	0.01	1.43	0.76	0.30	1.28
LO12	Identify causes and consequences of problem	0.15	1.11	0.77	0.59	1.20
LO13	Reframe problem into a HMW question	0.08	3.22	2.39	2.22	2.70
LO14	Describe at least one ideation technique	0.03	3.13	2.09	2.11	2.73
LO15	Implement at least one ideation technique	0.02	3.24	1.85	2.42	2.71
LO16	Identify methods to select the best ideas	0.02	1.97	1.06	1.22	1.78
LO17	Describe at least one prototyping technique	0.03	3.08	2.32	2.12	2.85
LO18	Implement at least one prototyping technique	0.07	2.62	2.21	2.04	2.80
LO19	Describe value of collaboration to creativity	0.01	1.70	1.11	0.67	1.85
LO20	Describe value of reflection to creativity	0.02	2.03	1.26	1.04	1.73

Finally, ANOVA with Project (Group or Crowd) and Semester (Fall or Spring) as the independent variables revealed a significant interaction effect of effect for prototype design, solution desirability, and viability demonstrating that students in the Group+ Project improved their solutions relative to Group participants in the Fall (see Figure 21). Contrasts between the two Crowd conditions in each semester revealed a significant difference on solution viability only, such that the solution viability in Spring 2021 in the Crowd condition decreased relative to the Fall 2020 Crowd condition. There was no significant difference between prototype design or solution desirability between the two Crowd conditions.

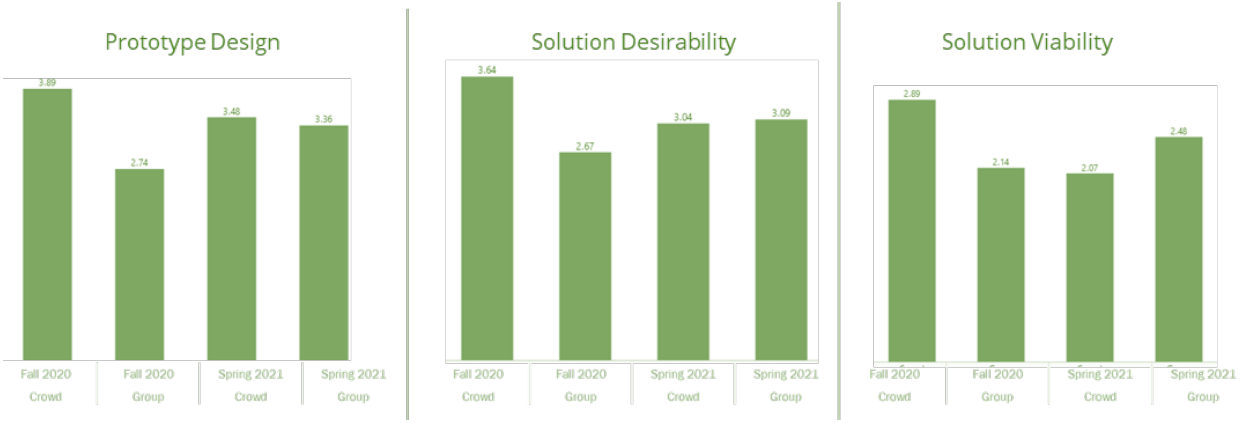


Figure 21: Average Prototype Evaluation by Semester and Condition

Summary

A generous interpretation of the new Group+ Project suggests that increasing faculty involvement in the group collaboration assignments to match that required in the Crowd assignment has the potential to increase student engagement, learning objective comprehension, solution design, and academic performance. Certainly, student scores in the revised Group Project were significantly better than in the earlier version, while scores in the Crowd condition did not change significantly between semesters. It is hard to claim, however, that this is solely because of the increased faculty effort. Many other changes occurred between the Fall 2020 and Spring 2021 semester that could have influenced student performance. COVID-19 cases peaked again in March 2021, though students had likely adjusted to living under pandemic conditions. The Spring semester sees many students graduating and in a different frame of mind. The weather brings promise of warm summer days. In short, it is near impossible to state that changes in the class project led to the dramatic increase in performance in the Group Project in Spring 2021.

On a more optimistic note, the data do support the conclusion that Stormboard itself is not to blame for the inferior performance of the Group Project in Fall 2020. This is encouraging because it suggests that Stormboard, with its easily digestible participation reports, is an adequate digital collaboration platform, at least for smaller groups. Similarly, since the Group students met in person on Mondays in both semesters, it is easier to rule out time of class meeting as an alternative explanation for the Fall 2020 Crowd Project superior performance. More generally, the results support the use of digital whiteboard software as a tool to manage group projects of any size and highlight how interactive stages of individual and group activities can minimize some of the downsides to implementing group projects in large classes.

DISCUSSION

Currently, educators view mass classes as an evil to be endured (Arias & Walker, 2004; Ballen et al., 2019; Becker & Powers, 2001; Diette & Raghav, 2015; Emerson et al., 2018; Gibbs et al., 1996; Johnson, 2010; Kara et al., 2020; Mandel & Süssmuth, 2011; Matta et al., 2015; Monks & Schmidt, 2011; Owuor, 2018; Paola & Scoppa, 2011; Saiz, 2014; Westerlund, 2007), requiring a switch to less effective pedagogical techniques that minimize instructor burden (Ake-Little et al., 2020; Arias & Walker, 2004; Cash et al., 2017; Kokkelenberg et al., 2008; Mathis, 2017; Taft et al., 2019). Drawing on crowdsourcing best practices, I set out to challenge that perception by redesigning an entry-level marketing course to capitalize on the potential collective wisdom within a large class. Mass classes are, effectively, crowds, and in industry, crowds are valued as an intelligent resource that can improve performance (Brabham, 2017; Cappa et al., 2019; Chawla et al., 2019; Hammon & Hippner, 2012; Howe, 2006; Lewicki, 2019; Pilloni, 2018; Richter, 2015; Vianna et al., 2020; Wilson et al., 2016). This research demonstrates that the same collaborative intelligence can be tapped to improve learning outcomes, creative confidence, academic performance, and the quantity and quality of creative ideas.

The findings in this research contribute to several academic literature streams. First, they support the burgeoning literature that suggests crowdsourcing can be an effective tool in industry to generate new product and service ideas (Al-Ghamdi et al., 2018; Castro, 2019; Chawla et al., 2019; Evans et al., 2016; Forbes & Schaefer, 2018; Geise, 2017; Mehtälä et al., 2016; Pohulak-Żołędowska, 2019; Richter, 2015). Students in the Crowd Project generated over 17% more new ideas on average compared to students in the Group Project. Perhaps more importantly, these ideas were rated as being more novel, desirable, feasible, and viable, all critical criteria for new product development success. Poor quality or hackneyed solutions, when presented to the crowd for assessment, were quickly voted down and not pursued further. The research also advances our understanding of how crowdsourcing can be used in academia. Current uses are limited to sharing information within and between students and educators (Llorente & Morant, 2015; Prpic et al., 2015). This research demonstrates the effective use of crowdsourcing to generate innovative solutions to wicked problems, such as student mental health.

Given the persistent growth in higher education class sizes, this research also identifies a potential route to implement project-based learning without overwhelming instructors. Thanks to the novel alternation between individual and collaborative phases, the project overcame many of the criticisms associated with traditional group projects, such as social loafing, inconsistent skill development, varying product quality, and the “divide and conquer” mentality (Lawrie et al., 2010; Le et al., 2018a; S. H. (Mark) Lee et al., 2016; Liu & Beaujean, 2017; McCorkle et al., 1999; Meyers, 1997; Tomcho & Foels, 2012). The project shifted learning from the instructor to the student, which may account for the performance gains. From an instructor perspective, the project all but eliminated student complaints about group member performance. The research also demonstrates the potential of collaboration for creativity. Not only were the final solutions in the Crowd Project rated as more creative (defined as novel and desirable) but these students improved their belief in their own creative potential. It is likely that being exposed to so many alternative inputs and ideas helped to expand their perspectives.

While the Crowd Project proved an effective alternative to the traditional group project in a mass class from a student learning perspective, it did not necessarily reduce the instructor burden. Disappointingly, depending on the collaboration platform used, grading may take even longer than individual written assignments.

New developments are needed in crowdsourcing platforms that bridge the gap between industry and academic needs. To not provide reporting functionality makes no sense and certainly limits broader adoption of certain platforms. OpenIDEO has a neat platform for collaborative innovation, but it is proprietary. HunchBuzz offered a similar solution, but early tests found it clunky and unintuitive to use. They also charge for use, though they were willing to negotiate free access in return for sharing and promotion of their platform. An alternative grading strategy would be to use crowdsource evaluation of student solutions, much as I asked students in a subsequent semester to evaluate the solutions generated in these two classes. The students in my current class actually found it invaluable to see the range of prototypes and adjusted their own expectations accordingly.

Future research should focus on understanding how exactly crowdsourcing improves individual performance. This research suggested that leadership (in the form of faculty intervention on the collaboration board) was critical for the success of any collaborative task, which has important implications for anyone seeking to crowdsource in the future. Future research could also examine how to best train students to collaborate effectively. In my classes, students sometimes did not want to share their ideas for fear of them being "stolen."

Despite the limitations of the Crowd Project, this research provides a clear solution to the traditional group project. Alternating between individual and collaborative assignments, irrespective of the size of the group the student is collaborating with, is beneficial for student learning and creative skill development.

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APPENDICES

Appendix A: IRB Letter of Approval

09-July-2020

RADFORD UNIVERSITY

Radford University's Institutional Review Board
P.O. Box 7015 Radford, VA 24142 | Phone: (540) 831-5290 | irb-iacuc@radford.edu

TO: Jane Machin, Ph.D.
RE: Initial Expedited Approval
STUDY TITLE: Teaching Creativity
IRB REFERENCE #: 2020-194 / FY20-123
SUBMISSION TYPE: Initial Submission ACTION: Approved
APPROVAL DATE: 09-July-2020

The above-referenced study has been approved by Radford University's Institutional Review Board (IRB). Please note that if your research includes stamped materials, they will be provided with this letter and must be used when conducting your research. A copy of your approved IRB protocol is available for your records in IRBManager under your dashboard of active protocols.

Your study has been approved under Expedited Category Expedited Category 7: Research is on individual or group characteristics of behavior (including, but not limited to research on perception, cognition, motivation, identity, communication, cultural beliefs or practices, and social behavior) or the research employs survey, interviews, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies).

Should you need to make changes in your protocol, you must submit a request for amendment for review and approval before implementing the changes. Amendments must be submitted via the IRBManager system. Please contact our office for assistance, if needed.

As the principal investigator for this project, you are ultimately responsible for ensuring that your study is conducted in an ethical manner. You are also responsible for filing all reports related to this project.

If you have any questions, please contact the Research Compliance Office at 540.831.5290 or irb-iacuc@radford.edu. Please include your study title and reference number in all correspondence with this office.

Anna Marie Lee

Good luck with this project!
Anna Marie Lee, MHA, CPIA Research Compliance Manager Radford University
Irb-iacuc@radford.edu
https://www.radford.edu/content/research-compliance/home.html

Appendix B: Consent Form for Interviews

Informed Consent Letter

Title: Teaching Creativity
Researcher(s): Jane E Machin,
PhD

I invite you to be in a research study designed to better understand ways of teaching creativity. If you decide to be in the study, you will be asked for permission to interview you regarding your experience designing and teaching classes, particularly online. The interview will take place via Zoom at a time of your choosing. The interview will take no longer than one hour. Information from this interview will be analyzed with a view to subsequent publication.

If you decide to be in this study, what you tell us will be kept private unless required by law to tell. If we present or publish the results of this study, your name will not be linked in any way to what we present. Your interview will not be recorded. Only notes will be taken by the Principal Investigator during the interview will be used. **Your comments during the interview will be scrubbed of all identifying details. Data will be reported at the aggregate level only. The data will be completely anonymous and confidential.**

There are no costs to you to participate in this study. There is no compensation for you to be in this research. This study has no more risk than you may find in daily life.

You can choose not to be in this study. If you decide to be in this study, you may choose not to answer certain questions or not to be in certain parts of this study. If you choose to stop the interview in the middle, notes on the information you already provided will be used. It is your choice whether or not to be in this study. What you choose will not affect any current or future relationship with Radford University.

If you do not wish to be in the study, or if at any time in the future you want to stop being in this study, you may stop without penalty or loss of benefits by contacting Dr. Jane Machin, Associate Professor Marketing, 540- 831-6402 or jmachin@radford.edu. If you have questions now about this study, please ask Dr. Jane Machin, Associate Professor Marketing, 540-831-6402 or jmachin@radford.edu.

This study has been approved by the Radford University Institutional Review Board for the Review of Human Subjects Research. If you have questions or concerns about your rights as a research subject or have complaints about this study, you should contact Ben Caldwell, Institutional Official and Dean of the College of Graduate Studies and Research, 540-831-5724.

Appendix C: Informed Consent Form for Course Participants

Informed Consent Letter

Title: Teaching Creativity
Researcher(s): Jane E Machin, PhD

I invite you to be in a research study designed to better understand ways of teaching creativity. If you decide to be in the study, you will be asked for permission to use the exercises and assignments you complete in MKTG 101: Creativity and Innovation for data analysis with a view to subsequent publication. Whether you consent to participate in this study or not will not be known until final grades have been recorded at the end of semester. All identifying data from the assignments will be removed prior to analysis (e.g. names, identification numbers).

If you choose to participate, you will complete exactly the same in class exercises and homework assignments as you are currently expected to compete as a regular part of the course. That is, **there will be no additional work involved over what you are required to complete already for this course!** The study will compare performance, including grades, on the assignments and exercises completed during an online versus face-to-face version of this course. **The goal is to better understand which assignments and exercises work best for improving creative ability in order to improve subsequent iterations of the class.** All students in MKTG 101: Marketing and Innovation are being offered the opportunity to participate in this research. **Participation in the study will have no influence on your grade in MKTG 101.** All data analysis will be conducted after the course is complete. The professor will have no knowledge of who signed this consent form until after final grades have been recorded.

If you decide to be in this study, what you tell us will be kept private unless required by law to tell. If we present or publish the results of this study, your name will not be linked in any way to what we present. **The exercises and assignments will be scrubbed of all identifying details. Data will be reported at the aggregate level only. The data will be completely anonymous and confidential.**

There are no costs to you to participate in this study. There is no compensation for you to be in this research. This study has no more risk than you may find in daily life.

You can choose not to be in this study. If you decide to be in this study, you may choose not to answer certain questions or not to be in certain parts of this study. If you choose to not participate in the study, you are still required to complete all the exercises and assignments that are a regular part of MKTG 101: Creativity and Innovation. Choosing to not participate means you do not give permission for your assignments to be used in further data analysis. It is your choice whether or not to be in this study. What you choose will not affect any current or future relationship with Radford University.

If you do not wish to be in the study, or if at any time in the future you want to stop being in this study, you may stop without penalty or loss of benefits by contacting Dr. Jane Machin, Associate Professor Marketing, 540-831-6402 or jmachin@radford.edu. If you have questions now about this study, please ask Dr. Jane Machin, Associate Professor Marketing, 540-831-6402 or jmachin@radford.edu. If you do not contact Dr. Jane Machin to notify that you do not wish to be included in the study, anonymized versions of the assignments you complete will be used for analysis after final grades have been recorded.

If this study raised some issues that you would like to discuss with a professional, you may contact Radford University Student Counseling Services at 540 831-5226

This study has been approved by the Radford University Institutional Review Board for the Review of Human Subjects Research. If you have questions or concerns about your rights as a research subject or have complaints about this study, you should contact Ben Caldwell, Institutional Official and Dean of the College of Graduate Studies and Research. Contact, 540-831-5724.

If you agree to participate in this study, please sign and date below. The signed forms will be collected by a graduate assistant not affiliated with the study and will remain locked in the graduate assistant's office until after final grades have been recorded.

Name:_____

Signature:_____

Date:_____

Appendix D Discussion Guide for Student Interviews

Thank you for agreeing to take part in this interview about MKTG 101: Creativity and Innovation. This will be a very open interview, guided by the responses you give to some broad questions I have. The interview should take no more than 1 hour. You are free to stop this interview at any point. You may also choose not to answer any questions.

- When did you take MKTG 101: Creativity and Innovation?
- Please describe your experiences in this class. Probe:
    - Teaching style
    - Learning objectives
    - Teaching tools (e.g. D2L, Stormboard etc)
    - Assessment techniques
    - Engagement with projects
    - Engagement in classroom
    - Engagement with peers
    - Group Projects (e.g. the innovation competition or dyslexia project)
    - Assignments (e.g. C2BC, Empathy Interview, Observation Exercise etc)
- Have you taken any courses online?
    - If yes, what worked and what did you dislike about those courses?

Appendix E: Discussion Guide for Expert Interviews

Thank you for agreeing to take part in this interview about online teaching practices. This will be a very open interview, guided by the response you give to some broad questions I have. The interview should take no more than one hour. You are free to stop this interview at any point. You may also choose not answer any questions.

- What is your background with regard to course development?
- What do you consider your area of expertise with regard to course development?
- What are key best practices in course development and online teaching, w.r.t:
    - Setting and aligning learning objectives?
    - Teaching tools (e.g. D2L)?
    - Teaching methods (e.g. asynchronous versus synchronous)?
    - Assessment techniques?
    - Collaborative learning?
    - Engagement of students?
    - Project based learning?
    - Creative problem solving?
- Are there any other tips you would like to share about course development?

Appendix F: Discussion Board Prompts

Week 1 Introduction Define creativity using 6 words, without using "novel" or "innovative" or "new" or "creative." What are different types of creativity? What do you hope to achieve in this class?
Week 2 Value Why do you need creativity? Why do companies value creativity? What are the benefits of creativity to organizations? What are downsides to creativity?
Week 3 Mindsets [After completing the mindset quizzes] What surprised you the most with your scores? Which scores do you believe captured and did NOT capture you accurately and why? What area(s) do you think you need to work on to become better at creativity? Describe one concrete activity you can do to work on this area(s).
Week 4 Design Thinking What are the steps of the design thinking process? What do you think about design thinking process? What areas are you worried or excited about?
Week 5 Practice Design Thinking Exercise What did you think of the wallet exercise? How did your designs differ from the beginning to the end? What do you believe contributed to the design changes?
Week 6 Finding Opportunities 1 What daily nuisances did you identify? Do you think now that this is a business opportunity? Using the design thinking process, what do you think your next steps should be?
Week 7 Understanding Problems What do you think about the design tools (e.g. empathy map and empathy interview and observation) that we used this week? What did you learn that was unexpected?
Week 8 Understanding Problems 2 What do you think about the design tools (e.g. empathy map and empathy interview and observation) that we used this week? What did you learn that was unexpected?
Week 9 Framing Problems How did the exercises this week help you think about your problem differently? What is the HMW problem you are now focusing on? How does this problem differ from where you started at the beginning of the semester?

Appendix G: Creative Personality and Self Efficacy tests

Creative Self-Efficacy Inventory

(Adapted from Abbott, 2010)

The attached form lists different activities. Rate how confident you are that you can do them as of now. Rate your degree of confidence by recording a number from 0 to 100.
0 means Not at All Confident. 100 Means highly certain that you can do the task.

- ☐ Get a large number of different ideas or responses?
- ☐ Come up with many possible solutions to a situation.
- ☐ Arrive at a variety of conclusions given a difficult situation.
- ☐ Think of many answers to a difficult problem or situation.
- ☐ Come up with different kinds of responses, not just different responses?
- ☐ Answer problems in different ways, each of which are unique and special?
- ☐ Think of many types of ideas while considering a problem?
- ☐ Answer problems in different forms or styles?
- ☐ Think of ways to defend a 'crazy' thought, by thinking back on what you already know?.
- □ Talk to your friends about wild ideas, and make them sound reasonable? .
- ☐ Tell stories based on dreams you had, even if you need to fill in answers?
- ☐ Connect day-dreams or new ideas to things you have already learned? .
- ☐ Be the first in a group to come up with an original suggestion?
- ☐ Arrive at a novel solution before other people?
- ☐ Beat other people in imagining a brand new idea first?
- ☐ Think of ideas no one else has?
- ☐ Make sense of something you want to learn to do?
- ☐ Start to learn to do something, even if there are obstacles to doing so?
- ☐ Teach yourself how to do something new?
- □ Create a novelty that people will choose, over other novelties available?
- □ Find an audience that is well-connected to others in society?
- ☐ Network with people to convince them that what you made is the best?
- ☐ Convince others that you have made a valuable contribution?
- ☐ Be motivated to come up with new ideas?
- ☐ Have fun coming up with new ideas, after having learned from others?
- ☐ Wake up feeling like you can come up with new ideas if you want to?
- ☐ Sustain wonder about something, even after working with it for years or decades?

Appendix H: Marketing Creativity and Innovation Syllabus

MKTG 101: Creativity and Innovation
Fall 2020 Course Syllabus

Section 2 (Meets in person Mondays)

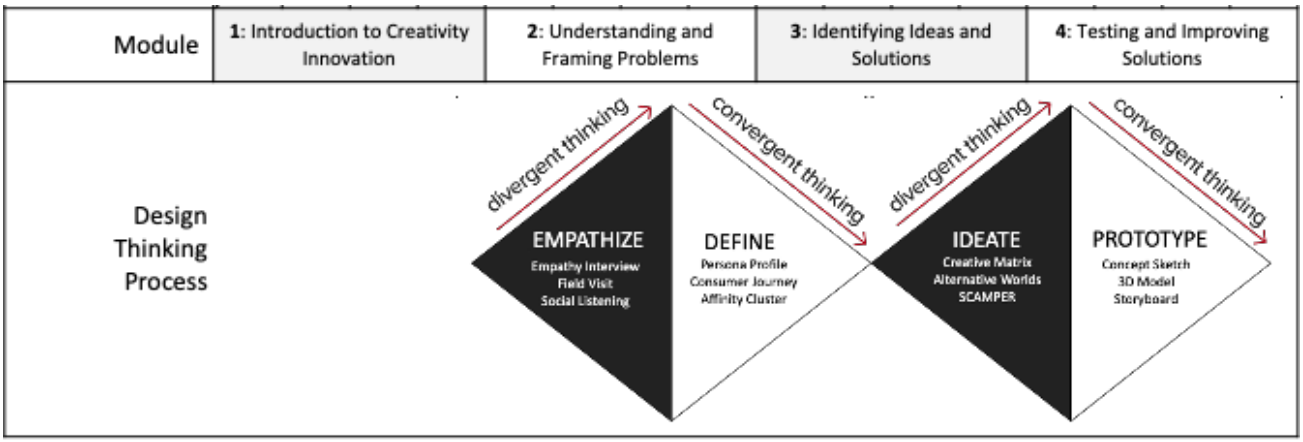
Professor	**Dr. Jane Machin**
Title	Associate Professor of Marketing
Telephone	831-6402
Office	Davis College, Room 386
Email	jmachin@radford.edu *Put **class, section** & **problem** in **subject line**. Please **address me properly** and be **courteous**. Sign with **your full name.** Your identity is often unclear from the email address*
Office Hours	Mondays 10 am to 1 pm **or** by appointment
Section	2
Class Room	KH 340
Class Format	Hybrid: Meets in person 2pm Mondays. Remaining class is asynchronous online
D2L	MKTG 101 Fall 2020
Textbook	*Innovating for People*, Luma Institute (Recommended but not required) Note: If you have *Kindle Unlimited* membership, this book is free to borrow.

Creativity is a <u>practice</u>.
You <u>can</u> be creative.
Business <u>needs</u> to be creative.

Imagine you want to learn how to play the piano. You cannot play right now, but you know that you can hire a piano teacher and, following a structured process, learn to play. At first, it might feel uncomfortable, awkward or frustrating. You may feel like you will never master it. But with regular practice and the right mindset, your piano playing skills will improve. Creativity is also a skill and, with time and practice you can become proficient in this skill. Through instructor presentations, guest lectures, active dialogue, small group work, observing, diagramming, sketching, photography and video you will exercise your creative muscles. You should finish this class feeling more confident in your ability to develop innovative solutions to any problem you encounter – personal or business. Because at the end of the day, creativity is about problem solving and there is not a job in the world today that does not require problem solving. In this syllabus you will find detailed explanations of the following. Please read carefully!

- Learning Objectives
- Assignments & Grading
- Course Policies

Semester at a Glance



		Day	Date	Topic	Task
Module 1: Introduction to Creativity Innovation	1	Wed*	8/12*	Course Structure	1. Syllabus Quiz
	2	Mon	8/17	Basic Concepts	2. Introductory Survey
	3	Mon	8/24	The Creative Person	3. Personality Quizzes
	4	Mon	8/31	The Creative Process	4. Wallet Design
Module 2: Understanding and Framing Problems	5	Mon	9/7	Knowing People: Empathy	5. Persona Profile
	6	Mon	9/14	Knowing Processes: Field Visit	6. Consumer Journey
	7	Mon	9/21	Knowing Products	7. Affinity Cluster
	8	Mon	9/28	(Re)Framing Problems	8. HMW Questions
Module 3: Identifying Ideas and Solutions	9	Mon	10/5	Ideation: Creative Matrix	9. Creative Matrix
	10	Mon	10/12	Ideation: Alternative Worlds	10. Alternative Worlds
	11	Mon	10/19	Ideation: SCAMPER	11. SCAMPER
	12	Mon	10/26	Idea Selection	12. Feasibility Grid
Module 4: Testing and Improving Solutions	13	Mon	11/2	Prototyping: Concept Sketch	13. Concept Sketch
	14	Mon	11/9	3D Models & Storyboards	14. 3D Model or Storyboard
	15	Mon*	11/16*	Review Session	
		Wed	11/18	Exam	Online at Home

Learning Objectives and Outcomes

This course is broken into four modules. Modules 2-4 teach you the design thinking process as a way to creatively solve problems.

Module 1:	Introduces you to basic concepts of creativity and innovation and different ways of thinking about these concepts.
Module 2:	Exposes you to techniques to understand and empathize with the people and environment surrounding the problem. You will also learn ways to report findings.
Module 3	Teaches you idea generation techniques to help you create solutions to your problem, as well as ways to evaluate and improve those ideas.
Module 4:	Prepares you to produce low fidelity prototypes of your different types of solutions (apps, physical products and experiences) to share and improve.

The next few pages **detail the learning outcomes you should be able to do at the end of each week** within each module after listening to the lecture and completing the homework assignments. **Keep track of your progress** and make sure you understand the learning outcomes at the end of each week. If you are unsure you can answer all the learning outcomes at the end of the week then that is a signal that you need to ask for help!

At the end of all the modules you will be able to:

- Define different approaches to creativity and innovation
- Explain the value of creativity to individual, business and society
- Identify measures of individual creativity
- Define mindset critical to creative problem solving
- Identify, define and apply design thinking as a creative process
- Identify, describe and apply techniques to understand and frame problems
- Identify, describe and apply techniques to generate novel solutions to problems
- Identify, describe and build prototypes to test and improve novel solutions

You have an activity due each week. In modules 2-4 these are all design thinking activities. I strongly urge you to keep all your work in a folder which can become a portfolio to be used in interviews demonstrating that you implement the design thinking process.

Module 1: Introduction to Creativity and Innovation

Can you check all learning outcome boxes at the end of this section?

Learning Objectives		Learning Outcomes At the end of each week you should be able to:
Creativity and innovation	Define different approaches to creativity and innovation	☐ Summarize different approaches to creativity ☐ Compare Big C, Pro C and Little C creativity & innovation ☐ Explain importance of collaboration to creativity ☐ Relate value of reflection to creative problem solving
	Explain the value of creativity	☐ Describe value of creativity to individual ☐ Describe value of creativity to business ☐ Describe value of creativity to society and economy ☐ Relate to personal beliefs about creativity value
The Creative Person	Identify measures of individual creativity	☐ Describe different tests of creative ability ☐ Compare pros and cons of tests of creative ability ☐ Describe tests of creative personality and beliefs ☐ Evaluate own personal creative potential beliefs
	Define mindsets critical to creative problem solving	☐ Explain mindsets critical for creative problem solving ☐ Explain mindsets that act as barriers to creativity ☐ Appraise own performance on mindsets ☐ Develop action plans to improve mindsets
The Creative Process	Explain the design thinking process model	☐ Identify design thinking as a model of problem solving ☐ Describe the stages of design thinking process ☐ Recall use & value of design thinking in industry ☐ Recognize history and potential of design thinking method
	Recognize key design thinking principles	☐ Define human-centered design philosophy ☐ Explain action-oriented, visual and rapid prototyping ☐ Contrast desirability, feasibility and viability ☐ Compare divergent and convergent thinking

Module 2: Understanding and Framing Problems

Can you check all learning outcome boxes at the end of this section?

Learning Objectives		Learning Outcomes At the end of this week you should be able to:
Knowing People	Design a plan to empathize with people in the problem	☐ Explain importance of empathy ☐ Identify research methods to understand people ☐ Evaluate research methods to understand people ☐ Implement Empathy Interview to understand people
	Summarize, evaluate & present data visually	☐ Develop questions to interpret data gathered ☐ Identify key insights from data gathered ☐ Categorize data gathered into themes or clusters ☐ Present findings in visual format (persona profile)
Knowing Processes	Design a plan to understand problem process & context	☐ Explain importance of understanding problem context ☐ Identify research methods to understand context ☐ Evaluate research methods to understand context ☐ Implement field visit to understand context
	Summarize, evaluate & present data visually	☐ Develop questions to interpret data gathered ☐ Identify key insights from data gathered ☐ Categorize data gathered into themes or clusters ☐ Present findings in visual format (consumer journey)
Knowing Products	Design a plan to identify existing solutions	☐ Explain importance of understanding existing solutions ☐ Identify research methods to find existing solutions ☐ Evaluate research methods to identify existing solutions ☐ Implement social listening to identify existing solutions
	Summarize, evaluate & present data visually	☐ Develop questions to interpret data gathered ☐ Identify key insights from data gathered ☐ Categorize data gathered into themes or clusters ☐ Present findings in visual format (evaluation grid)
(Re)Framing Problems	Identify causes and consequences of problem	☐ Define from own research a problem that needs solving ☐ Describe importance of reframing problems ☐ Identify tools to reframe problems ☐ Apply fishbone tool to reframe your problem
	Reframe problem into a Cinderella HMW question	☐ Define HMW question ☐ Explain characteristics of good HMW questions ☐ Write your problem in HMW statements ☐ Evaluate and select best HMW to focus on

Module 3: Identifying Ideas and Solutions

Can you check all learning outcome boxes at the end of this section?

Learning Objectives		Learning Outcomes At the end of this week you should be able to:
Ideation Technique: Creative Matrix	Describe Creative Matrix as an ideation technique.	☐ Explain key constructs in this ideation tool ☐ Summarize how to conduct this ideation tool ☐ Explain pros and cons of this ideation tool ☐ Critique this ideation tool
	Implement Creative Matrix as an ideation technique	☐ Apply this ideation tool to generate novel ideas to problem ☐ Apply technique to extend idea generation (round robin) ☐ Apply tool to evaluate the ideas generated ☐ Reflect on value of using this ideation tool
Ideation Technique: Alternative Worlds	Describe Alternative Worlds ideation technique	☐ Explain key constructs in this ideation tool ☐ Summarize how to conduct this ideation tool ☐ Explain pros and cons of this ideation tool ☐ Critique this ideation tool
	Implement Alternative Worlds ideation technique	☐ Apply this ideation tool to generate novel ideas to problem ☐ Apply technique to extend idea generation (dot voting) ☐ Apply tool to evaluate the ideas generated ☐ Reflect on value of using this ideation tool
Ideation Technique: SCAMPER	Describe SCAMPER as an ideation technique.	☐ Explain key constructs in this ideation tool ☐ Summarize how to conduct this ideation tool ☐ Explain pros and cons of this ideation tool ☐ Critique this ideation tool
	Implement SCAMPER as an ideation technique	☐ Apply this ideation tool to generate novel ideas to problem ☐ Apply technique to extend idea generation (RTB) ☐ Apply tool to evaluate the ideas generated ☐ Reflect on value of using this ideation tool
Selecting Ideas	Identify methods to select high potential ideas	☐ Identify different methods to select high potential ideas ☐ Describe how these idea selection methods work ☐ Describe pros and cons of different methods to select ideas ☐ Reflect on pros and cons of different idea selection tools
	Implement a Feasibility/Desirability Grid	☐ Apply this tool to evaluate feasibility of all ideas ☐ Apply this tool to evaluate desirability of all ideas ☐ Identify high potential ideas ☐ Reflect on value of using this ideation tool

Module 4: Testing and Improving Solutions

Can you check all learning outcome boxes at the end of this section?

Learning Objectives		Learning Outcomes At the end of this week you should be able to:
Prototyping: Concept Sketch	Design Concept Sketch	☐ Describe what a concept sketch is and appropriate use ☐ Describe key elements of a concept sketch ☐ Design a new concept sketch ☐ Critique the concept sketch prototyping technique
	Evaluate Concept Sketch	☐ Critique ideas presented on a concept sketch (RTB) ☐ Receive feedback on own concept sketch ☐ Evaluate feedback given on own concept sketch ☐ Improve prototype on basis of feedback
Prototyping: 3D Model	Design 3D Model	☐ Describe what a 3D Model is and appropriate use ☐ Describe key elements of a 3D Model ☐ Design a new 3D Model ☐ Critique a 3D Model prototyping technique
	Evaluate 3D Model	☐ Critique ideas presented on a 3D Model ☐ Receive feedback on own 3D Model ☐ Evaluate feedback given on own 3D Model ☐ Improve prototype on basis of feedback
Prototyping: Experience Storyboard	Design Experience Storyboard	☐ Describe what a concept poster is and appropriate use ☐ Describe key elements of a Experience Storyboard ☐ Design a new Experience Storyboard ☐ Critique a Experience Storyboard prototyping technique
	Evaluate Experience Storyboard	☐ Critique ideas presented on a Experience Storyboard ☐ Receive feedback on own Experience Storyboard ☐ Evaluate feedback given on own Experience Storyboard ☐ Improve prototype on basis of feedback

Assignments and Grading

This class is about learning **the process** of creative problem solving. Emphasis on process. If you understand the creative problem-solving process you will be able to apply it to any future problems you face. Mastery of the process is more important than any single solution or idea you may generate. For this reason, I grade your understanding of the process. I want to see your work, in other words, not just the final output! **Keep detailed records of everything that you do and take photographs of your work.**

Weekly Assignments

There is an assignment due every week. For each assignment you will go through **five stages: (1) Understand, (2) Plan, (3) Act, (4) Collaborate and (5) Reflect**. Research shows that following these stages is the best path to mastery of this material**.** Allow the appropriate amount of time for each assignment (see table). Radford University uses the Carnegie unit to measure semester credit hours awarded to students for course work. A semester credit hour is measured by the number of hours of academic engagement and preparation. For a 3-credit class that means you are expected to engage in **3 hours instruction** and **6 hours of homework every week** or approximately **9 hours of work per week (including the weekly lecture**).

Stage	1. Understand	2. Plan	3. Act	4. Collaborate	5. Reflect
Action	Attend lecture and take notes	Read material and ask questions	Implement directions	Post and discuss output of action	Reflect on action
Format					
Type	Individual	Individual	Individual	Collaborative	Individual
Location	Kyle 340	D2L DESIRE2LEARN Content	D2L DESIRE2LEARN Assignments	Stormboard	D2L DESIRE2LEARN Discussions
Deadline	2 pm Monday	Midnight Wednesday	Midnight Friday	Midnight Sunday	Midnight Sunday
Validation	Attendance register & class participation	Digital record of access & time spent	Upload process documentation	Digital record of collaboration	Post responses on discussion board
Time	**75-min in person**	**105-min asynchronous**	**240-min action**	**90-min online**	**30-min online**
	3-hours of instruction each week		**6-hours of homework each week**		

There are **100 points available each week** for completing the creative problem-solving process task elements for that week. The points are distributed across the five stages according to the amount of work they are expected to take. **You will upload process documentation and be graded on the depth and breadth of stage completion of the stage**. Please note the allocation of points and you're your time accordingly for each assignment. The collaborative phase allows you to learn from and teach your peers which improves your own understanding of material. **Note that while there are not many points allocated to Understand and Plan phases, participation in these is critical to success in the later phases!** Skipping a stage will hurt your grade. The assignments take time and cannot be left to the last minute. To ensure you succeed on the assignments, dates are given for completion of each stage of the assignment. **To get the full points for the assignment you need to complete each stage by the given deadline**. If you miss a deadline, you can still continue and complete the final project and get credit for the remaining stages, so long as they are completed by the given deadline. You will not get credit for stages whose deadline you miss. **The last opportunity to submit the work is midnight on the Tuesday before the next class.**

Stage	1. Understand	2. Plan	3. Act	4. Collaborate	5. Reflect
Action	Attend lecture and take notes	Read online material	Implement directions	Post and discuss results	Reflect on task
Validation	Attendance	Digital record of access	Upload process documentation	Digital record of collaboration	Discussion board content
Deadline	2 pm Mon	Midnight Wed	Midnight Fri	Midnight Sun	Midnight Sun
Points (100 total)	**5**	**5**	**50**	**30**	**10**

Module Review

At the end of each of the four modules there will be a short review quiz online to ensure you comprehend the concepts covered. These are open note. My goal is to identify any areas I need to go over again. There are 100 points available to be earned for each module review quiz.

Exam

The final exam takes place in the last week of the semester and will be online. It will consist of questions about creativity processes, aptitudes, attitudes and behavior. It will be open note. There are 200 points to be earned in the final exam.

Final Grade

	Points	Quantity	Total			Letter Grade
Weekly Task	100	14	1,400		1,800+	A
Module Review	100	4	400		1,600+	B
Final Exam	200	1	200		1,400+	C

Possible Total Points	**2,000**		1,200+	D

Course Policies

COVID-19 Statement

Students are expected to complete the University's Daily Symptom Tracker, available on RU Mobile and the MyRU Portal. Under Governor Northam's Executive Order 63 and Radford University's Fall 2020 Campus Reopening Plan, all campus community members are **required to wear a face mask or covering** when in this class. **Students not wearing a mask in class will be asked to leave**. Students who have concerns or questions about the masking requirement should contact Dr James Lollar, Chair of the Marketing Department or Dr. Joy Bhadury, Dean of the Davis College of Business and Economics. Those who do not wear face masks/coverings may face disciplinary action.

It is my expectation that you **attend the in-person portion of this class**, unless you have made alternative arrangements with me prior to the start of class due to illness, medical reasons, or the need to isolate or quarantine due to COVID-19. Many of the topics and content explored in the course will be taught and communicated via class demonstrations, activities, and discussions. Therefore, attendance and participation are crucial for a complete understanding of course material.

In the event that you find yourself experiencing COVID-19 related symptoms, please stay home and follow university guidelines. When you report your symptoms into the COVID-19 Daily Symptom Tracker you will receive an email. **Forward me this email for an excused in-class absence. It is my expectation that you will also contact me to review missed assignments and arrange a timeline and plan for completing that work**. In the case that you are not able to make up missed coursework by the end of the semester, we will need to consider options that may include a medical withdrawal or incomplete for the semester. Be assured that I will do what I can to work with you to facilitate your successful completion of this course. I encourage you to contact me if you have questions or concerns. The Dean of Students Office is also available for assistance regarding extended absences (dos-web@radford.edu, 540-832-6297, www.radford.edu/dos).

Academic Integrity

The Radford University Honor Pledge provides the foundation for a university community in which freedom, trust and respect can prevail. In accepting admission to Radford University, each student makes a commitment to support and uphold the Honor Pledge without compromise or exception. **Anyone violating the Honor Pledge will receive an F in the course, and will be turned in to the student conduct office**. For more information you are referred to https://www.radford.edu/content/sga/home/HonorCode.html

Radford University Honor Pledge

I shall uphold the values and ideals of Radford University by engaging in responsible behavior and striving always to be accountable for my actions while holding myself and others to the highest moral and ethical standards of academic integrity and good citizenship as defined in the Standards of Student Conduct. The following behaviors are prohibited: **lying stealing/possessing unauthorized material, cheating, fabrication and falsification, multiple submissions, abuse of academic materials, complicity in academic dishonesty and plagiarism**.

Inclusive Learning

In this class, ensuring that students from diverse backgrounds and learning abilities are able to contribute, learn, grow, and succeed is my highest priority. I commit to offering learning materials and activities that express, and are respectful of diversity, and in which all students can see themselves in our field. Your suggestions are encouraged and appreciated. Sexual, racial or any other type of harassment **will not be tolerated inside my classroom nor during assigned activities.** If you think you are encountering this problem, please inform me, or the Marketing Department Chair, Dr James Lollar, or the RU EEO/Affirmative Action Office. http://www.radford.edu/persweb/ourstaff.htm. **If you engage in harassing behavior, whether in person, via text, email or phone, you will receive an F for this class.**

Accessibility Services

If you are a student with special needs or circumstances, I invite you to contact me early in the course so appropriate supports and scheduling can be addressed. *Students seeking academic accommodations under the Americans with Disabilities Act must register with Radford University's Center for Accessibility Services (CAS).* The policies regarding students with disabilities may be found at http://www.radford.edu/content/cas/home.html. You may also contact the CAS office at: 540-831-6350; ASL users 540-922-1176; email cas@radford.edu; or visit the website www.radford.edu/cas.

Academic Support

RU students have access to a wide range of free academic support services, including subject tutoring and writing assistance. The Harvey Knowledge Center is a Radford University resource to explore class content, learn new skills, prepare for your exams, or receive individualized academic coaching. In the HKC you can:

- Work with an academic coach to discuss course content, study strategies, or college success skills
- Get your classmates together and form an online facilitated study group
- Reserve a single-use room for Zoom coaching or for working on your online class
- Access tips and guides for taking your learning to the next level

For more information, either call 540-831-7704, email at: hkc@radford.edu, or visit the website https://www.radford.edu/content/harvey-knowledge-center/home.html These services can be scheduled through the Starfish app inside the My RU portal.

Technology Support:

The Technology Assistance Center provides a number of options for students to find answers to common questions and request assistance.

- Find common answers or submit an online support request: www.radford.edu/itonestop
- Phone Support: (540) 831-7500; Monday - Thursday 8 a.m. – Midnight, Friday 8 a.m. - 5 p.m.
- Walk-in Support (Appointment Recommended); Walker Hall 1st floor lobby; Monday through Friday 8 a.m. – 4:45 p.m.

Appendix I: Prototype Evaluation Form

Evaluation of Prototypes

Concept Name:_____

Please use a 5-star ranking where **1-star means you disagree completely** and **5-stars means you agree completely**).

THE PROBLEM. Is the problem or need **clearly defined?**	☆☆☆☆☆
THE AUDIENCE. Is it clear **who they are solving** the problem for?	☆☆☆☆☆
THE PROTOTYPE: DESIGN. Does the prototype include easy to follow visuals?	☆☆☆☆☆
THE PROTOTYPE: FIDELITY. Is it clear how the solution works from the prototype?	☆☆☆☆☆
THE SOLUTION: NOVELTY. Is it the solution **original** and **different**?	☆☆☆☆☆
THE SOLUTION: DESIRABLE. Does the solution **effectively solve** the problem?	☆☆☆☆☆
THE SOLUTION: FEASABLE. Is the solution **technically feasible to produce**?	☆☆☆☆☆
THE SOLUTION: VIABLE. Is the solution likely to **generate a profit**?	☆☆☆☆☆
THE SOLUTION: VALUE. What would you be willing to pay to purchase it?	$_____

Likes

Dislikes

Suggestions

Appendix J: Thesis Slick

The Class as a Crowd

Using Design Thinking to Explore the Potential of Crowdsourcing in Large Classes

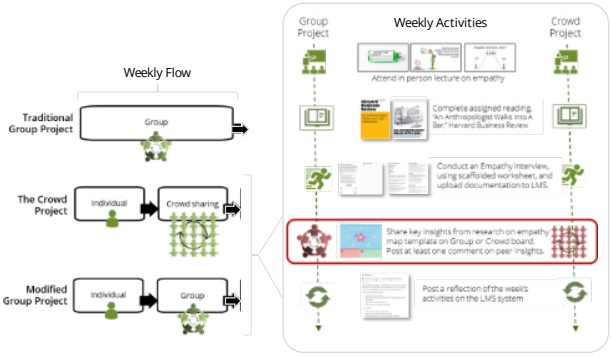
MFA Thesis Slick | April 2022
Jane Machin, Ph.D.

Class sizes in higher education are increasing, with students today spending over 40% of their time in large classes, that is, those with over40 students (Cash et al., 2017; Estimated Class Sizes, 2019;Mitchell et al., 2019; Pilliet al., 2018; Saiz, 2014; Tafi, 2019;Umbricht & Stange, 2019). While larger classes help university administrators balance enrollments with funding decreases, they come at the cost of student academic achievement, satisfaction, and retention. Research in a wide range of disciplines finds that large class sizes harm student academic achievement, both in terms of probability of passing exams and the grades obtained in those exams (Arias & Walker, 2004; Ballen et al., 2019; Becker & Powers, 2001;Diette & Raghav, 2015; Emerson et al., 2018; Johnson, 2010; Kara et al., 2020; Mandel & Süssmuth, 2011; Matta et al., 2015; Monks & Schmidt, 2011;Owuor, 2018; Paola & Scoppa, 2011;Saiz, 2014). Poorer performance is associated with higher drop-out rates and decreased retention (Bettinger & Long, 2016; Cash et al., 2017;Millea et al., 2018). Importantly, the costs of increasing class size are not uniformly distributed (Ake-Little et al., 2020). Research shows, for example, that the negative effects of large classes are significantly worse for vulnerable student populations such as first-generation, freshmen, low-ability, minority, and low-income students (Beattie & Thiele, 2016;Diette & Raghav, 2015; Kara et al., 2020; Mathis, 2017). Large classes regularly hurt women more than men, especially in math and science courses (Ballen et al., 2019; Matz et al., 2017).

Student satisfaction also dramatically decreases as class size increases (Emerson et al., 2018; Russell & Curtis, 2013;Sapelli & Illanes, 2016), since less frequent student -faculty interactions leave students feeling anonymous and isolated, which decreases engagement and motivation to participate (Burruss et al., 2009; Cash et al., 2017; Gleason, 2012. Faculty are no happier with mass classes, having to deal with both the increased workload administrating and managing a larger body of students (Exeter et al., 2010; Orellana, 2006). Teaching practices such as collaborative and project -based learning are seen as too unwieldy to implement in large classes, and are sacrificed in favor of more manageable, but less successful, pedagogy, such as lectures and multiple-choice tests (Ake-Little et al., 2020; Arias & Walker, 2004; Cash et al., 2017; Mathis, 2017; Tafi et al., 2019). The aversive and inequitable consequences have led many researchers and policy makers to call for class size reductions (Millea et al., 2018; Orellana, 2006). However, if instructors could engage students in a large class through evidence-based teaching practices without increasing the faculty workload to implement and grade applied projects, reducing class size may not be a requirement for increasing student academic performance and class satisfaction. Here, I propose that the large number of students in a mass class represent a crowd, and, outside of academia, **crowds are not evils endured because of resource limitations**; they are valued as intelligent forces that can achieve positive societal change and business growth.

> **Crowds are a hit!**
> Millions of people, connected by the Internet, are contributing ideas and information to projects big and small. Crowdsourcing is helping to **solve tricky problems** and with the right knowledge, contributing to the crowd and using its wisdom is easier than ever"
>
> The New York Times, July 31, 2013

Drawing on industry crowdsourcing best practice, I designed, implemented and tested a novel project that embraced, rather than struggled against, the vast quantity of students in a mass class. Moving between individual and collaborative phases, the so-called Crowd Project captured the wisdom of the crowd, while holding students accountable for their personal contribution. Using a quasi-experimental design, 81 students were randomly assigned to one of two conditions. Students in the Crowd Project shared findings from individual assignments with the entire class while students in a modified Group Project just shared their findings with their immediate group members.



Weekly Activity flow comparing for the Group Project versus Crowd Project

Results indicate that students in the Crowd Project were **more engaged**, performed better on course and **module learning objectives**, and **had higher grades** compared to students the modified Group Project. Students in the Crowd Project also reported greater increases in a self-reported measure of **creative self- efficacy**

	Learning Objective	Crowd Change	Group Change	p value
LO1	Define different approaches to creativity	1.76 (0.29)	1.59 (0.30)	n.s.
LO2	Explain the value of creativity	1.52 (0.31)	0.80 (0.32)	0.11
LO3	Identify measures of individual creativity	1.89 (0.27)	1.21 (0.289)	0.08
LO4	Define mindsets critical to creativity	1.97 (0.30)	1.96 (0.32)	n.s.
LO5	Explain the design thinking process model	2.61 (0.30)	2.00 (0.31)	0.16
LO6	Recognize key design thinking principles	2.68 (0.27)	1.97 (0.27)	0.07
LO7	Implement the design thinking process	2.61 (0.32)	1.53 (0.34)	0.02
LO8	Design a plan to empathize with people	1.86 (0.32)	0.94 (0.33)	0.05
LO9	Design a plan to understand problem	1.34 (0.28)	0.88 (0.30)	n.s.
LO10	Design a plan to identify existing solutions	1.78 (0.29)	0.77 (0.30)	0.02
LO11	Summarize, evaluate & present data visually	1.43 (0.31)	0.76 (0.32)	0.14
LO12	Identify causes and consequences of problem	1.11 (0.30)	0.77 (0.31)	n.s.
LO13	Reframe problem into a HMW question	3.22 (0.34)	2.39 (0.6)	0.09
LO14	Describe at least one ideation technique	3.13 (0.34)	2.09 (0.36)	0.04
LO15	Implement at least one ideation technique	3.24 (0.32)	1.85 (0.33)	0.00
LO16	Identify methods to select the best ideas	1.97 (0.29)	1.05 (0.31)	0.03
LO17	Describe at least one prototyping technique	3.08 (0.32)	2.32 (0.34)	0.11
LO18	Implement at least one prototyping technique	2.62 (0.33)	2.21 (0.35)	n.s.
LO19	Describe value of collaboration to creativity	1.70 (0.32)	1.11 (0.32)	n.s.
LO20	Describe value of reflection to creativity	2.03 (0.32)	1.26 (0.33)	0.09

Average scores in green are significantly different at $p < 0.05$; (SD) in parentheses

Students in the Crowd Project also generated more 20% more collaboration posts on average over the course of the semester, both in total (2,093) and on a per student basis (53.67), compared to students in Group Project condition (total=1728, per student average=45.26). Students blind to the experimental conditions also rated the prototype solutions that emerged from Crowd Project as more novel, desirable, feasible, and viable, compared to the Group Project.

	Solution Novelty	Solution Desirability	Solution Feasibility	Solution Viability
Crowd	3.44 (1.23)	3.64 (1.13)	3.75 (1.11)	2.89 (1.55)
Group	2.74 (1.54)	2.67 (1.28)	2.82 (1.52)	2.14 (1.36)
t-test *p*	0.04	0.00	0.00	0.03
Cohen *d*	0.52	0.82	0.73	0.51

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