Using technology to enhance learning benefits accrued through assignments

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Abstract
In the current educational environment, there is an increasing demand on students to become skilled learners. As course offerings include more in online or hybrid formats, with even in-person classes incorporating significant amounts of technology, there is a shift in focus from teaching to (self)learning. Of course, self-learning has always been the emphasis of (homework) assignments, and experienced teachers know that certain assignments work particularly well as a means to obtain certain student learning outcomes. The intriguing challenge now is to use technology as a strength, and to an advantage, in designing work for students to do on their own and become skilled self-learners. An added dimension is when students are from under-represented groups that have not obtained all the benefits of education systems, or technology.

In this paper we describe and discuss design of assignments in business classes that utilize technology in various different ways to build varied learning skills in students and that are consistent with well-known learning pedagogies such as scaffolding and differentiation. This is based on approaches and assignments developed over time and tested out in classes. We discuss assignments in three different areas of business – Marketing, Operations and Strategy. These assignments have transitioned from traditional classroom settings to hybrid and online formats. While the final learning goals remain consistent, the latter settings present both challenges and opportunities. In addition, we suggest that assignments can be linked, even loosely, across courses in order build skills in students as they progress from lower to higher level courses.

This paper will provide a foundation for viewing design and execution of assignments through the perspective of education pedagogies and in a strategic manner.

Introduction
Assignments play a critical role in education; their importance and impact has been noted by researchers. Assignments (homework) can be considered as essential to education by providing students with opportunities to practice and learn beyond the classroom (Sert 2015). Teachers across the spectrum utilize assignments as learning mechanisms and attempt to design assignments with the goal of engaging students and helping them learn on their own (Fish, 2015).

An intriguing but unavoidable and potentially beneficial change in the education environment has been the advent of technology. Careful attention to detail may be necessary in migrations to online formats (Martinez-Arguelles et al. 2015). The effect of technology, as it is presently available and accessible, has been to create a distinct shift away from teaching to (self)learning. Integrating technology in order to gain maximum benefits both in terms of teaching efficiencies and learning outcomes is a continuing challenge. This is even more difficult when students are from under-represented groups that had not obtained the full benefits of education systems in the past.

In this paper we meld these issues with regard to the design and delivery, including management, of assignments. We note that our approach has been used with a degree of success with students from under-represented groups. We discuss its pedagogical underpinnings and also the role technology has played in both design and delivery.
Literature Review

For the purposes of discussion in this paper, we define homework as “work assigned to be completed outside of class that provides an opportunity for students to practice and master the concepts under study” (Young et al 2016, page 21).

Research supports the notion that designing effective homework assignments and guiding students through the process of completion challenges the experience and expertise of instructors. The benefits of homework are intuitively obvious (Mitchell & Mitchell 2017), but its impact can be difficult to measure. Research has validated a positive relationship between homework and academic performance, as assessed through exam scores (Power et al 2007). Young et al (2016) noted that students that got homework were likely to learn more than those that did not and showed that a very strong link existed between homework and GPA. Rayburn & Rayburn (1999) found that, regardless of length of course, students that successfully completed homework assignments performed better. Galyon et al (2013) asserted that homework performance was a better predictor of academic performance than critical thinking ability. Based on such positive results and the experience of authors as faculty, we accept as fundamental a premise that homework has a positive effect on, and can play a critical part in, student learning.

Technology must, of necessity, be factored into all aspects of education now. Inclusion of technology into homework can run the gamut from assigned work that is managed completely online, to “computer supported” work (Mendicino et al 2009). Students appear to learn more when homework was “computer supported”, mainly benefitting by immediate feedback, hints as needed and “step-by-step scaffolding” (Mendicino et al 2009, p. 331). Students in an introductory college Finance course felt that any homework helped increase understanding but preferred online assignments to traditional ones (Smolira 2008). Students liked many features of e-learning on the Blackboard platform, with the strongest response being the ability to submit, and check grades for, assignments online (Buzzetto-Moore 2008). At the same time, Zhou et al (2017) note the more active guidance by teachers is needed in online homework.

Although homework generally accrues benefits to students, these benefits are unevenly distributed. Power et al (2007) identified age as a factor in K-12 education. Extrapolating this, we could hypothesize that as (adult) students gain academic skills, homework becomes increasingly beneficial. Other researchers identified race, academic preparedness and even specific courses as differentiating factors (for instance, Mendicino et al 2009, Palocsay & Stevens 2008, Cole 2010). Minority students, in particular, may not be obtaining all the benefits of homework. Cole (2010) found that criticism by faculty led to decline in performance of minority students. The author postulated that criticism had an egregious impact of negatively influencing such students’ “intellectual self-concept”. Additionally, their situation could actually have worsened with the increasing use of technology in education (Richardson 2015, Terry et al 2015). Finally, accrued benefits of homework can be temporary and unsustainable (Fish 2017).

The question then turns prescriptive. Are there any general principles for good homework design? Vatterott (2010) identified five desirable characteristics -clear academic purpose, efficiency, student ownership, building sense of competence and appearing to be enjoyable and interesting. Designing homework is a complex decision wherein instructors have to balance demands to place on students against the practicalities of what students would be able to do and what instructors would be able to grade. Thus, beyond Vatterott’s generalities, there is a need for specific and practical guidelines. What can be done to ensure that homework benefits all students, and to maximize benefits? Finally, what can be done to make learning be long-term?

Model

Designing homework assignments includes managing the process as well: communicating all relevant information to students, guiding them as needed or appropriate in completing the work,
grading the work and providing feedback. We discuss assignments in the context of two well-known teaching methods: scaffolding and differentiating.

Scaffolding can be understood as the “support given by a teacher to a student when performing a task that the student might otherwise not be able to accomplish” (Van de Pol et al 2010, p. 276). Scaffolding is difficult since multiple goals need to be addressed simultaneously such as: adjustment for student variability, teacher skills, teacher availability and course content. Adjustment in teaching approach falls in the realm of differentiation. A general definition of differentiation is that it is “teaching that accommodates all of the learning needs of all of the students in a class, enabling each student to attain the desired academic results” (Birnie 2015, p. 64). Differentiation points to flexibility of approach and consideration of factors such as student learning styles.

Our examples were all in required courses in a BS in Business program. We describe assignments in three of them (one taught by each of the authors): Principles of Marketing (MAR 231), Operations Management (MAN 351) and Business Strategies (BUS 451). Although these courses are at different levels, none of them is a pre-requisite of any other. The common pre-requisite course is the introductory course in Management. However, students understand that Operations and Marketing are the two pillars of any business, representing decisions with regards to Products and Markets, respectively and typically take MAR 231 and MAN 351 before BUS 451 (which functions as a capstone). Although each course has its own set of student learning outcomes, there are some common threads running through the program. An important set of skills that students are to pick up relate to information: gathering, evaluating and using to make recommendations. These skills are repeatedly reinforced in various courses, albeit in different contexts. Some other skills repeatedly addressed in the program are, to use terms from Bloom’s taxonomy, analysis and synthesis.

MAR 231 Principles of Marketing.

This is the first course in Marketing for business majors and covers standard and essential topics such as target markets, segmentation, marketing mix and basics of marketing strategy. The assignment requires students to develop a marketing campaign for the student marketing club at the college (Appendix A) and was used in both online and face-to-face courses. A typical marketing campaign includes the process of describing the opportunity, executing the recommendations, and giving an evaluation. This assignment covers learning materials from the chapters and topics given in the syllabus with a focus on these learning outcomes: Getting business information from reliable sources; Understanding of concepts in Marketing; Critical evaluation of business information; Proposing courses of action based on analysis.

To facilitate scaffolding, students were directed to prepare three versions of the assignment which is graded on a continuum of low (ungraded) to increasingly higher stakes (graded) in evaluations. This is in alignment with the view of scaffolding, in the context of both online and in-class education, as a tool generally used to facilitate student learning by organizing learning materials so that students have multiple opportunities to complete an assignment in sequential, smaller steps rather than having a single opportunity to complete the entire assignment (Puntambekar & Hübscher, 2005, pg. 4). Additionally, the instructor provided feedback by communicating to students the improvement observed across the three versions of the assignment. Grading was based on a scale of 0 (no credit) to 10 (full-credit). The grade criteria included comprehensiveness, use of evidence, effective management of writing, and demonstrating linkage between ideas in lesson topic and other concepts, ideas and materials in a coherent manner which was supported by cited sources.

MAN 351 Operations Management.

This course covers all content related to producing the product, including production processes, facility, materials management and quality. In general, undergraduate OM courses can have a focus on strategy, a mathematical bias, or be a hybrid of these two approaches (as in MAN 351). Keeping in mind the student body, the two main objectives of this course are: 1) presentation of
course material such that students can appreciate the value and role of OM in their own lives, and 2) (as far as practicable) a hands-on approach to most of the concepts presented. In addition, the underlying goal is to develop students’ skill sets for broad business settings as well as enable a certain level of independence in their own businesses. Moreover, there has been the felt need to continuously upgrade and retool to meet the challenges of today’s business environment. Therefore, for those wishing to start their own small businesses and to scale up, a comprehensive but realistic grounding in some of OM’s mathematical methods and OM strategy were deemed to be an imperative as part and parcel of the instruction set. A judicious use of differentiation and scaffolding teaching techniques proved effective in meeting these objectives.

Differentiating (Differentiation 2013) and Scaffolding (Scaffolding 2013) are useful, perhaps necessary, to accommodate for skill variation levels in both reading and mathematics. The diversity, as it relates to the wide variations in their reading and mathematical skill levels, within the student cohorts is a most critical element in teaching OM. This issue also extends to their knowledge of statistics. However, differentiated instruction is a challenge especially as it relates to quantitative work.

Scaffolding was more generalized and varied through the semester. The challenge was to gain the assurance that learning had taken place. This meant taking students from where they were found, with regards to the subject matter (Point A) to a place where they should be (Point B). Thus, all students were exposed to the final same course-level of homework assignment difficulty (no differentiation). Necessary vocabulary for the most, or for future exercises and chapters were introduced by way of discussion for a, required readings and multiple-choice review questions. Supplementary background readings were also given, to expose and scale to the most complex topics. In addition, incremental learning by way of numerical examples was used to enable students to follow, or to serve as worked examples. Additional help was provided through instructional videos and annotated graphics with step by step instructions regarding solution to the most difficult issues and topics in this course (see Scaffolding 2013).

Distinct areas of assessment for this OM course were essays, discussions, and numerical take-home questions. Student reaction in relation to some homework assignments, particularly reading assignments were as expected. The absence of certain expected terms in the assignments tended to reflect the level of comprehension and extent to which instructions were missed. As noted by others, the use of technology such as calculators and MS EXCEL spreadsheet as the data and analysis software has been a success (see Roblyer & Hughes 2019). Here too, the response was good: classmate cooperation and adaptation were in evidence. By dint of repetition, students who originally stumbled or were originally apprehensive, found the mathematical part of the course especially, less formidable. This was application of scaffolding.

The approach taken in this course is aligned with the SAMR education technology model (Magana 2017). The SAMR Model, being techno-centric, offers a continuum showing which technology tools (techniques) change the nature of tasks to be done. From the model, in the augmentation stage (at one extreme), technology acts as direct substitute while adding some improvement in the task. Both in the substitution (an intermediate stage) and augmentation aspects of the SAMR model, there is task enhancement. In the next stage the Modification stage the technology in use makes for a redesign or modification of the task. Turning to the final or Redefinition Stage, technology use enables the development of entirely new tasks that were not possible without the use of the technology.

The SAMR Model has a focus on technology and not pedagogy. However, homework assignments for the OM course can be assessed for efficiency and effectiveness in terms of technology use. Scaffolding efforts were not uniformly successful as expected, for all students at the individual level. Perhaps time and individual circumstances did not allow all students to complete required readings. In the future, a rigorous study can probe these issues in greater detail. Through the prism of the SAMR continuum (see Magana 2017), the education technology went beyond mere
substitutions. There was change (modification) from use only of the hand-held calculator to the MS EXCEL spreadsheet, aided by scaffolding (a tool change). Not all students, however, liked the extra effort required. This means that the approaches used need refinement. Therefore, in terms of student reaction, the results of completing the various stages of homework assigned regarding the OM course were a mixed bag.


The main topics of discussion in the course are environmental analysis, business analysis and making strategic recommendations. Every student was assigned a (publicly traded) company, referred to as “YourCo”. There are assignments through the semester that relate to this company (Appendix B). Publicly traded companies were chosen for information availability reasons. The learning goals of this long assignment were, in order of Bloom’s Taxonomy of complexity: Obtain business information (including financial data); Identify reliable sources; Understand and analyze information; Apply business concepts; Synthesize information; Develop an evaluation system; Create a plan.

Scaffolding in this long assignment was manifest in different ways. An important issue that was stressed constantly was the importance of using reliable, and published information. Thus, the first few assignments explicitly asked for citation. This was dropped in later assignments. Another kind of scaffolding was making explicit references to the text and requiring students to use classifications and categorizations therein (for instance for different aspects of external environment as Economic, Social etc.). Finally, the instructor also had a “YourCo” and posted information about it to model what was required of students. Differentiation in the long assignment was done through questions posed in each assignment. Every assignment had a basic and a more advanced level. For instance, in the internal environment assignment, some students would stop at simply describing what the company did, or even just post an article. More advanced students would analyze the implications.

The assignment was hosted on Blackboard, thereby providing opportunity for feedback, both individually and also to the class as a whole. Individual feedback gave a chance to differentiate and bring up issues specific to the company or of interest to the student. Individual feedback also functioned on occasion as individual scaffolding, since some students required more direction than others. In the group feedback, general issues were addressed. For instance, a feedback after the External Environment assignment might note that the economy had affected different companies in different ways.

Findings

As had been reported by other researchers, students in all classes responded well to assignments, and seemed to understand and accept their importance to learning. At the same time, students wanted clarity at all levels – the exact assignment, time requirements and other related policies. In some assignment’s students responded well to explicit scaffolding, such as the instructor posting an “example” response.

In this paper we discussed three required courses for all students, none a pre-requisite for another. Typically, students took them in different semesters in the sequence of MAR 231, MAN 351 and BUS 451, as had been recommended in the planning guide distributed to them. Ideally, they would remember content learned across classes. However, the student mix at the college was such that most students had a gap between taking these classes. In addition, there were also a significant number of transfer students. Both these factors meant that scaffolding of similar kinds had to be provided in each of the classes.

There were two kinds of scaffolding provided to students – group and individual. Group scaffolding was in the form of explicit information regarding work completion, announcements and class feedback to assignments. Individual scaffolding was assisting a student on a specific issue.
Indeed, individual scaffolding is a form of differentiating. Thus, students were provided two kinds of scaffolding – general and differentiated.

General scaffolding addresses issues common to a particular set of students in a particular course. Such scaffolding could be communicated to students either in the classroom during class hours, or posted on a platform like Blackboard, to which all students in the class, or group, have access. General scaffolding need not be static; it could and should change over classes, courses and time, depending on the need.

Students responded well when the business-related necessity for requirements in the assignment were explained to them. An example was that of providing references and citing them. In the past, students would often bypass this requirement and proffer statements that were in fact mostly personal opinions and based on partial information. However, the citation requirement was explained as the necessity for basing business decisions on accurate, verifiable and reliable information. Further, this was modeled by the instructor providing citations in certain assignments. After the explanation, response rate of students was close to 100%. Initially during the semester, the need for providing references was explicitly stated in the assignment and removed later on during the semester. A majority of students continued providing references. Any student that did not provide them was reminded of it – this could be considered as individualized scaffolding.

A common factor in all three courses was this mix of general and individualized (or customized to groups) scaffolding in the form of response. It was difficult to differentiate further than that. The courses differed quite widely in terms of content and skills of students. The Marketing course introduced students to ideas and concepts for which they might have an intuitive understanding – the goal was for them to dig deeper into analyzing and evaluating, and finally creating a plan. The Operations Management course dealt with less intuitive concepts and also trained students in quantitative analysis and decision making. The Strategy course combined elements of both qualitative and quantitative analysis but required students to synthesize more.

Conclusions

Teaching is a highly complex process and is inextricably intertwined with learning. The use of homework assignments as a means to ensure (long term) learning and skill building has had varying degrees of success. The successes and near misses suggest the need for even greater scrutiny and further study. It follows that the use and application of various education technologies, and related techniques, must go beyond being mere props in the delivery of certain subject matter areas.

We add the caveat that, whereas the concept of “homework” is clear in traditional courses, the lines can get blurred in the realm of online learning. One can argue that any work completed by the student, including tests, is “homework” in an online (asynchronous) course. Indeed, in fully online learning environments, assessments sometimes can be continual (Martinez-Arguelles et al., 2015).

Teaching non-traditional students adds to the complexity and difficulty. Some aspects of non-traditionalism are crucial. One is that such students often have temporal gaps in their education process, and hence continuity, and even memory, of content learned is lost. In the context of pedagogy, this would mean they need extra scaffolding. Another aspect is that for such student’s choice of class times has to factor in work and family as well. This means that there are rarely cohorts that go through classes together. Indeed, there may not be more than a handful in a class who had taken prior classes together. In pedagogical terms, this means that instruction has to be differentiated.

In this paper we presented sample approaches to assignments in three required classes taken by undergraduate business majors at a college where most students are non-traditional and also are from under-represented groups. We framed assignments in the context of the two important pedagogies noted previously - scaffolding and differentiating. As noted by Puntambekar & Hübscher (2005). “The notion of scaffolding is now increasingly being used to describe various forms of support provided by software tools, curricula, and other resources designed to help students learn...
successfully in a classroom”. Ideally, every student would have completely customized responses to each assignment. However, as a practical matter, instructors would not have time to do so. Generalized scaffolding is more efficient, and also could be highly effective if the instructor identifies a matter on which all students need guidance.

Technology is of great assistance in making differentiated, individualized scaffolding become more efficient as well. A simple matter such as the ability to copy and paste (and alter as needed) responses reduces time significantly from having to handwrite responses on each student’s assignment. Technology also offers the potential for improving scaffolding. For instance, an analysis of assignments turned in by students would help identify issues on which there is a need for general scaffolding. Further analysis might even help in being prescriptive about differentiated scaffolding, or even semi-differentiated scaffolding. This would be one in which scaffolding is customize for groups of students in the class, who have a specific and distinct need. For instance, such a group might be students who had taken a pre-requisite year back, while the remainder of the class had taken it the previous semester. Differentiating for groups could be considered a form of “mass customization” – a method that combines both the efficiency of general (standardized) scaffolding and effectiveness of targeted differentiated scaffolding. Indeed, this approach is completely attuned with practices in the business world to leverage technology.

Instructors judge whether an assignment has been effective by viewing student performance in completing it. That would reveal the extent of student learning but that would be short-term as well as limited to the scope of the assignment. As mentioned earlier, researchers have measured the impact of homework by looking at linked grade and exam performance (see, for instance: Fish 2017, Mitchell & Mitchell 2017, Orchard 2016, Peters et al 2002, Rayburn & Rayburn 1999). While not as limiting as the specific homework’s grade, these need not provide an accurate measure of the depth of learning or long-term benefits. Since education is meant for the long-term (Fish 2017), a longitudinal, and possibly multi-course, approach could lead to a better measurement of a homework assignment’s impact.

We hope that viewing assignments in a deeper and more holistic manner and framing their design and delivery in terms of fundamental teaching pedagogies will lead to their being effective and successful teaching tools. We would look to applying models such as the SAMR in other business courses. An ideal would be to link critical assignments across courses, which have linked learning outcomes. This would serve to reinforce key concepts and skills and contribute to deeper and more lasting learning.

Appendix A Marketing Assignment (MAR 231)
The objective of this assignment is for you (the student) to describe the series of actions that you would take to get students to attend an event which promotes the idea of becoming a member of a newly created Marketing Club at MEC.

Instructions:
Step 1: Review the Marketing Club Flyer provided by the instructor.
Step 2: Work with the members of your group in class and on blackboard to answer the questions in the action items given below.
Step 3: Review and apply the grade rubric for group work to the completion of this assignment.
Step 4: Upload version 1 of this assignment in PowerPoint format to blackboard by the deadline given in the Assignment Manager.
Step 5: Make modifications that are responsive to the professor’s feedback in the grade rubric.

Action Items:
Understanding the marketplace. What is the opportunity? For instance, identify trends and other information which is related to describing opportunities to attract students to the club.
Designing a customer driven marketing strategy. What actions were taken to attract people to attend the event? What would you like to see the club offer which would pique students’ interest in possibly
becoming a member? In other words, what actions should be taken by the Marketing Club to attract students to join the club?

Communication - creating a media mix. How will the public be told? Describe at least 3 different ways that you would make students aware of the upcoming event to promote the club. What would the message be?

Evaluating the success of the campaign. How would you evaluate the success of your campaign?

**Appendix B Business Strategies & Policies (BUS 451)**

This was a semester-long assignment that was broken into 11 smaller assignments

Assignment 1 - Online Discussion Board. State why you could consider your assigned company (henceforth referred to as “YourCo”) as the “best in the world”!

Assignment 2 - Industry Competition Assignment. Provide the website url for YourCo, provide a brief description of the company. Identify the Industry and key competitors. Comment on the industry, the nature of competition and how YourCo is positioned.

Assignment 3 - External Factors. Choose an article about YourCo in a reliable source. Discuss external issues affecting YourCo mentioned in the article. Provide citation(s).

Assignment 4: Internal Factors. Choose an article about YourCo in a reliable source. Discuss internal issues related to YourCo mentioned in the article. Provide citation(s).

Assignment 5 - YourCo SWOT. Identify key SWOT factors for YourCo.

Assignment 6 – Globalization. Give an example of YourCo pursuing globalization. If YourCo did NOT go global, either recommend how and why it should go global or give reasons why going global is a bad idea for the company.

Assignment 8 - Ethical Factors. Give an example of YourCo behaving in an ethical manner OR in an unethical manner. Please do not use information from the company website (such as "social responsibility" page).

Assignment 9 - Financial Report YourCo. Provide and discuss (changes in) financial information for YourCo for the last three years.

Assignment 10 – Strategy. Describe the strategy followed by YourCo over the last five years. Identify the strategy type and discuss if this was the right strategy for YourCo.

Assignment 11 - Report Card YourCo. Prepare a "report card" for YourCo. You can include any factors to evaluate performance and use any approach. Develop a recommended strategy for the future (3-5 years).

**References**


