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# INFORMATION SYSTEMS EDUCATION JOURNAL

# Student Engagement: The core model and inter-cohort analysis

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## Abstract

Prior research in higher education shows that engagement has been inconsistently conceptualized: semantic inconsistency has been compounded by variations in the constructs used to operationalize engagement. Acknowledging these limitations, we conceptualize student engagement as a multi-faceted meta-construct, overcoming some of the limitations evident in prior studies. This supports a research design that enables us to tap the capacity of the LMS at our institution to operationalize the constructs that undergird the Bundrick et al (2014) model. Our inter-cohort analysis reveals significant variations in individuals' engagement with the on-line course. Our findings suggest that interactions among the primary elements of the learning environment—the student, the teacher, and the content—significantly affect engagement and student outcomes. Our findings also suggest an urgent need to deepen investigation of student engagement to more fully investigate the dynamics of interaction as on-line learning environments account for an increasing proportion of higher education.

**Keywords:** online learning, engagement, interaction, information systems, analytics

### 1. INTRODUCTION

Quality Matters Standard 5, Learning Interaction and Engagement, is based on research on best practices for online course design. Each of the four guidelines encompassed within this standard promote *engaging* students to become active learners, which will contribute to their learning process and their persistence (Quality Matters, 2011). These guidelines include learning activities to promote the achievement of the stated learning objectives; learning activities to provide for the interaction that support active learning, the instructors plan for response time and feedback, and explanation of requirements for student interaction.

In the wider context of higher education, engagement is seen primarily as a quality of the school or college rather than a trait of the individual. The amount of time and effort students put into their studies and other educationally purposeful activities is one of the 'critical features' of engagement used by Indiana University's National Survey of Student Engagement (NSSE) to measure collegiate quality. NSSE also assesses how the institution deploys its resources and organizes the curriculum and other learning opportunities to enable and encourage students to participate in activities that, they argue, research studies show are linked to student learning.

In this research, we revisit this linkage and explore the dynamics of participation in a little more depth. Rather than estimates of how students spend their time and what they gain from attending college – the focus of NSSE – we explore engagement at the individual student, course and instructor level. This is the locus of evolution for engagement. Summary statistics mask variations at these levels which, we argue, are critical to understanding students' learning needs and performance. In this research, we have strived to address this limitation by making the student the primary unit of analysis. This enables us to explore the interactions between the three 'core' components of learning – the instructor, the material and the student. Both our course design and our research design emphasize the need for effective scheduling and 'choreography' of these core components.

The assignment schedule for the course is one of the content elements developed with this need in mind: it also follows best practices for interaction and thus aligns with Standard 5 of the Quality Matters rubric. The rubric outlines three types of interaction to promote student success within an online course: student-student interaction, student-content interaction, and student-teacher interaction. With the implementation of these best practices for student interaction and engagement in place within the course, it seems reasonable to expect that students should perform well academically if they complete the course assessment schedule. This paper will test this expectation using empirical data to compare student engagement and academic achievement in a Systems Analysis and Design course over two semesters.

## 2. PRIOR RESEARCH

Prior research in higher education shows that *engagement* has been inconsistently conceptualized (Appleton, Christenson, & Furlong, 2008; Fredricks & McColsky, 2012). Behavioral and psychological indicators (e.g., Finn, 1989; Newmann, 1992) have been used in various combinations, giving rise to inconsistent terminology (Bundrick et al, 2014). Terms such as *school engagement* (e.g., Fredricks, Blumenfeld, & Paris, 2004), *student engagement* (Willms, 2003) and *academic engagement* (Libbey, 2004) have been used interchangeably. This semantic inconsistency has been compounded by variations in the constructs used to operationalize engagement. Acknowledging these limitations, we conceptualize *student engagement* as a multi-faceted meta-construct that accommodates important distinctions among students' evaluations and experiences in the various conceptually distinct dimensions of their learning environment: behavioral, cognitive, and emotional.

Bundrick et al (2014) articulate these distinctions: *Behavioral engagement* refers to various behaviors that are directly oriented to learning, such as attending and contributing to classes, compliance with rules, completing assignments and the time and effort put into studying. *Cognitive engagement* is a little less tangible since it involves the student's psychological 'investment' in learning and mastery of academic materials and their desire for challenge. Cognitive engagement is manifest in metacognitive strategies such as planning, monitoring, and evaluating one's thinking; and self-regulation. *Emotional engagement* refers to students' feelings about their relationships with others in the learning environment (e.g., teachers, peers) and the general sense of belonging and connectedness that is often derived from such relationships: these inform student perceptions of self-efficacy (Compeau et al, 1995, 1999) and confidence regarding their academic ability.

Prior research on effective student interaction and engagement provides the basis for implementation of our course design objectives. Student-student interaction, often implemented through discussion boards, has been found to increase student satisfaction in a course (Rothmund, 2008). Additionally, social interaction has been found to play a significant role in students' sense of learning (Hill et al., 2009). Davies and Graff (2005) found that the level of participation in online discussion boards did not correlate with overall course performance; however, Rovai and Barnum (2003) found that active interaction, the number of messages posted by students per week, was a significant predictor of perceived learning. Nussbaum et al (2004) found that the quality of interactions could play an important role in student outcomes. Therefore, a set of criteria demanding high quality participation, such as including sources and providing examples in discussion responses, could provide a meaningful level of engagement to act as a predictor of student success. Sher (2009) found that both student-student interaction and student-instructor interaction were significant contributors to student learning and satisfaction.

Prior research on the effectiveness of student interaction and engagement in online courses has focused primarily on measuring success through student perceptions and student satisfaction. However, as Bundrick et al (2014) have shown, research into engagement among students in higher education has been distorted through over-abstraction – the assumption that summary statistics have a generalizable validity to whole populations.

We address this shortcoming by focusing attention on more fundamental measures of personal interaction within the core learning components. We aim to develop a more causally robust linkage between engagement and performance and, in so doing, propose indicators of engagement that are more immediately relevant to students, instructors and course designers in the rapidly evolving milieu of on-line core learning components.

## 3. RESEARCH SETTING

The University of South Florida St. Petersburg (USFSP) offers a range of distinctive graduate and undergraduate programs in the arts and sciences, business, and education within a close-knit, student-centered learning community that welcomes individuals from the region, state, nation and world. We conduct wide-ranging, collaborative research to meet society's needs and engage in service projects and partnerships to enhance the university and community's social, economic and intellectual life. As an integral and complementary part of a multi-institutional system, USF St. Petersburg retains a separate identity and mission while contributing to and benefiting from the associations, cooperation, and shared resources of a premier national research university. The university's online learning is delivered through a learning management system; Canvas by Instructure.

The recent adoption of Quality Matters (Quality Matters, 2013), an online course quality management program, at USFSP has provided a set of specific standards that can be used to enhance the accessibility of courses. Quality Matters is a quality assurance program that facilitates a peer review process to recognize courses that follow best practices for design and promote student success in online education. Courses are reviewed using a rubric (Quality Matters, 2011) comprising a set of eight research-based standards for design that heavily promote student engagement.

## 4. RESEARCH DESIGN

The review above prompts us to posit that students who display higher levels of engagement perform academically at a higher level than those who display lower levels of engagement. In this initial research, we explored this relationship using a robust but rather rudimentary analysis which enabled us to directly compare two cohorts of students in the Systems Analysis and Design course.

The complexity and conceptual richness of the design artifacts and process taught and assessed in the Systems Analysis and Design course provides a broad and diverse range of opportunities for engagement (Avison and Fitzgerald, 2006; Topi et al, 2010). The learning outcomes are both a prerequisite for and a predictor of success in the major (Kmetz & Davis, 2014): they have also been aligned with the skills indicative of mastery of the language, tools and techniques that enable their effective use in employment (Yourdon, 1993; Topi et al, 2010).

Professional as well as instructional experience in this highly applied field highlights engagement as a 'critical success factor' for the synthesis of the technical skills and cognate knowledge. Although by no means unique, the interdependence of these learning outcomes and the core learning components on which they depend place students who disengage at substantially higher risk of failure than those pursuing more didactic courses.

Bundrick et al (2014) consider how the primary elements of the learning environment—the student, the teacher, and the content—interact to affect engagement, and propose a conceptual model that highlights the interdependence of these core elements and interactions.

Our research design operationalizes this model: however, our units of analysis are rather coarse, limited by the range of metrics provided by the LMS. Following Bundrick et al (2014) we identified a number of surrogate metrics to operationalize the constructs underlying engagement: data for the analysis was drawn directly but anonymously from the course analytics provided by the LMS. These include

page views, participations, and assignment submissions.

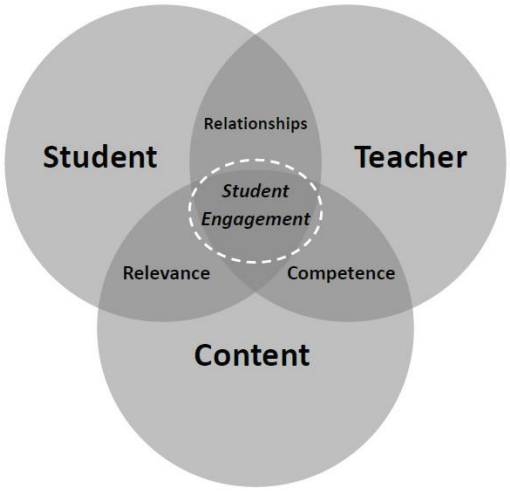


**Figure 1** The Student Engagement Core Model (Bundrick et al, 2014)

Page views are calculated for each student from the day that the course opens to the day that the course closes. Canvas records a page view anytime a student lands on a page within the course. Course pages include Home, Syllabus, module instruction pages, and assignment instruction pages.

In addition to page views, Canvas analytics calculates cumulative participation counts for each student. A participation is recorded any time a student submits a quiz, starts taking a quiz, submits an assignment, creates a wiki page, posts a new comment to a discussion, joins a web conference, or loads a collaboration to view or edit the document.

The analytics also provides an overview of the student's assignment submissions over the semester. It provides a count of the on-time submissions, late submissions, and missing submissions.

The first section of this course was offered during a six-week session during Summer 2013. The second section of was offered during a full-length semester in Fall of 2013. Both sessions were offered completely online and shared a common teaching and assessment model comprising 24 assignments.

**Figure 2** Example view of student analytics.

The assessment regime is comprehensive, designed using the pedagogic and evaluative guidance provided by Topi et al (2010). The synthesis of cognate, analytic and design competence responds both to this curricular guidance and the trends through industry and employment analyses (Avison et al, 2006).

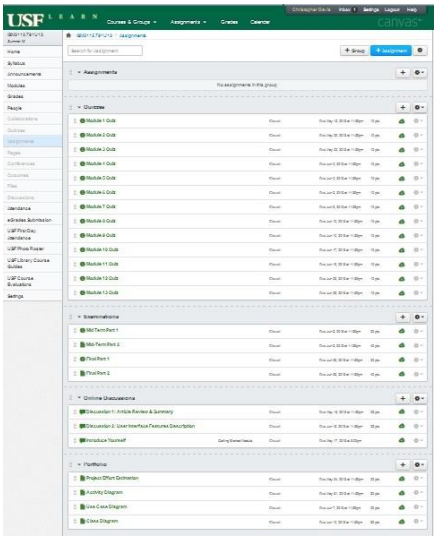

**Figure 3** Assessment 'regime' (see also Appendix A)

Opportunities for engagement in this course are designed to promote student-student, student-content, and student-instructor interaction. The assessment schedule includes a discussion board to allow students to introduce themselves and meet their classmates. This creates a community of learning within the course. Each of the 13 learning modules includes a low-stakes quiz that acts as a knowledge check for the students. To assess students' comprehension and application of the material there are two discussion boards centered around important topics in the field and four portfolio assignments allowing students to demonstrate their ability to complete major

tasks within a systems analysis and design project. The summative assessment for this course includes two exams; a midterm and final. Both exams consist of two parts; a multiple choice portion and an essay portion. Each module also includes lectures, examples, and readings.

## 5. FINDINGS

The Summer 2013 Section was completed by 34 students: the table below summarizes the surrogate metrics that we used to assess their levels of engagement and the resultant leaning outcomes. The table sets the data out in broad grade-based classes (rows) to maintain cohesion in our commentary, providing consistency with the performance and outcome metrics used in the research reported in Section 2. This also provides a familiar basis for comparison with grading schema used to report learning outcomes at other institutions.

| Final Grade Range | Average Page Views Per Student | Average Participations Per Student | Average Assignments submitted on time per student | Average assignments submitted late per student | Average assignments missing per student |
|---|---|---|---|---|---|
| 90% - 100% (6 students) | 548.00 | 35.30 | 23.80 | 0.20 | 0.00 |
| 80% - 89% (25 students) | 601.80 | 32.90 | 23.10 | 0.10 | 0.80 |
| 70% - 79% (3 students) | 713.70 | 26.30 | 20.30 | 1.70 | 2.00 |
| Below 70% (0 students) | Not applicable | Not applicable | Not applicable | Not applicable | Not applicable |

**Table 1** Summer 2013 Engagement and Outcomes

Table 1 shows the relationship between participation and outcome: note that no students were assessed at below 70% in this cohort. The cohort size in this short six-week 'semester' was reduced significantly (from an initial 40 students) immediately prior to the 'drop' date. The dynamics of the relationship between students' anticipation of success or other 'outcome' is not clear. However, it seems reasonable to infer that those in this cohort with failing grades chose not to continue. The brevity of the semester gave students an opportunity to drop the class without academic penalty just a few days before its end: this skews the sample significantly.

Such discontinuance clearly affects the grade distribution. Recent work by Munro (2014) highlights other significant characteristics of such disengagement: often condoned by instructors, it gives rise to grade inflation and, he argues, is a form of fraud.

Nevertheless, Figure 4 provides insight into the relationship between outcomes and engagement as measured through participation in the assessment 'regime' set out in Figure 3. To provide a benchmark to interpret these data, it should be noted that there are 24 assessments that students participate in: of those, 18 provide one opportunity to participate (the quizzes and modeling submissions that build the student portfolio). The discussions, on the other hand, are more interactive. The two graded discussions require multiple participations: the first to 'post' and 'reply'; the second to 'post' and then reply to each of two 'threads'. In combination, the 24 participations span a range of interactions and thus provide the multi-faceted indication of engagement that Bundrick et al (2014) propose.

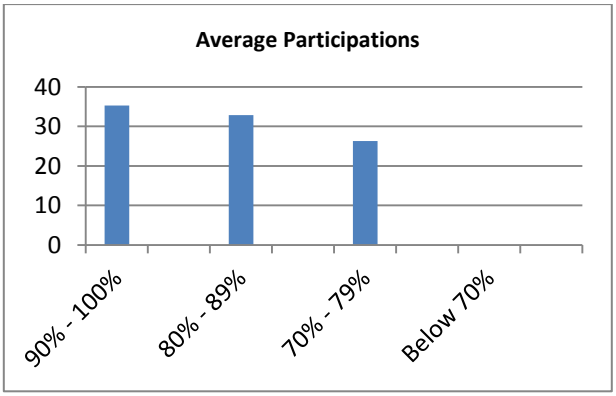


**Figure 4** Summer 2013 Participation

A differently nuanced indicator of engagement is provided through measurement of the number of page views. Although less substantive than measures of participation - since they do not discriminate between mere browsing and more intellectually engaged reading and assimilation -

their overall volume provides a complementary scale and arguably more normalized measure of engagement.

Overall, students in this cohort engaged with the material 621 times or about 15 times per day during the 6 week duration of the course. Figure 5 shows that the standard deviation in this much larger data sample is quite low: the difference between the highest and lowest columns is only 166.

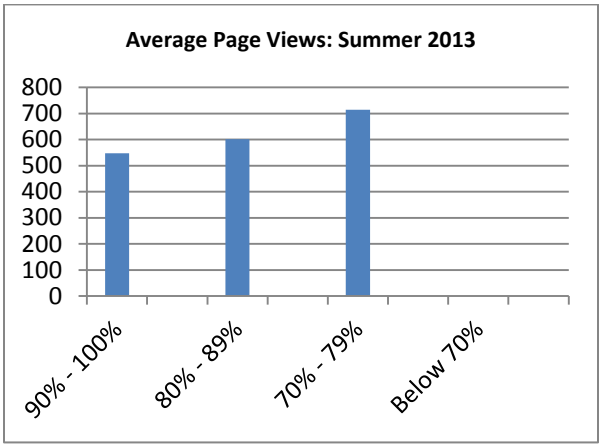


**Figure 5** Summer 2013 Page views

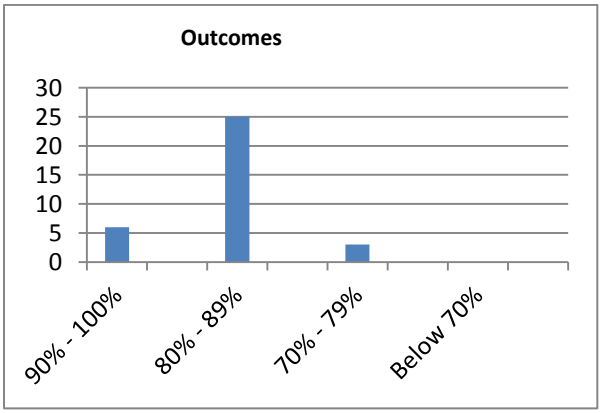


**Figure 6** Summer 2013 Outcomes

Two observations can be made here: firstly, classification of the data using outcomes masks internal variations. Our observations while the course was live showed significant variations within each of the broad categories in Figure 4. Our current research strives to make these episodic variations more tractable. Secondly, the trend of the data seems counterintuitive: the relationship between number of page views and quality of outcome as indicated by the grade received is inverse. In the context of engagement, this seems significant, suggesting that participation is a more reliable indicator of outcome than page views.

We turn now to consider two more assessment indicators of engagement. Figure 7 shows the average counts for timely submission of the twenty four assignments (see Figure 3). Here, a more direct relationship is immediately clear: timely submission of assignments correlates positively with outcomes.

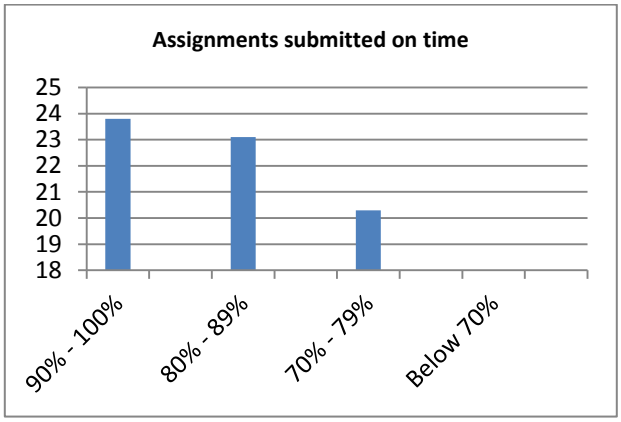


**Figure 7** Summer 2013 Assignment timeliness

As might be anticipated, late submission of assignments correlates negatively with outcomes. Although significantly smaller, this data set shows remarkable symmetric consistency with those in Figure 8.

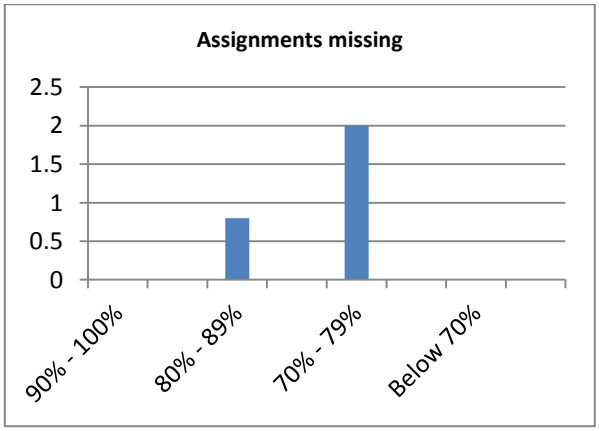


**Figure 8** Summer 2013 Assignment completeness

Considering Figures 5, 6, 7 and 8 together, the data present apparently contradictory relationships between the level of engagement with the materials overall and outcomes (compare Figures 5 and 6) and that between engagement with the assignments (compare Figures 6, 7 and 8).

The metrics for Fall 2013 are summarized in Table 2: they show the engagement and outcomes for the (larger) 41 student cohort and allow us to explore this apparent contradiction a little further.

| Final Grade Range | Average Page Views Per Student | Average Participations Per Student | Average Assignments submitted on time per student | Average assignments submitted late per student | Average assignments missing per student |
|---|---|---|---|---|---|
| 90% - 100% (4 students) | 811.50 | 49.00 | 24.00 | 0.00 | 0.00 |
| 80% - 89% (24 students) | 611.30 | 42.40 | 23.40 | 0.60 | 0.00 |
| 70% - 79% (8 students) | 483.00 | 36.10 | 23.10 | 0.30 | 0.60 |
| Below 70% (5 students) | 283.40 | 13.40 | 7.20 | 1.00 | 15.80 |

**Table 2** Fall 2013 Engagement and Outcomes

The cohort size in this full semester was more stable than Summer 2013, although large for such a technical course.

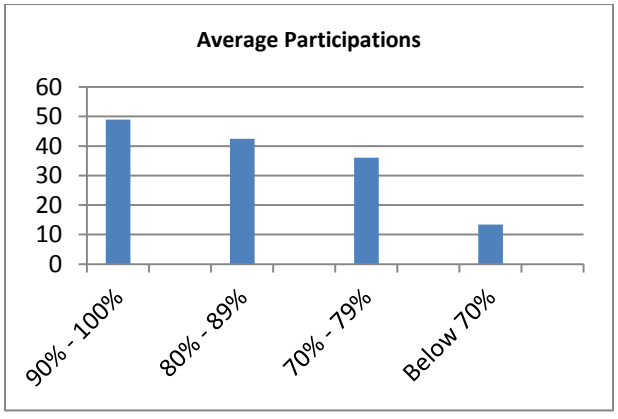


**Figure 9** Fall 2013 Participation

Figure 9 shows a strong correlation between outcomes and engagement as measured through participation in the assessment 'regime' set out in Figure 3. Participation rates are high: an average of 49 participations for students in the top performance category.

Students in the lowest category show substantially lower engagement, participating on average only 27% of the level of those achieving the highest grade outcome.

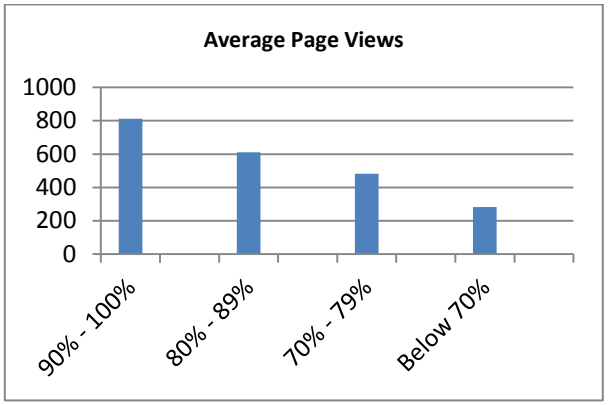


**Figure 10** Fall 2013 Page views

Overall, students in this cohort engaged with the material 547 times. This represents a lower 'density' of engagement in this longer 15 week semester at only 5 views per day. This is consistent with the number of student 'effort hours' expected at this institution: 5 views per day when 10 hours of effort per week are expected equates to about 12.5 views per day in a six-week semester – such as the one analyzed above - where 25 hours effort per week are anticipated.

Figure 10 also reveals a higher standard deviation for the longer course: the difference between the highest and lowest columns is significant at 527. On average, higher performing students viewed the course content three times more frequently than those in the lowest category.

Again it should be remembered that our classification of data using outcomes masks internal variations. Our observations while the course was live showed similar significant variations *within* each of the broad categories in Figure 10. The highest and lowest number of views for the highest outcome class was 1102 and 585: the low is less than half of the high.

For those who achieved a B (80-89%) the figures were 996 and 339: the low is a little over one third of the high. This is consistent with the size of this group (24) in our outcome distribution. Those who achieved a C (70-79%) ranged from 754 to 476 page views: a much narrower range – again a function of the group size (8 students).

The lowest performing group included two students who did not complete the course. The range is large here: from 669 to 40 page views. Nevertheless, the overall trend of the data for the Fall 2013 cohort seems more intuitive: the correlation between number of page views and outcome is positive.

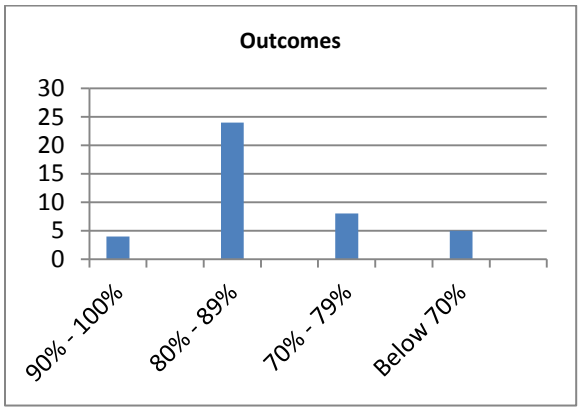


**Figure 11** Fall 2013 Outcomes

Turning to our assignment-oriented indicators of engagement, we see that Figure 12 reveals a similarly direct correlation between submission timeliness for the twenty four assignments (see Figure 3) and outcomes.

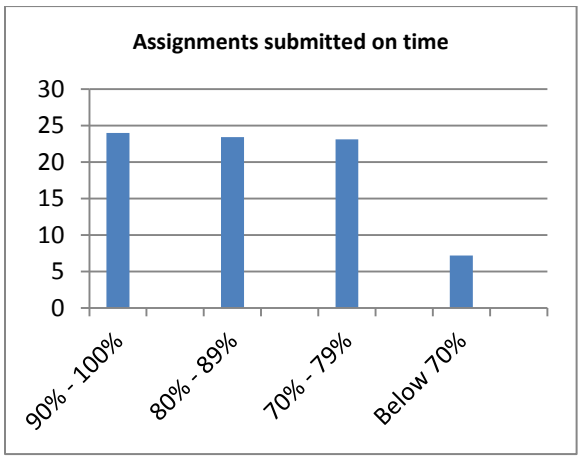


**Figure 12** Fall 2013 Assignment Submission

Again we see some intuitive complementarity in the distributions of assignments submitted on time and those missing completely. However, comparison of Figures 12 and 13 shows a stronger 'fall off' between those achieving passing grades and those who didn't.

The apparent contradiction seen when Figures 5, 6, 7 and 8 (for the Summer cohort) are considered together is not evident when Figures 10-13 are compared. For the Fall 2013 cohort the relationships between the level of engagement with the materials overall and outcomes (Compare Figures 9 and 11) are more consistent with that for engagement with the assignments (Compare Figures 11, 12 and 13).

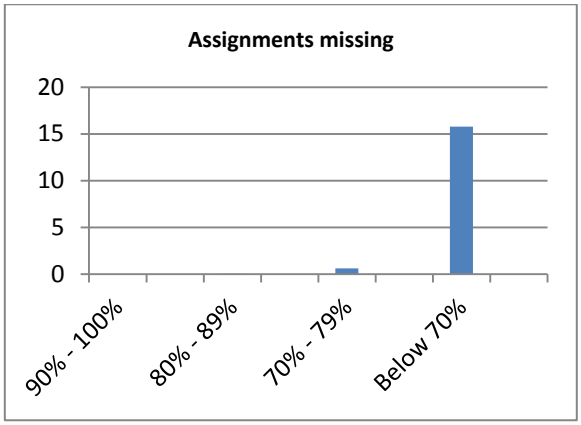


**Figure 13** Missing Assignments Fall 2013

## 6. COMMENTARY

Our analysis uses metrics that measure some of the interactions in the Bundrick et al (2014) Student Engagement Core Model (Figure 1). Despite the limitations that we discuss below, the data provide coherent and consistent comparisons of student engagement. The overall similarity between the data sets for the two cohorts highlights this. It also highlights the significant difference in the patterns of engagement between the two cohorts as measured by page views.

Figure 14 shows opposing trends in the relation between page views and outcome. The blue bars show engagement for the Summer cohort. The correlation between page views and outcomes is negative. These summary data again disguise intra-class variation.

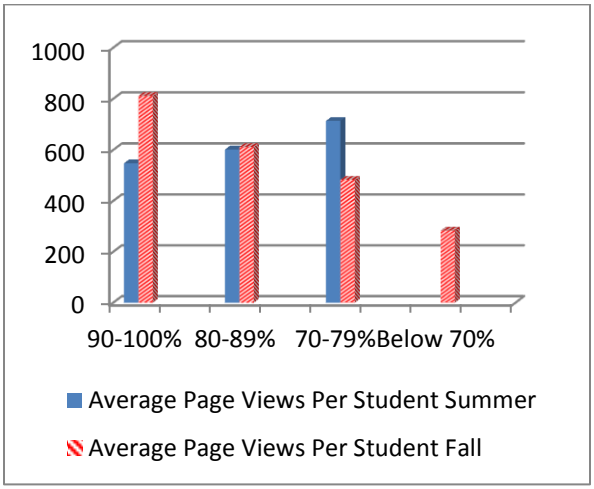


**Figure 14** Engagement and Outcomes: two semester comparison

The highest and lowest number of views for the highest outcome class was 1003 and 366. Here, the low is close to one third of the high, a significantly larger proportion than that seen among the equivalent group in the fall cohort. For those who achieved a B (80-89%) the figures were 951 and 292: here the low is less than one third of the high (31%). This is consistent with both the size of this group (25 students) in the outcome distribution and – perhaps significantly – the range in the higher performing group. Those in the Summer cohort who achieved a C (70-79%) ranged from 952 to 590 page views: two observations are pertinent here. Firstly, the range among the students (n=3) in this group is narrow, the low being almost two thirds (62%) of the high. Secondly – and perhaps consequently – the average for this group is closer to that for the other two outcome groups in this cohort. This gives a much lower gradient to the trend in Figures 5 and 14.

The trend for the Fall 2013 cohort (Figure 10 and the red bars in Figure 14) has an inverse gradient but one which – more intuitively – indicates that performance decreases as page views decrease.

Page views among students in the 80-89% outcome class are remarkably similar, both in number and range. For the Summer cohort, the low of 292 is 31% of the high (951). For the Fall cohort, the low is 34% (339) of the high (996).

Although the data for this inter-cohort comparison do not immediately reveal a causal link between page views and outcomes, the inconsistencies are significant and raise a number of questions. Although, on the face of it, it might be argued that participations and assignment submission figures provide more reliable prediction of outcomes, this deflects from the potential that these finer-grained data contribute to our understanding of the dynamics of student engagement.

## 7. CONCLUSIONS

In this work we have strived to overcome some of the limitations evident in prior studies of student engagement. By conceptualizing engagement as a multi-faceted meta-construct we developed a research design that enabled us to explore the capacity of the LMS at our institution to operationalize the constructs that undergird the Bundrick et al (2014) model.

Clearly, our study is limited by a number of factors: the single course comparison and the 'coarseness' of the data provided by the LMS, both in terms of the range of scales measures and the limited number of time-points at which they are reported.

Nevertheless, this initial research highlights the potential of the cohort and individual (student) units of analysis to provide insights into engagement that substantially supplement the collective institution-level analyses presented by NSSE.

Although 'complete', this research presents more questions than answers: we are currently working with our LMS providers and administrators to extract data that will provide an even more dynamic view of the interactions at the heart of the Bundrick et al (2014) model (Figure 1 above). This will enable our future work to address the limitations set out above and the questions posed. In particular, we will use the more comprehensive data to relate student interactions, engagement and outcomes in the on-line 'classroom' setting to examine the level and significance of inter-student engagements noted by Baepler & Walker (2014). The research question here is whether participation in collaborative assignments such as those designed for the course discussed in this paper allow more full 'exploitation' of the opportunities that 'new classrooms' present and thus positively affect student outcomes.

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**Editor's Note:**

*This paper was selected for inclusion in the journal as an ISECON 2014 Distinguished Paper. The acceptance rate is typically 7% for this category of paper based on blind reviews from six or more peers including three or more former best papers authors who did not submit a paper in 2014.*

**Appendix A**

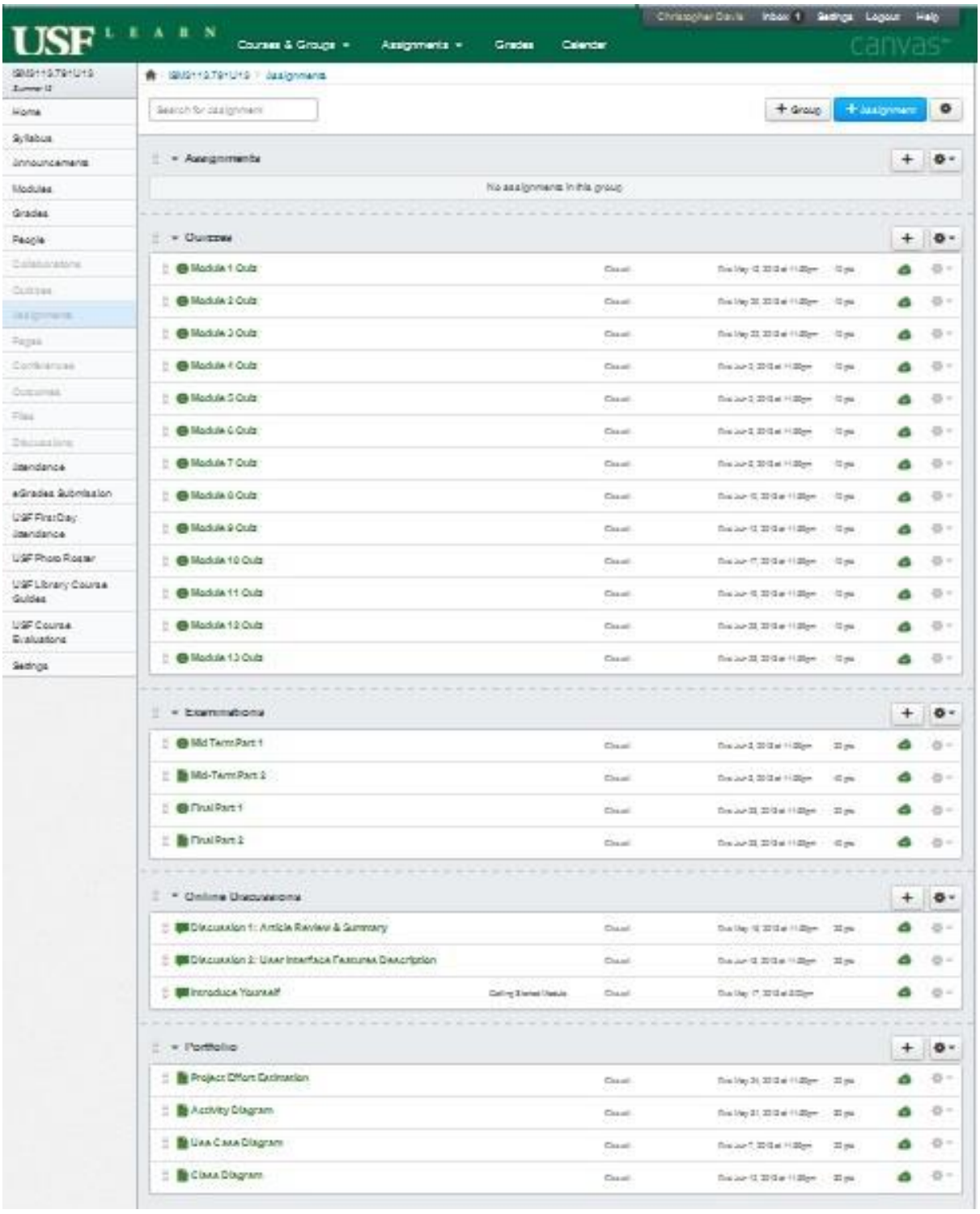


**Figure 3 Assessment Regime**