International Journal of Curriculum Development and Learning Measurement
Volume 4 • Issue 1

What Can Data Tell Us?
Using Classroom Data to Determine Student Engagement

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ABSTRACT

Researchers have found that student engagement has an impact on student learning, retention, motivation, and persistence in higher education. However, faculty often experience challenges in maintaining high levels of student engagement in their classes. Data collected in class during activities, through learner generated reports, and at various points in students' academic careers can provide valuable insight into student engagement. This datum can be used to enhance instructional approaches and curricula to improve student academic gains and interest. Further, universities can use student engagement data to better support vulnerable student populations and improve institutional effectiveness. Because student engagement can have a profound effect on student engagement, this literature review highlights how universities can collect and analyze data to provide targeted instructional practices to augment student performance.

KEYWORDS

Assessment, Data, Engagement, Higher Education, Motivation, Pedagogy, Student Engagement, Student Retention

INTRODUCTION

This literature review focuses on the impact of using data to further engage students in their learning efforts. This topic is vital given that student engagement can be viewed as an indicator of teaching success. When students are engaged in their learning, they are motivated toward goal completion and are attentive, curious, and interested in their class sessions and activities. The term student engagement is prominent in institutions of higher education. Researchers have defined student engagement as participation in education practices within and outside the classroom (Kuh et al., 2007), the extent of student participation in activities aligned with learning outcomes (Krause & Coates, 2008), and students' efforts directed to desired learning goals (Hu & Kuh, 2003). Student engagement has been found to be positively related to academic achievement (Casuso-Holgado, 2013; Chen & Chiu, 2016; Schnitzler et al., 2020). Barkley and Major (2020) stated that student engagement is a factor of effective teaching. However, in today's classroom settings, educators often have a difficult task of determining

DOI: 10.4018/IJCDLM.320219 *Corresponding Author

how to maintain student engagement. Indeed, Christopoulos et al. (2018) claimed that educators are often faced with the challenge of engaging learners with course learning materials. Ineffective instructional approaches can be detrimental to student success and persistence in their educational pursuits. As a result, the concept of student engagement has been at the forefront of policymakers, government officials, and educational leaders' concerns in how to situate student success in higher education (Kahu & Nelson, 2018).

Today's learners are completing their coursework through a variety of formats that include both traditional brick and mortar and virtual learning platforms. Regardless of the educational environment, educators are tasked with ensuring that students receive access to high quality instruction. Holmes (2018) postulated that high levels of student engagement can occur in all learning modalities including online, blended, and face-to-face. Further, Nasir et al. (2020) shared that researchers have discovered that students in diverse learning contexts have performed similarly and that students have reported comparable feelings of course satisfaction. Moreover, Nasir et al. (2020) conveyed that regardless of classroom structure student engagement data can share vital information concerning instructor effectiveness. Recently more emphasis has been placed on how to efficiently use student data to enhance students' levels of learning engagement. For example, Jones (2020) proposed using metrics that capture student progress in order to develop retention strategies and identify areas of student success. Student retention is considered a global issue and has become the focus of many institutions of higher education (Far-Wharton et al., 2018). Far-Wharton et al. (2018) indicated that in the last decade universities have centered on student inadequacies that result in lower engagement and attrition or institutional strategies geared toward enhancing engagement and increasing retention rates. However, "fostering student engagement is a critical challenge for instructors regardless of their disciplinary focus" (Alvarez-Bell et al., 2017).

STUDENT ENGAGEMENT

Student engagement is referred to as academic engagement, student involvement, academic integration, and student experiences (Bowden et al., 2019; Khademi Ashkzari et al., 2018). Further, student engagement has been the focus of many researchers for the last several decades due to their interest in how to better define this concept and apply it in educational contexts. The notion of student engagement has been of particular importance due to its crucial role in higher education settings. Recently, researchers have investigated students' levels of engagement to more effectively determine how to structure curricula (Khan et al., 2017; Manwaring et al., 2017; Morton, et al., 2019), implement assessments and interventions (Appleton & Silberglitt, 2019; Serrano et al., 2019), select a learning platform (Al-Tameemi & Xue, 2019; Wang, 2017; Williams & Whiting, 2016), and identify effective instructional approaches (Czerkawski & Lyman, 2016; Russell et al. 2017). The concept of student engagement emerged as a framework for providing more insight into being able to understand, diagnosis, and improve education (Kinzie, 2017).

Current literature defines student engagement in a variety of ways. However, Kahu and Nelson (2020) indicated that "the mechanisms contributing to the individual students' engagement have not yet been clearly articulated and the term engagement is used differently in various contexts" (p. 58). Student engagement is also defined as "a process and product that is experienced on a continuum and results from the synergistic interaction between motivation and active learning" (Barkley, 2010, p. 8). Astin (1999) described student engagement as "the amount of physical and psychological energy that the student devotes to the academic experience" (p. 518). Further, student engagement has been characterized as students' willingness to participate (Bornia et al., 1997), efforts toward learning (Tai et al., 2019), degree of online interactions with educational resources (Wintrup, 2017, 89), and feelings toward a class activity (Barkely & Major, 2020). Prior researchers have predominately defined engagement as student participation and their time on task (Fredericks, et al., 2011). University faculty often describe engagement as students being involved in their learning tasks and using higher-order

thinking skills (Barkley & Major, 2020). Similarly, Barkley and Major (2020) shared that students indicate that engagement is being more involved in their learning and being active learners.

Student engagement similarly has been described as intrinsically linked to the learning metrics of student satisfaction and student experience (Homes, 2018). How students perceive their learning and the experiences that they receive while engaged in their studies impact their perceptions of quality educational experiences. Students who are engaged in their learning are more likely to be successful in their university courses. In essence, student engagement is perceived as an intervention to further encourage students to be active classroom participants. When students are engaged in their courses, they are more likely to be on task and complete their classroom activities and assignments, which results in higher levels of participation and achievement. Quin (2016) described student engagement as being an *antidote* to disruptive behaviors, truancy, academic failure, and high dropout rates. Researchers have found that disengaged students are more often disruptive, earn lower grades, experience higher dropout rates, and have lower aspirations for higher academic goals (Kaplan et al., 1997). Contrastively, engaged learners are attentive, exert higher levels of effort, and exhibit an interest to learn (Fredericks et al., 2004).

In Northey et al.'s (2017) study, their findings revealed that increased engagement results in enhanced levels of participation and academic achievement. Further, Lin et al. (2019) found students' engagement toward learning activities positively impacted their levels of classroom participation, readiness to learn, and acquisition of course outcomes. Additionally, meta-analysis studies have shown moderately strong positive correlations between student engagement and achievement (Chang et al., 2016; Lei et al., 2018). Essentially, student engagement encompasses emotional, motivational, and cognitive domains that impact students' behaviors and desire to participate in their classes. Still, careful consideration should be placed on how instructors create classroom interactions and their impact on students.

Christopoulos, et al. (2018) discovered that thoroughly and appropriately designed interactions (e.g., real-world examples) can have a significant impact on learner engagement. University faculty are able to create engaging learning environments through a variety of resources in which they provoke critical and creative thinking and when they have a strong instructor presence in their courses. For example, faculty can include develop essential discussion questions, allow for structured arguments, and provide hands-on practical applications of course content. By providing students engaging learning experiences, students may be more likely to persist in their studies, perform higher on assessments, engage in prosocial behaviors, and persist when completing challenging tasks (Bae & Lai, 2019). When examining college students' experiences, Milesi et al. (2017) determined engagement had an impact on leaners' persistence in pursing their selected degree of study.

Further, Kimbark et al. (2016) also found in their study that student engagement resulted in higher levels of persistence, retention, and academic achievement. By engaging students in their classes, instructors provide learners meaningful academic experiences that promote personal growth, higher levels of creativity and productivity, and allow students to *fail forward* in which they learn through their experiences and mistakes. Students are further provided opportunities to become autonomous learners and work successfully toward achieving their goals. Engaged students may be more likely to put forth more effort into their work and submit higher quality products. The amount of student learning that occurs in classrooms has been found to be directly linked to the quality and quantity of student engagement in their courses (Junco, 2012).

Student Engagement Dimensions

The concept of student engagement has been conceptualized as being multidimensional. Specifically, student engagement encompasses three interrelated dimensions which include: 1) behavioral, 2) emotional/affective, and 3) cognitive components (Fredricks, et al. 2018). These dimensions impact students' actions, levels of commitment and participation, and feelings and identification toward their academic studies. For example, behavior engagement is focused on students' participation

in academic activities and learning tasks (Finn, 1989; Skinner et al., 2008). Whereas, emotional engagement may impact students' sense of belonging, connection to their school, and concern toward learning (Appleton et al., 2006; Ghanizadeh et al., 2020) and their levels of involvement (Skinner et al., 2008). Cognitive engagement is centered on the students' willingness to take on and complete learning activities and their willingness to invest in the task (Rotgans & Schmidt, 2011). Researchers reported positive correlations between all domains and students' academic achievement (Chang et al., 2016; Lei et al., 2018). Further, Ghanizadeh et al. (2020) examined these engagement dimensions and found that they are all impacted by instructional approaches. They proposed that educators "need to develop a sense of caring and relatedness in their classrooms by emphasizing a sense of community (p. 142)," which can further promote student engagement in the behavioral, emotional, and cognitive dimensions. The concept of engagement is vital for researchers to understand since it impacts student performance (Rashid & Asghar, 2016), retention (Al-Tameemi & Xue, 2019; Holmes 2018; Mandernach, 2015), study habits (Paulson & McCormick, 2020), and achievement (Çakıroglu et al 2017, 98; Fredricks et al., 2016). Casuso-Holgado et al. (2013) conducted a study in which they measured academic achievement and engagement. The findings of their study align with other studies that similarly found that there is a positive correlation among students' achievement and levels of achievement. Essentially, student engagement is aligned with academic success and achievement. Therefore, universities need to determine how to engage students in their courses and identify what internal and external factors impact student engagement.

Academic Data

The literature also notes the value in faculty providing students active, engaging learning experiences in the classroom or in the online setting. In fact, Ontario's Distance Education and Training Network (2020) contented that students expect to be engaged in their classes. However, in addition to experiencing challenges in implementing these learning conditions, faculty struggle in their assessment of student engagement at the course level (Mandernach, 2015,). One approach that could be utilized to ensure institutional effectiveness, in which the university is engaged in continual self-evaluation to measure achievements and outcomes, is the inclusion of evidence-based practices rather than faculty applying approaches that they are most familiar or comfortable using. The inclusion of evidence-based practices has been found to positively impact student engagement and learning gains (Strambler & McKown, 2013). Particularly, studies conducted by researchers have demonstrated that evidence-based practices can improve student engagement, satisfaction, and performance (Abla & Fraumeni, 2019; Russell et al., 2015). By including evidence-based practices in which educational strategies are supported by research, universities are also able to strengthen the connections found between educational research and instructional approaches (Kinzie, 2017). There are a vast range of ways that faculty can incorporate evidence-based practices to engage their learners. Examples of these practices include providing students the opportunity to synthesize and apply their learning, engage in quality interactions with their faculty and peers, and receive learning experiences that are practical, relevant, and that can be applied in authentic settings (Zepke, 2018).

In recent years, there has been a growing interest from faculty and researchers in using data to support student engagement in academic settings. By collecting and analyzing data, faculty gain valuable insights into how students are interacting with the learning materials, what motivates them, and what obstacles they are facing. This information can be used to tailor instruction to better meet the needs of individual students, and to identify areas where additional support may be needed. Therefore, universities need to collect and analyze student data (e.g., final grades, performance on capstone projects, time to completion rates) to better understand student learning and identify potential interventions to enhance institutional effectiveness. Further, by examining student academic data (e.g., grades, retention rates, performance on state and national certifications), faculty are able to determine the appropriateness of their curricula, the impact of class activities, and the usefulness of technological resources to support learning (e.g., number of student questions related to assignment). Atherton et

al. (2017) suggested that academic data can be used as a predicator to enhance student learning and academic outcomes. By successfully structuring course content, students are more likely to remain connected to the class and their learning. Dixon (2015) further found that active class interactions are an essential component of student learning and as a result of these communications students are afforded the opportunity to engage more deeply with course content.

ASSESSMENT MEASURES

Faculty can be accountable for identifying factors of student engagement that may impact academic performance. Particularly, by understanding factors that impact student learning outcomes, faculty may be able to identify low-performing students or at-risk learners. Specifically, newer forms of technology are also making it possible for faculty to more easily identify students who need more comprehensive academic support (Gray & Perkins, 2019). For example, data analytics retrieved from learning management systems provide evidence of students' use of online resources (Atherton et al., 2017) and allow for monitoring of students' progress toward course objectives (Schumacher & Ifenthaler, 2018). One vital measure in determining the quality of instructional practices is student engagement (Zhang et al., 2019). Jones (2020) suggested that student engagement data can be collected during individual courses (across several weeks), each semester, and throughout students' programs of studies. Specifically, student engagement can also be measured at a single activity level (e.g., course assignment) to determine in the moment engagement or at the completion of the student's entire school experience (Henri et al., 2018). Mandernach (2015) indicated that student engagement could be assessed through items focused on the behavioral (e.g., number of times a student asks a question), cognitive (e.g., development of learning goals), and affective domains (e.g., perceptions of course activities). Additionally, researchers have studied engagement through measuring individual (e.g., each student) and group levels (e.g., cohort of students) and by a variety of analytic techniques (e.g., grouping methods) (Fredericks et al, 2016).

Other researchers have also examined user activity logs (e.g., number of log-ins, time spent on resources), learning and predictive analytics, and student generated data (e.g., course questions, submitted assignments, discussion posts) that are produced in university learning management systems (Henrieet al., 2018; Wintrup, 2017) and self-report measures (Fredricks et al., 2016) in order to further understand student engagement. With the advent of innovative technologies, faculty are also observing new forms of student engagement regarding how they interact with their assignments, group projects, and discussions. These various types of metrics (e.g., course grades, learning analytics) are valuable in providing faculty an understanding of student performance and success and an understanding of why students fail to complete their academic studies. For example, Alvarez-Bell et al. (2017) found that student learning is influenced by how they feel about their educational environment (e.g., positive classroom culture). They further found that students' perceived learning is also impacted by their instructor's level of commitment and guidance to student learning attainments. Essentially, faculty members' efforts in promoting student success impacts learners' perceptions of their academic experiences. Henrie et al. (2018) recommended that in order to most effectively capture student learning, impact of instructional design, and student persistence in their coursework, assessment measures should focus on specific learning activities (e.g., course assignments, discussions, etc.). One of the key benefits of effective assessment measures is that they can help to identify areas where students are struggling and provide opportunities for faculty to offer additional support or resources. For example, if multiple students perform poorly on a particular exam or assignment, it may be an indication that the material was not presented clearly or effectively. Faculty can use this feedback to adjust their teaching methods or provide additional resources to help students master the material.

Faculty also have access to sophisticated technology to analyze metrics associated with student access of resources, attendance records, use of technology, expectations, and learning barriers (e.g., content students experience a difficult time attaining). By using learning analytics, Atherton et al.

(2017) shared that student engagement and success could be improved particularly with students who are identified as most vulnerable (e.g., low-performing students). Essentially, the use of learning analytics provides faculty access to tools that they can utilize in order to provide equitable learning experiences across student groups (e.g., instructional approaches, resources). Learning analytics has been a leading trend in higher education and has been found to enhance academic activities and instructional practices (Atherton et al., 2017). Specifically, learning analytics provides valuable information on teaching and learning approaches (Lee et al., 2020). Analytical tools are valuable in providing educational institutions access to data in order to make more informed decisions on how their courses are structured and the effectiveness of their faculty members.

The inclusion of course-related technology and innovative forms of technology (e.g., learning management systems, video conferencing platforms) has also contributed to student connectivity and engagement (Collaco, 2017). For instance, faculty are able to collect data via survey instruments in which students self-report their levels of engagement in their courses. Dixon (2015) recommended the following three student engagement measures in order to collect this type of data: Rubric for Assessing Interactive Qualities of Distance Courses (captures students' perceptions of other students' behaviors), Classroom Survey of Student Engagement (students report their behaviors inside and outside of class), and the Student Course Engagement Questionnaire (focused on multiple factors that include skills engagement, emotional engagement, participation/interaction engagement, and performance engagement). In online settings, faculty need to capture student data that is focused on their interactional patterns (e.g., number of posts in a discussion forum) and time spent on different course resources (e.g., readings, videos, modules of study).

. Essentially, effective assessment measures provide valuable information on the effectiveness of teaching methods and curricula. By analyzing the results of assessments, faculty gain insights into which teaching methods are most effective in promoting student learning, and which areas of the curriculum should be revised or updated. For example, Casimiro (2016) examined online discussions and discovered that students were most active in their courses when the instructor structured content to be relevant to students' needs and that was perceived as personal and accommodated cultural realities. Further, Purinton and Burke (2020) found that the inclusion of student videos, meaningful course projects, and a fostered sense of classroom community were all ways to enhance student engagement. Additionally, in order to better understand student engagement in online learning contexts, faculty should review student course evaluations and collect student survey data focused on students' perceptions of course activities. To maintain student engagement in online settings, faculty are recommended to include the seven principles of cooperative activities, increased contact, active learning, timely feedback, individualization, high standards, and time requirements (Bolliger & Martin, 2018). These principles are also important for face-to-face instruction in maintaining student engagement. In brick and mortar classes, faculty may also subjectively measure engagement through students' levels of verbal participation. However, Frymier and Houser (2015) discovered that the relationship between verbal participation and engagement is weak and that there was a positive association found between student nonverbal attentiveness and engagement Regardless of the learning format educators need to incorporate key elements of engagement which include active learning, peer collaboration, and interactional opportunities (Paulson & McCormick, 2020). Ensuring that students remain active in their courses can result in higher retention rates and levels of student satisfaction in their academic studies. Waldrop et al. (2019) highlighted the substantial of benefits associated with attainment of a university degree including more opportunities for career advancement, higher salaries, longer life spans, and overall better health.

HIGHER EDUCATION IMPLICATIONS

One key implication of using data to support student engagement in higher education is that it can help to create a more personalized learning experience for students. By analyzing data on students'

performance, preferences, and behaviors, faculty can identify patterns and tailor their teaching strategies accordingly. For example, if a particular student is struggling with a certain concept, instructors can use data to identify areas where the student needs additional support and provide targeted resources or feedback to help them improve. This insight is vital given that students have provided a wide range of reasons for why they decided to discontinue their university studies including a lack of support, course load issues, feelings of academic unpreparedness, and factors related to socio-demographics (Jones, 2020). As such, educational leaders are tasked with the ongoing challenge of how to provide students quality educational experiences that are reflective of their unique needs for academic success. Historically, institutions of higher education have place emphasis on systematically measuring student experiences through student evaluations, pedagogical approaches, and educational practices (Grebennikov & Shah, 2016). Analyzing student data helps universities to measure trends in higher education (e.g., flipped classrooms, innovative technologies) that impact student outcomes and their levels of engagement in their coursework. Although measuring student engagement can be difficult (Boulton, 2019), faculty and university leaders need to understand the factors that impact student engagement and their implications on learning gains and relevancy to students' professional goals. In a study conducted by Callaco (2017), students shared that faculty increase student engagement by having learners actively involved in their learning experiences, incorporating relevant and enjoyable classroom lessons that enhance student and teacher interactions, and allowing students to partake in collaborative activities. Further, faculty can capture students' attention by structuring the content so that it is relevant and applicable to real-world events and professional settings.

By engaging students, faculty may be more apt to provide effective learning that is aligned with students' professional goals and aspirations. In fact, Kahu and Nelson (2018) indicated that student engagement is a well-known pathway to academic success. Using data to support student engagement allows for fostering a culture of continuous improvement in higher education. By regularly collecting and analyzing data, faculty have the tools needed to\ identify trends and patterns over time resulting in informed decisions about curriculum, teaching methods, and student support services. This approach can help to ensure that students are receiving the best possible education, and that faculty are continually refining their practices to meet the changing needs of their students. However, effective teaching extends beyond subject matter expertise to faculty understanding effective instructional strategies that engage their learners. Although faculty may be challenged by this task, universities have a fundamental obligation to students to promote effective learning and active engagement of their students. Essentially, institutions with well-developed and effective student engagement strategies are able to impart students with necessary skills, empowerment, and sense of responsibility needed for attainment of their academic goals.

CONCLUSION

By analyzing classroom data, educators can further understand students' levels of engagement and how to better align their curricula and instructional approaches in order to more effectively capture students' interests and enhance their academic gains. Indeed,

researchers have found that instructional styles are associated with improved academic grades (Andres, 2017; Bartholomew et al., 2018; Dever & Karabenick, 2011; Quin, 2016; Wang et al., 2016). Using data to determine student engagement is further valuable in providing institutions additional support in determining appropriate student resources needed for student retention and program completion. For example, Fredricks et al. (2016) postulated that there is evidence to suggest that engagement is "malleable and responsive to change" in instructional and institutional practices and that "engagement holds tremendous potential as a key target for interventions." Particularly, institutional census data provides only a snapshot of student program completion and does not capture the teaching and learning processes and the resources involved in these efforts (Jones, 2020). Paulsen and McCormick (2020) cautioned that universities need to also consider students' backgrounds to

ensure that nontraditional students enrolled across all modalities are also supported and engaged throughout their studies. University faculty also need to determine how to make their pedagogical approaches be inclusive of the diverse dimensions of student engagement. Instructional approaches can encapsulate these dimensions by providing students a voice, offering opportunities for learners to emotionally connect to their universities, monitoring participation and attendance, providing transformative learning experiences, and enhancing their employability competencies (Bowden et al., 2019).

This literature highlights how student engagement is a powerful and impactful aspect of student success and learning. Actually, Fredericks et al. (2016) shared instructors often report that the greatest obstacle in their classes is student disengagement. Moreover, Kahu and Nelson (2018) indicated that student engagement and success are "inextricably inter-twined." Student engagement can be captured through various assessments and via technological resources. By examining student engagement data, universities are able to rethink their instructional approaches and better capture student academic preferences. In sum, because student engagement will continue to be an ongoing concern for universities, faculty need to continuously modify their approaches to be reflective of motivating and meaningful learning experiences. Bowden et al. (2019) recommended that universities "cannot expect students to engage themselves" (p. 15). Consequently, educators need to understand the various factors that impact student engagement to improve student success and retention. Particularly, using data to support student engagement in higher education has the potential to transform the way we think about teaching and learning. By leveraging the power of data, faculty can create a more personalized, effective, and engaging learning experience for students, and ensure that they are well-prepared to succeed in their academic and professional pursuits.

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