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# Can Student Engagement in Online Courses Predict Performance on Online Knowledge Surveys?

**Bernard BAHATI, Uno Fors, Matti Tedre**
University of Rwanda, Stockholm University

**Abstract.** The link between student engagement and academic performance has been widely examined. However, most of these studies have focused on ascertaining the existence of such a relationship on the summative assessment level. By comparing students' experience points in an online course and students' scores on online knowledge surveys (KS), this study examined the relationship between student engagement and performance on online KS on the formative assessment level. Knowledge surveys were developed and formatively administered in four sections of an online Integration of ICT in Education course. Using Moodle Feedback Module, knowledge surveys were designed based on three key elements: learning objectives, the course content, and the revised Bloom's Taxonomy of learning objectives. Using rated multiple choice KS questions, the correlation between students' scores on KSs and students' experience points was calculated using SPSS. The results show that students' confidence levels in ability to answer KS questions increased in some of the course sections and decreased in others. The student engagement in online course was positively—but weakly—related to student performance on online KS and the strength of this relationship increased as the course unfolded. Our conclusion is that student engagement in online courses would not be an accurate predictor of student performance on online Knowledge surveys right at the beginning of an instructional process.

**Keywords**: Formative e-assessment, knowledge survey, student engagement

## 1. Introduction and theoretical background

The relationship between student engagement and performance has attracted many educational researchers' and practitioners' attention. Student engagement is a glue or mediator that may establish a link between various contexts of student's learning (Christenson et al., 2012) and for Dunne (2013), "engaged student" is synonymous with "successful student." Presumably, the more students engage with a learning subject, the more they learn about it (Kuh, 2009). In their comprehensive review of the research on the influence of colleges on students' learning, Pascarella & Terenzini (2005) are considered as the

pioneers of engagement-learning pairing. They argued "the greater their engagement with academic work, the greater the level of knowledge acquisition."

The advent of Internet and digital technologies have profoundly revolutionized and altered the way teaching and learning events might occur. Online learning is pervasive, is here, is not going away and the question is not whether it works but how (Shea-Schultz & Fogarty, 2002). One of the biggest questions or challenges associated with online learning is student engagement. In her blog on eLearning dilemma, Gutierrez (2014) observed that while there are already many issues related to student engagement in other learning settings, online learning may bring about additional obstacles resulting from a number of problems, including lack of (or) reduced interaction student-teacher and student-student interaction. Paradoxically, these interactions are key to an effective online student engagement and correspond to Moore (1989)'s widely applied approach to designing distance education whereby three online student engagement types should prevail: learner-learner engagement; learner-teacher engagement; and learner-content engagement.

Learner-content engagement is at the heart of any instructional activity and there cannot be education if the learner does not interact with the subject of study (Moore, 1989). The second type of engagement described by Moore points to the interaction established between the learner and the expert who prepared the learning material or any other person who acts as an instructor. Despite the increasing use of technologies in teaching and learning, the role of the teacher is as important as ever. Technology will hardly replace a teacher because, as Earle (2002) put it, technologies are just tools and they can only be valuable when a "human intelligence" uses them productively. In the classroom, the human in question is the teacher. The third type of student engagement in online learning appertains to the interaction between learners. This "inter-learner" interaction, argues Moore (1989), can take place between one learner and other learners, alone or in group settings, with or without the teacher 's synchronous or asynchronous presence. A number of research studies have suggested that student-student interaction in online learning can impact the learning process in various ways. In his study that examined student success, failure, withdrawal, and satisfaction in online course, J. Moore (2014) suggested that student-student interaction is one of the strongest predictors of success and satisfaction in online courses (see also Chang & Smith, 2008) and the higher the level of student interaction with other students, the higher the level of student satisfaction as well as learning (Hiltz, 2005). Moore (1989)'s theory of student interaction is well-known and can be applied to any educational setting. However, as online learning was growing in popularity, research studies started to increasingly question the completeness of the three-dimensional construct as a way to explain student interaction in online learning (Zimmerman, 2012). To address this concern, the original three-dimension interaction theory was revisited and a fourth dimension was added: the "learner to interface" interaction was proposed by Hillman et al. (1994) who contended that this

interaction was critical because its failure could inhibit student learning. In this interaction, interface refers to various technologies, platforms, and applications students need to use and manipulate in order to interact with course content, teachers and peers (Bourne & Moore, 2003). Ultimately, the student engagement in online learning revolves around four dimensions as we conceptualise it in Figure 1 for the purpose of this study.

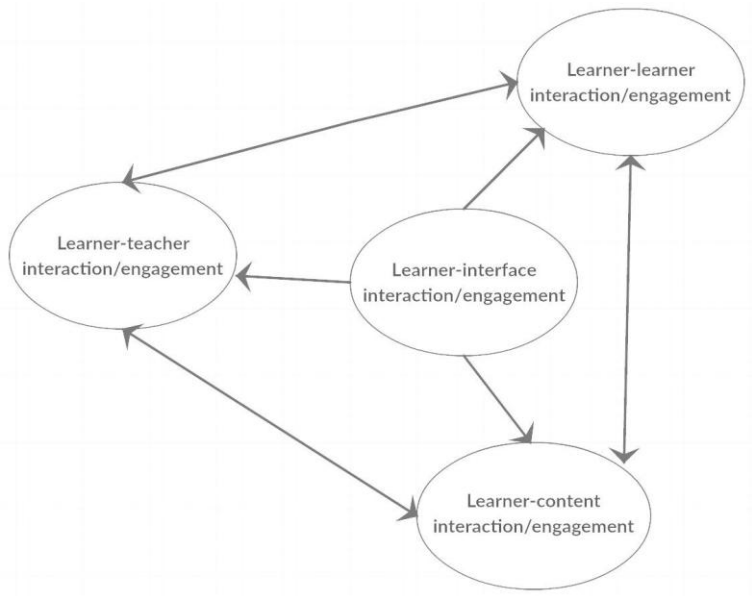



***Figure 1:*** *Conceptualisation of student engagement in online learning environment*

Figure 1 portrays a functional relationship that characterises the four dimensions of student engagement in online learning whereby the learner-interface interaction serves as a gateway to other interactions. In other words, a successful and effective learner-interface interaction will be a catalytic factor for effective and successful learner-learner, learner-instructor, and learner-content interactions. Conversely, a failed learner-interface interaction may compromise other interactions and thus inhibiting successful learning

## 1.1. Pairing student engagement and performance

The relationship between student engagement and academic performance has been well investigated. Results from McClenney et al. (2012)'s 20-year research study on undergraduate students were unequivocal: "the more engaged students are" —with teachers, peers and subject matter —"the more likely they are to learn" and keep a sustained focus and efforts on their studies and realise their learning goals. In the same vein, Li et al. (2008) found out that student engagement was associated with better grades while GUNUC (2014) demonstrated significant relationships between student engagement and the student' s academic achievement. In a study that involved 1,058 college and university students, Carini et al. (2006) examined the association between student engagement and various measures of academic performance and found out that student engagement was positively linked with targeted learning

outcomes and grades. In general, strong relationships have been found between students' time investment, interest, and effort in various educational activities and increased performance, persistence as well as satisfaction on academic task, Trowler (2010) and Kuh (2009) concluded that: "*students gained more from their studies and other aspects of the college experience when they devoted more time and energy to certain tasks that required more effort than others*".

Research studies on the relationship between student engagement and performance have focused on traditional (face-to-face) as well as online educational settings. The results from Rodgers (2008)'s study that examined the impact of the student engagement in online learning process on their end-of-year examination results, showed that greater interaction in online learning has a positive and statistically significant impact on academic performance (see also Wong, 2013). Johnson-Smith (2014) compared associations between learner's engagement and academic performance in technology enhanced and traditional (face-to-face) learning environments, and found out a significant difference between students' grades in those two learning environments. He concluded that multiple factors, coupled with the use of technology, led to an increased students' involvement in technology enhanced learning environment compared to the traditional one. Several other research studies concurred with these findings. Student engagement in online learning activities can be used as indicator of online learning experience and academic performance (Henrie et al., 2015); learners who are actively engaged score higher grades compared to less engaged learners (Kushwaha et al., 2015); and strong association was established between performance in midterm exams and a deliberate practising and problem-solving activities using online interactive spreadsheets files (Bertheussen & Myrland, 2016).

### 1.2. Knowledge surveys

Knowledge surveys consist of sets of questions that cover the entire content of the course (Wirth & Perkins, 2005). They can serve as tools students can use for analysing their understanding of the course contents, and teachers can use them for organising and reviewing the curricula (Bell & Volckmann, 2011), like a sort of self-evaluation procedure. The theoretical background of knowledge surveys is rooted into metacognition, or the student's "abilities to predict their performances on various tasks and monitor their current levels of mastery and understanding" (Bransford et al., 1999). Knowledge surveys build on two key features: *breadth* and *depth*. The breadth of a knowledge survey tool requires that the survey questions cover the entire content of the course, while depth requires the coverage of different levels of the cognitive domain (Wirth & Perkins, 2005). Knowledge survey practices can serve formative assessment purposes by providing students with an opportunity to monitor their understanding of the learning material as the teaching and learning process goes on, to know where and when they have deficiencies, to monitor their progress, and to get a prompt feedback which allows them to continuously track learning gains as the course unfolds (Nuhfer & Knipp, 2003). Knowledge survey also enhances student confidence and self-efficacy (Johnson, 2017; Villafañe et al., 2016) thus fostering self-regulated learning (Nilson, 2013) although student self-confidence and self-

efficacy do not always translate into real skills or knowledge mastery (Forsberg et al., 2016; Mac Giolla Phadraig et al., 2016; Pantziaras et al., 2015). More clearly, knowledge surveys may support formative assessment purposes by serving as a blueprint for students, explicitly laying out the expected competencies to be learned from the class, indirectly evaluating these competencies and immediately indicating student's strengths and weaknesses which leads to a more tailored learning experience (Baumgart & Hassemer, 2008).

The use of KS as an instructional tool has not been widely researched. Research studies in this area focused on examining the link between pre-and post-KS and student performance in final exams. By using pre-and post-knowledge surveys, Bowers et al. (2005) claimed that KS was not a reliable measuring tool of student learning as measured by final marks or exams, while Wirth & Perkins (2005) compared knowledge survey responses and examination results and suggested that knowledge surveys provide meaningful measures of learning gains. Later on, still in contrast with Bowers et al. (2005), Bell & Volckmann (2011) demonstrated that students' confidence levels on knowledge surveys were accurately reflected in their actual knowledge and Favazzo et al. (2014) showed that knowledge surveys could be an effective assessment tool of knowledge in terms of both breadth and depth.

Unlike previous studies that sought to examine the relationship between KS and final summative exams by using pre-and post-KS, this study used KS not in a pre-and post-format but rather as an online formative assessment tool that was implemented throughout the course. This study sought to use KS not as a diagnostic (pre-KS) and verification (post-KS) assessment tool, but as an assessment for learning tool that was implemented throughout the course to assess the student progress and not the end product (Smith, 2014). In addition, this study focused on the relationship that was examined in this study was between student engagement and performance on KS and not between KS and student performance on final summative exams.

## 2. Context of the study

This study was conducted in one of the colleges of the University of Rwanda (the College of Education) and focused on the undergraduate teacher training program. The study was carried out amid drastic reforms in Rwandan public higher education that led to a merger of all public higher learning institutions into one University of Rwanda. Among other expected outcomes, the merger aims at addressing the increasing demand for higher education by means of streamlining Open and Distance Learning and introducing e-learning. In addition, this study follows up and builds on others studies previously conducted at UR in the same area. Ngendahayo (2014) advocated for increased emphasis on assessment for learning practices. Ngendahayo & Askell-Williams (2016) called for the use of new assessment methods and practices that focus on collecting information on student learning and monitoring student's learning and progress, such as the use of technology in production, publication and engagement with formative feedback in order to address "time and large class

constraints" (Bahati et al., 2016). These constraints were found to compromise in-class formative assessment practices, and thus, overlooking students' needs as they prefer to be involved in assessment activities that are integral parts of the teaching and learning process (Mugisha, 2010).

## 3. Methodology

### 3.1. Study design

In this study, a correlational study design was used to assess the relationship between two continuous variables (SAGE research methods online [electronic resource], 2011): student engagement in and online course (Integration of ICT in Education) and performance on online knowledge surveys, gathered from all students in a single course.

### 3.2. Research question and hypothesis

By assessing the relationship between the two variables mentioned above, this study wanted to answer the following research question: Is there a significant relationship between student engagement in an online course and performance on online knowledge surveys? The reviewed literature shows links between student engagement and performance, thus lending support to a testable hypothesis that student engagement in online courses and and performance on online knowledge surveys are positively and significantly related.

### 3.3. Sampling

The participants in this study were selected through convenience sampling. The study sample was made of third-year student-teachers at the University of Rwanda-College of Education. Selection of the students invited to participate in this study was based on them being conveniently and readily available (Salkind, 2010; Grove et al., 2014). Each and every third-year student-teacher is required to take Integration of ICT in Education course (EDC 301). In view of this, 109 students were enrolled in the course and were ipso fact conveniently considered as research participants and they all gave their consent to voluntarily participate in this study.

#### 3.4.1 The online module EDC 301

This 10-credits module was taught during the first semester of academic year 2016-2017 at the University of Rwanda-College of Education and was delivered through the UR online learning platform (Moodle). The instructor used Knowledge Surveys in 4 of the 5 sections of the module. 109 students were enrolled in this course. However, since the use of KS was voluntarily based, some of them opted not to do KS as shown in Table 3 below:

***Table 1:*** *Expected and submitted responses to Knowledge Surveys*

| Knowledge | Expected | Submitted |
|---|---|---|
| KS 1 | 109 | 103 |
| KS 2 | 109 | 93 |
| KS 3 | 109 | 95 |
| KS 4 | 109 | 85 |

### 3.4.2 Measuring student performance on knowledge surveys

Knowledge surveys for EDC 301 were developed basing on three key elements: learning objectives, the module content, and the revised Bloom's Taxonomy of learning objectives (Krathwohl, 2002). The KS question items were developed using Moodle Feedback module and were sequenced along the four sections of the module. Questions were distributed among the various levels of the revised Bloom's Taxonomy of learning objectives as follows:

***Table 2:*** *Distribution of Knowledge Survey Questions into 6 levels of the Revised Bloom's Taxonomy of learning objectives*

| Knowledge Surveys | Number of questions | Remember | Understand | Apply | Analyse | Evaluate | Create |
|---|---|---|---|---|---|---|---|
| KS 1 | 32 | 6 | 8 | 4 | 4 | 4 | 6 |
| KS 2 | 27 | 7 | 6 | 4 | 3 | 3 | 4 |
| KS 3 | 26 | 4 | 3 | 5 | 3 | 6 | 5 |
| KS 4 | 23 | 10 | 3 | 2 | 3 | 3 | 2 |
| **Total** | **108** | **27**(25%) | **20**(18.5%) | **15**(13.5%) | **13**(12%) | **16**(14.8%) | **17**(15.7%) |

Sample question-items taken from KSs that were administered to students are presented in Table 3 below:

***Table 3:*** *A sample of Knowledge Survey Question items*

| **Revised Bloom's levels** | **% in KSs** | **Sample question-items** |
|---|---|---|
| Remember | 25 | (1). Define ICT. (2). What is the overall goal of ICT in Rwandan education policy? (3.). What are the main areas under which the findings from "Coping with change in ICT-based learning environments" are analysed? |
| Understand | 18.5 | (5). Draw a chronological line showing the evolution of ICT in Education in Rwanda. (6). Why Rwanda ICT Essentials for Teachers training module can be seen as a good example of blended learning? |
| Apply | 13.5 | (7). Write a brief outline about how much/well any in-service teacher would change upon completion of this training module. (8). What do you think would happen next if all Rwandan secondary teachers completed this training module on ICT Essentials for Rwandan Teachers? |
| Analyse | 12 | (9). By using convincing examples distinguish between "teaching ICT" and "teaching with ICT." (10). What do the |

| | | |
|---|---|---|
| | | authors of this research paper assume about Coping with change in ICT-based learning environments? |
| Evaluate | 14.8 | (11). Having in mind the current level of "available resources" in Rwandan school What do you think should be prioritized: (1) Teaching ICT or (2) Teaching with ICT? Defend your position. (12). The Rwandan ICT policy statement may appear "utopian" for some and "realistic but aiming-too-high" for others. What is your stand on this? Justify your answer. |
| Create | 15.7 | (13). Basing on a SWOT analysis you developed before (or you have to develop). Propose an implementation strategy for the 7th ICT policy area in your school. That is: "management, support, and sustainability." (14). If you were a head teacher and had all required resources how would you plan and implement a school based training for your teachers using ICT Essentials training module? |

### 3.4.3 Delivery of Knowledge Surveys

Knowledge surveys that were used in this study aimed at serving formative assessment purposes by helping students to monitor their understanding and progress throughout the EDC 301 module delivery. Prior to KSs delivery, students were given explanations on how and why KSs were going to be used in the EDC 301 module, and it was emphasised that KS was not an exam and thus they were not expected to know and give all the correct answers. Rather, for each question item of the KS, students were asked to rate their confidence in ability to answer the question on a scale of 1 to 5, where 1 means "not confident at all" and 5 means "absolutely confident."

### 3.4.4 Scoring of Knowledge Surveys

The KSs were not formally graded. However, question items were assigned scores using Moodle rated multiple choice questions whereby each option had a numerical value associated with it using one point for "not confident at all" response, two points for "neither confident or unconfident" response, three points for "somewhat confident", four points for "confident", and five points for "absolutely confident". Therefore, the higher the student's score, the greater the student's confidence level in ability to answer the KS question-items.

### 3.4.5 Measuring student engagement in EDC 301 online course

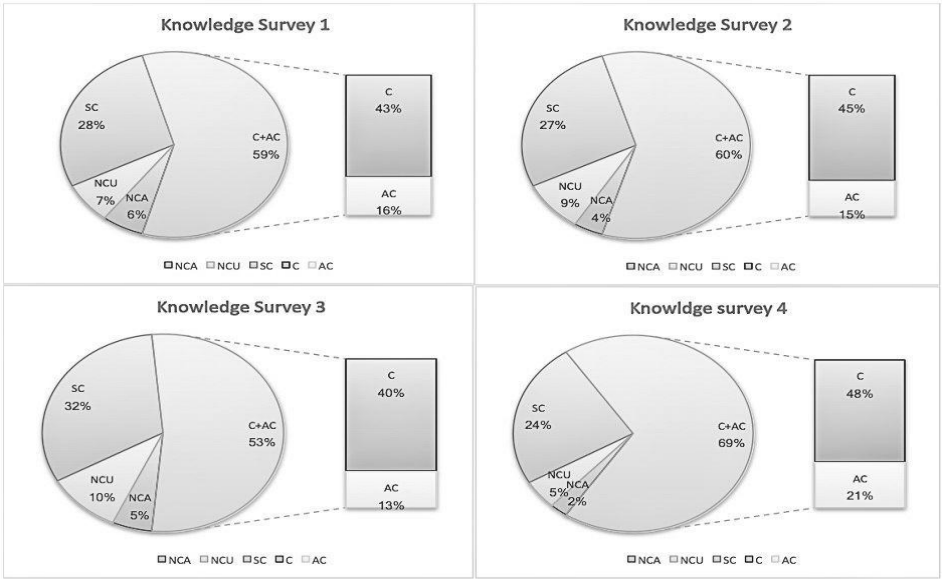
Student engagement in EDC 301 course was measured by using a Moodle block plugin called "level up". This Moodle plugin automatically captures and attributes "experience points" to student's actions in online course. The block listens to various events triggered in a learning management system, and

captures and records some events based on pre-defined rules. In this study, three pre-defined rules that were used to serve as "cheat guard" included: (1) the time frame for maximum actions was set to 60 seconds, which the student could not exceed; (2) ten actions that would count for experience points during the time frame and any subsequent actions were ignored; (3) the time required between identical actions was set to 180 seconds.

## 4. Results

### 4.1. Analysis of knowledge survey results

The results from the students who completed the surveys (see Figure 2) show that, in general, students were confident (KS1: 43%, KS2: 45%, KS3: 40%, and KS4: 48%) in their ability to answer the KS questions.




**NCA**: Not Confident at all, **NCU**: Neither Confident nor Unconfident, **SC**: Somewhat Confident, **C**: Confident, **AC**: Absolutely Confident

**Figure 2:** *Knowledge survey results*

Combined with the number of students who rated themselves as absolutely confident (KS1: 16%, KS2:15%, KS3:13%, and KS4: 21%) in answering the KS questions, the overall picture of the knowledge survey results changes. The results show that, for all of the four KSs, more than 50% of the students perceived themselves as confident or absolutely confident (KS1:59%, KS2: 60%, KS3: 53%, and KS4: 69%) in answering the KSs questions. As mentioned earlier, although KSs were not graded per se, KS questions-items were assigned scores using Moodle rated Multiple choice questions and the students' scores are summarised in Figure 3.

| KS1 | | |
|---|---|---|
| N | Valid | 103 |
| | Missing | 0 |
| Median | | 114.00 |
| Skewness | | −.380 |
| Std. Error of Skewness | | .238 |
| Minimum | | 64 |
| Maximum | | 150 |
| Percentiles | 25 | 100.00 |
| | 50 | 114.00 |
| | 75 | 128.00 |

| KS2 | | |
|---|---|---|
| N | Valid | 93 |
| | Missing | 10 |
| Median | | 98.00 |
| Skewness | | −.392 |
| Std. Error of Skewness | | .250 |
| Minimum | | 58 |
| Maximum | | 124 |
| Percentiles | 25 | 86.50 |
| | 50 | 98.00 |
| | 75 | 106.00 |

| KS3 | | |
|---|---|---|
| N | Valid | 95 |
| | Missing | 8 |
| Median | | 94.00 |
| Skewness | | −.359 |
| Std. Error of Skewness | | .247 |
| Minimum | | 52 |
| Maximum | | 125 |
| Percentiles | 25 | 78.00 |
| | 50 | 94.00 |
| | 75 | 102.00 |

| KS4 | | |
|---|---|---|
| N | Valid | 85 |
| | Missing | 18 |
| Median | | 90.00 |
| Skewness | | −1.226 |
| Std. Error of Skewness | | .261 |
| Minimum | | 36 |
| Maximum | | 113 |
| Percentiles | 25 | 80.00 |
| | 50 | 90.00 |
| | 75 | 98.00 |

***Figure 3:*** *Distribution of students' scores on Knowledge surveys*

Figure 3 shows that, for all of the four KSs, the distribution of students' performance in all four KSs is negatively skewed thus most of the students scored above the average. The maximum score obtained for KSs was 150 out of 160 for KS1, 124 out of 135 for KS2, 125 out of 130 for KS3, and 113 out 115 for KS4 and the minimum score was 64 for KS1, 58 for KS2, 52 for KS3, and 36 for KS4. To determine whether students' experience points could be used as accurate predictors of students' performance on KSs, we plotted KSs scores against experience points (Figure 4) for each section of the online module EDC 301.

Figure 4 shows that there was no correlation (with Spearman's rho: 0.099) between students' scores on KS1 and students' experience points in section one of the course. The correlation coefficients for section two and three (with Spearman's rho: 0.212 and Spearman's rho: 0.235) were relatively negligible but more significant for section four (with Spearman's rho: 0.454).

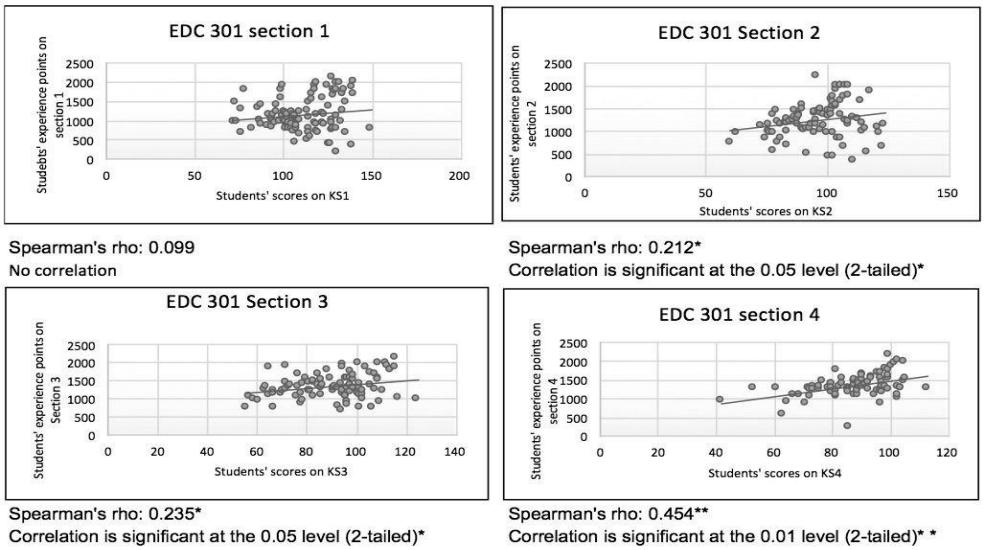



***Figure 4:*** *Plot of the relationship between students' performance on KSs and students' experience points*

## 5. Discussion

In this study, KS was used as an online formative assessment tool in 4 out of 5 sections of EDC 301 online course. By completing knowledge surveys, we expected students to predict their ability to perform in various activities of the course but also monitor their level of mastery and understanding, and reflect on their learning. Student engagement in online course and student confidence in ability to answer KS questions were analysed to ascertain whether experience points (used to measure student engagement) could accurately predict student performance on KSs. Unlike Bowers et al. (2005), who observed a significant increase of students' confidence over the semester in all of the sections of the course, we found out that students' confidence in ability to answer KS questions was not generally following a uniform pattern as students were progressing in the course. Actually, the students' confidence increased in section two, decreased remarkably in section three and then increased again dramatically in section four.

We assumed that an increase or a decrease in student perceived mastery was dependent upon a number of overlapping factors related to the course content, motivation to learn, teaching strategies, and the learning environment. For the course content, students' level of confidence was higher in two sections (two and four) whose content was part of the teacher-prepared course textbooks — reliance on textbooks (Kitao & Kitao, 2013) —and low in sections whose content was taken from other readings. We thought student motivation to learn, learning environment and the unfamiliar teaching and learning strategies were critical as well. At the beginning of the semester, students were experiencing a sort of "performance anxiety." Taking an online course (for their very first time) in a non-conducive learning environment (inadequate ICT facilities) and student-led assessment practices were putting students in a somewhat uncomfortable situation characterised by "the fear of failing" and affecting their motivation to learn. The students perceived confidence level in section one (at the beginning of the semester) and three (where unstable internet connection and a frequently inaccessible UR e-learning platform were observed) was lower and increased in sections two and four where the students' motivation to learn and self-assessment skills had been improved (Wirth & Perkins, 2005).

This study's findings concur with some studies (Ehrlinger et al., 2016; Stankov et al., 2014; Miller & Geraci, 2011; Bell & Volckmann, 2011; and Sieck et al., 2007) conducted previously about the phenomenon of students' overconfidence in rating their ability to perform. Despite the aforementioned challenges and uncertainty that students were facing in the course, the knowledge survey results show that, for all of the four KSs (See Figure 2), more than 50% of the students perceived themselves as confident or absolutely confident (KS1:59%, KS2: 60%, KS3: 53%, and KS4: 69%) in answering the KSs questions. This was also reflected in the students' scores in knowledge surveys (see percentiles in Figure 3) where, in all KSs, 75% of the students scored above 50% of the possible obtainable score. The results indicate that 75% of the students who submitted

their answers scored at least 100 out 160 in KS1, 86 out of 135 in KS2, 78 out 130 in KS3, and 80 out 115 in KS4. We agree with Favazzo et al. (2014) who suggested that asking students to provide a reason for their choices or rate their confidence and answer the questions at the same time would decrease over-estimated confidence.

This study's data do not support the hypothesis of a positive and significant relation between student engagement in online course and performance on online knowledge surveys. There was no correlation at all between student engagement (as measured by students' experience points) and student performance on online KS (as measured by students' scores in KSs) at the beginning of the course. In subsequent sections of the course, the student's level of confidence in their ability to perform in the course did not follow a uniform pattern. It increased in section two, decreased in section 3 and increased again in section four. Although the correlation between their experience points and scores in KS kept on increasing, it was still negligible. The highest correlation coefficient (with Spearman's rho: 0.454) was observed in the last section of the course. Our data suggests that student engagement in online course was positively—but weakly—related to student performance on KS and the strength of this relationship increased as the teaching and learning progressed. In view of this, we contend that student engagement in online course would not be an accurate predictor of student performance on online knowledge surveys at the beginning of an instructional process. When the focus is put on the middle and towards the end of the semester, our data slightly deviate from Bowers et al. (2005)'s claim with regard to an increase in student confidence in their knowledge of the course material. This study's results indicate that the students' confidence increased and decreased while the correlation between their level of confidence and their performance in KSs kept on increasing. Despite clear guidelines and clarifications that were provided to students, there were some concerns about their ability to accurately rate their level of confidence in ability to answer the KS questions and this might have impacted the KS scores. We thought the students' ability to self-assessment takes longer to develop (Carroll, 2009) and can take more than just one course and go well beyond one semester (King & Kitchener, 1994).

## 6. Conclusion and future work

In this study, Knowledge Surveys were used as an online formative assessment strategy. The main purpose of this research was to study whether there exists any relationship between student engagement in online course and the student performance on online KS. Additionally, we wanted to answer the question of whether student engagement in an online course can predict performance on online KSs. Based on our data, we suggested that student engagement in this online course was positively—but weakly—related to student performance on KS and the strength of this relationship increased as the teaching and learning progressed. In view of this, we concluded that student engagement in online course would not be an accurate predictor of student performance on online Knowledge surveys right at the beginning of an instructional process. However,

we think that this study's findings are not based on quite conclusive evidence due to some limitations relating to the lack of well-established students' self-evaluative skills, the limited scope of the study in terms of the reduced number of experimentation cases (only one course) during only one semester, and the teaching and learning environment that was not as conducive as expected. Therefore, the future research studies to be carried out in this area (and in more or less similar context and teaching and learning environment) should take into account these limitations.

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