Technology's roles in student-centred learning in higher education

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Abstract
Given challenges of covering course content, ensuring skills acquisition, and assessing student's work, higher education faculty often experience difficulties in practicing student-centered learning. The education literature has shown that one way of addressing these concerns is through the use of educational technologies. In this action research, ten faculty members from a Philippine university participated in a coaching programme on using technology for student-centered learning. From interviews and classroom observations, the study finds that when introduced to appropriate tools, higher education faculty use technologies for interactive learning, timely feedback, and better engagement with students. The present research elaborates how faculty from different departments have used these technologies and how the students have responded to their use. The study contributes to the discussion of how technologies can enhance student learning and complement classroom instruction.

Keywords: student-centered learning; educational technology; student engagement; interactive learning; Philippine higher education

Los roles de la tecnología en el aprendizaje centrado en el estudiante de educación superior

Resumen
Dados los desafíos de cubrir el contenido del curso, garantizando la adquisición de habilidades y evaluando el trabajo de los estudiantes, los profesores de educación superior a menudo experimentan dificultades para practicar el aprendizaje centrado en el estudiante. La literatura educativa ha demostrado que una forma de abordar estas preocupaciones es a través del uso de tecnologías educativas. En esta investigación-acción, diez miembros del cuerpo docente de una universidad filipina participaron en un programa de capacitación sobre el uso de la tecnología para el aprendizaje centrado en el estudiante. A partir de entrevistas y observaciones en las clases, el estudio descubrió que cuando se introducen las herramientas apropiadas, los profesores de educación superior utilizan tecnologías para el aprendizaje interactivo, realizan devoluciones oportunas y tienen un mejor compromiso con los estudiantes. La presente investigación aborda cómo los docentes de diferentes departamentos han utilizado estas tecnologías y cómo los estudiantes han respondido a su uso. El estudio contribuye a la discusión de cómo las tecnologías pueden mejorar el aprendizaje de los estudiantes y complementar la instrucción en el aula.

Palabras clave: aprendizaje centrado en el estudiante; tecnología educacional; compromiso de los estudiantes; aprendizaje interactivo; educación superior filipina.

1. Introduction

Stemming from constructivist theories where knowledge is actively created by learners (Dewey 2011; Vygotsky 1978), student-centered learning (SCL) has gained credence as an effective educational approach. In this approach, students are actively engaged in their understanding of topics, and the teacher's role is about facilitating and scaffolding the learning process (Hoidn 2017). Although many teachers subscribe to SCL in principle, there are challenges in fully implementing this method, particularly in higher education. First, there are competing visions of what student-centered means and subscribing to this method can be a steep learning curve. Second, teachers need to cover the course content and SCL may take more time than the usual lecture format. Third, putting so much responsibility on students' motivation may lead to uneven acquisition of skills. Lastly, assessments are more difficult to prepare or correct, given the openness of questions and differences in answers (Hannafin & Land 2000).

Although the challenges are valid and understandable, there are ways that teachers have addressed these concerns. Teachers who actually started using SCL reported higher satisfaction and improved student academic outcomes (Dear 2017; Veldman, Admiraal, van Tartwijk, Mainhard, & Wubbels 2016). They also used creative ways like problem-based learning and small group discussions to cover more course content (Loyens, Rikers, & Schmidt 2006; Wijnia, Loyens, & Derous 2011). Another prominent way to address the challenges is to employ technology in practising SCL (Kang, Hahn, & Chung, 2015; Lowry & Flohr 2004). Thus, different technologies could be harnessed for classes and courses to be more focused on the learning of the students.

In this action research, we ask how university faculty understand student-centered learning and how they use educational technologies in instructing and teaching their classes. This present research shows that technology plays different roles for different teachers, particularly in relation to their disciplines and contexts. However, technology use can be categorized in terms of its different functions: increasing interactive learning, providing feedback on student learning, and fostering closer engagement with students. In this study of ten faculty members from a Philippine university, we highlight the current literature in student-centered learning, the process of training and coaching teachers in the use of technology, the results of the coaching, and the key insights from these results.

2. Student-centered learning and technologies

This literature review is divided in two parts. The first discusses the basics of SCL: its effects, assumptions, and challenges to implementation. It then shifts to how technology addresses these challenges and what framework is used for this present research.

Student-centered learning (SCL) is an educational approach where students direct their own learning, are supported in scaffolding their knowledge, and have a more active role in

the learning process (Brush & Saye 2000). In principle, the role of the teacher shifts from being "sage on the stage" to being "guide on the side," where teachers are no longer the sole knowledge source in the classroom and where students learn alongside the teacher (Weimer 2013). The shift is often seen *from* the lecture- or teacher-centered mode of learning *to* one where students engage and co-construct knowledge through experiential education, creative outputs, problem-based learning, and collaborative discussions (Abe 2011; Passehl-Stoddart & Monge 2014; Tom 2015). Although applicable to any grade level, SCL approaches are very appropriate in higher education because students already have advanced cognitive skills suitable for deeper learning, and social emotional skills for motivating and directing their education (Wright 2011).

Many studies have shown positive effects when using SCL, particularly with student motivation and achievement. Umbach and Wawrynzski (2005) use two United States datasets and find that students report higher levels of engagement when teachers use active and collaborative strategies. In addition to engagement, SCL contributes to better understanding and higher academic scores (Granger et al. 2012; Nurjannah, Husniyah, & Harjanto 2017; Wijnia et al. 2011). However, there have also been studies showing negative effects. This is particularly true in developing countries where SCL's efficacy is reduced because of implementation problems, lack of resources, and cultural differences (Abbasi & Hadadi 2014; Schweisfurth 2011).

It is possible that SCL works in some situations and not in others because of the strong assumptions that underlie this practice. For students, they are assumed to be motivated, self-managing, and collaborative (Brush & Saye 2000; Harju & Åkerblom 2017) while for teachers, they must prepare class activities in addition to lectures, offer assessments that test skills rather than memory, and create accountability measures so that all students are on task (de la Sablonnière, Taylor, & Sadykova 2009; Krahenbuhl 2016). Although helpful in principle, SCL does entail important shifts and significant challenges for instructors who use a more teacher-directed approach.

Challenges to the implementation of SCL are often the main concern of teachers who are resistant to this learning approach. First, teachers will have to shift teaching styles: from one where they direct the instruction to one where they facilitate discovery and knowledge construction with students (Kirschner, Sweller, & Clark 2006). This leads to a second concern in terms of time, where teachers may have less time to cover course materials and need more time to prepare student-centered activities (Cooper, MacGregor, Smith, & Robinson 2000; Patrick, Howell, & Wischusen 2016). A third concern from the students' perspective is their responsibility and motivation for learning. The strong assumption of self-directedness can prevent less motivated students from attaining the skills their more motivated peers are able to reach (Kozanitis & Desbiens 2016; Lee & Hannafin 2016). A fourth challenge is the difficulty in assessment, particularly for large classes since teachers will have to correct papers and clarify rubrics for more open-ended questions (Borda et al. 2017). It must be emphasised that not all lessons necessarily need to shift towards student-centred activities since there are still circumstances when teacher-directed instruction is necessary.

Although the challenges can dissuade teachers from incorporating strategies in this approach, educational technologies address some of the implementation challenges (Polly &

Hannafin 2010). Researchers have shown various ways for technology to improve, rather than substitute, teacher instruction (Dondlinger, McLeod, & Vasinda 2016; Kalathingal & Buchanan 2017). Technology can help in instruction, particularly when engaging students in active learning (Ralph & Ralph 2013), and contrary to the usual concern, there are opportunities for technology to help in terms of time because of activities outside the usual class meeting (Damewood 2016; Thoma, Hutchison, Johnson, Johnson, & Stromer 2017). It can also help in student motivation, and assist in providing timely assessments and feedback (Connor 2017; Nation-Grainger 2017).

Those critical of technology use in classrooms often have low expectations for technology to improve learning, and focus on technology fostering technical skills rather than realizing course content (Fu 2013; Lim 2007). In this evaluation, technology is seen as an add-on to the teaching process, and does not enhance student learning (Kay, Benzimra, & Li 2017; McCabe & Meuter 2011). Mindlessly using technology for its novelty has also led to negative effects with detrimental off-task activities, like using cellphones (Aagaard 2015; Kuznekoff, Munz, & Titsworth 2015). Thus, there is a caveat that technology should serve as means rather than as ends in the learning process.

Since technology should be used so that students learn better, this present research uses a framework that integrates technology knowledge with both content and pedagogical knowledge. Koehler and Mishra (2009) propose the TPACK (technological pedagogical content knowledge) framework. They argue that teachers have knowledge on three realms (technology, pedagogy and content), and that the three's interaction form the basis of effective teaching. Using this framework, teachers learn and integrate content knowledge (what to teach), pedagogical knowledge (how to teach), and technological knowledge (what technologies to use), all within the context of the learner (Archambault & Barnett 2010). In the realm of higher education where teachers have significant training in content knowledge, there are opportunities for teachers to clarify their pedagogy and see how technology could aid their instruction. Thus, this action research looks into technology's roles during the teaching of disciplinal content.

3. Context and methods

In 2017, Marian University, a pseudonym for a Catholic university in the Philippines, established its Institute of Education as a consortium of schools and departments that offer education programs and advance the school's education agenda. One of its main thrusts is research on student-centred learning in higher education, and the core team of the institute gave a workshop on SCL and technology's possible role in assisting and advancing learning. Ten university faculty from different departments and schools attended the workshop and tried to incorporate SCL and education technology to their classroom instruction and assessment.

3.1 Participants

At the end of the first semester of school year 2017-2018, the Education Institute opened registration in the *Learning with Technology* programme, and there were twelve college

faculty members who signed up, although only ten participated in the first workshop. Thus, this action research is limited to these ten members: five from the School of Humanities, two from Management, two from the School of Science and Engineering, and one from the Social Sciences.

The ten members were informed of the action research component of the study and have given their informed consent to participating. In the study, the only identifier used is the department they belong so that the use of technology is contextualised. The participants ranged from second-year instructors to associate professors who have been in the university for more than ten years.

3.2 Implementation of SCL action research

Action research is the strategy used to better understand SCL in higher education. Similar to the action research cycle (Coghlan & Brannick 2014; Kemmis, McTaggart, & Nixon 2014), the researchers *planned with* the teachers through workshops and coaching sessions, the teachers then *implemented* SCL with educational technologies, and the researchers were there to *observe* the execution and *reflect* with the teacher after the class or semester.

Before the start of the second semester, participants attended a whole-day workshop on SCL and education technology use. As the participants registered, they received informed consent forms that detail their voluntary participation in the program and research. After a round of introductions, the first session concentrated on teachers writing about their own teaching practices, learning objectives, student activities, and missed opportunities. The second session focused on technologies that can be integrated and used in the classroom. The last session applied insights from the first two sessions as the teachers individually designed a lesson or modified their course syllabus to have a more student-centered perspective.

During the first three weeks of the semester, the researchers worked individually with the teachers to plan their classes in terms of creating SCL environments and using appropriate technologies for instruction and assessment. The planning sessions are directed by the teachers and their lesson objectives, and the researchers provided ideas and technical support. The planning session often ended with a summary of the steps for a particular lesson and the researchers being invited to the implementation.

After this, the researchers observed the execution of some lessons, particularly noting how teachers apply SCL practices and use technology with these practices. After some time, the researchers asked the teachers about their experience: what transpired, what they learned, what they wanted to change, or what they wanted to improve. If needed, the teachers and researchers set another date to do planning and observation for another application of SCL in their classrooms.

3.3 Data collection

The *Learning with Technology* action research is interested to know how college faculty members understand student-centered learning and technology's roles in creating a SCL environment. Thus, data mainly derive from teachers, either through interviews during the planning and reflection phase, or through classroom observations.

In the planning phase, teachers are asked about their insights from the workshop, their ideas of student-centered instruction, the changes they have made in their classes, and how they plan to use technology in a lesson or their classes. In the reflection phase after the execution, the teachers talk about their classroom practice, their assessment of SCL practice and technology's role, their students' reactions to the changes, and the possible improvements arising from the reflection. These interviews were recorded with the participant's permission and transcribed afterwards.

3.4 Data analysis

After the interviews were recorded and transcribed and the observations were typed on Word documents, the researchers looked at the digital transcripts and notes, and analysed these for themes in terms of SCL, technology use, and the interaction between the two. The main means for analysing themes was abductive reasoning (Timmermans & Tavory 2012), where surprising findings interact with anticipated ones from prior SCL and technology research.

To identify the themes, both researchers read the transcripts independently and discussed the codes to be used and identified three general themes that relate with the present research. In order to show new findings that expand current literature, the researchers have been sensitive to themes that are unanticipated but common to at least two teachers. They have also taken note of themes that are common to previous literature on the use of technology for SCL. All interviews and observations were analysed, and particularly recurring words were highlighted.

For this research, we find three major categories for the teachers' answers on how they understand SCL and where they use technology: 'interactive instruction', 'feedback', and 'student engagement.' These themes come from both verbal answers during interviews and independent observations during in-class implementation. To protect the privacy of the respondents, they were given pseudonyms in this research and the identifiers are general but give some sense of the person's teaching background.

4. Student-centered learning and technology use

Since higher education faculty members teach diverse disciplines and are given a lot of instructional freedom, there are differences in how they understand SCL and how this is implemented with technologies. In this present research, we found teachers using technology to have more interactive work, more intentional feedback mechanisms, and more students engaged in course tasks. Although there were significant advances in the teachers' intentional use of technology, there were also some limitations and challenges that teachers encountered.

4.1 Technology for Interactive Learning

A number of teachers have used technology so that students can interact and collaborate with each other. There were instructors who used Kahoot and Plickers for group quizzes

where students had to deliberate their group's answer. Although both are online platforms where teachers can set-up quiz games, *Kahoot* needs both the teachers and the students to have access to internet-connected devices while *Plickers* only require wireless connection for the teacher who scans the students' printed plicker cards. The printed cards can be positioned to show a particular response (a, b, c or d), and the responses are captured through a mobile device's camera, tallied in real time and displayed on screen.

Anthony, a chemistry instructor, said that Kahoot "was a refreshing way to ask questions and get the class and workshop excited." For Plickers, he mentions that this technology is an effective way to track students' learning and a good avenue for students to work as groups. Karina, a physics professor, used Plickers and talked about how "it helped in making the otherwise boring question and answer activity more lively." Both of these science faculty members show how these applications help in creating interactive learning environments where students feel engaged and excited.

Other faculty members also highlight the use of this technology so that students can interact with each other. In his classes on theology, Howard uses Kahoot to test the students' understanding of the lesson and also incorporates *Padlet* in his interactive tool kit. This program allows a teacher to setup a virtual wall where students can post virtual sticky notes containing texts, links, images, and videos. After this, the teacher projects the image on the screen and discusses people's "sticky notes." He does these at the beginning of class to facilitate interaction among students and adds that it streamlined collection of discussion items and created a space for people to share ideas.

Providing space for interaction did not only affect the students' engagement with course materials, it also affected the teachers' understanding of their own pedagogies. Nina, a professor at the School of Management, said, "I realised that my classes have been lecture-intensive; I often see bored faces. By incorporating [interactions in class] they become more engaged, and they seem excited to participate in class." Thus, technology's use in fostering interactions not only affects students but also teachers. It is important to show that one of the ways technology can help in instruction is through the interaction it facilitates between students, and between teacher and students.

4.2 Technology for Feedback on Student Learning

A second theme on teachers' use of technology is them receiving feedback on students' learning. In this sense, technology is used so that teachers can gauge how deeply the contents are learned or how intently the skills are practiced. One of the tools used is *Today's Meet*, an online platform for teachers to setup a chat room where students can enter questions or insights being discussed in class. It allows teachers to respond directly to questions or clarifications, and it provides teachers quick feedback if there are students who are struggling with the course content.

In her many years of teaching, one of the difficulties experienced by Michelle, a finance professor, is that some students are not comfortable raising their hands and asking questions. Because of this, she tried using *Today's Meet* to create a chat room where students can post their questions anonymously, and she found out that people actually asked thought-provoking questions and she was able to respond to these before the end of class. Howard agrees and says, "The anonymity associated with these tools made students really

willing to participate and share their thoughts." Both teachers show the technology's potential in getting immediate feedback so that students can clarify their understanding.

Another way to get feedback from the students is by having online objective quizzes and short essay homework. A member of the philosophy department, Daniel gives online quizzes and short essay assignments to his students so that he can get immediate feedback and see gaps in students' understanding of ethics concepts. He also sees these activities as students' "preparation for class discussions." From this, teachers do not just get feedback on the students' performance; the students also try to be accountable for their own learning. Having quizzes helped Daniel see which philosophy topics to focus on because of the quick feedback on student's initial understanding.

In terms of time, online quizzes can also save teachers a lot of time because the checking happens automatically. This can free teachers up for more thoughtful evaluation of students' essays and creative work. As Sara, a faculty of the humanities, said prior to the coaching, "Assessments might be overly focused on comprehension and recall of other authors' critique [that there is] not enough opportunity for students' own critique." By having technology assist in feedback mechanisms, teachers can actually have more time for more thoughtful activities.

4.3 Technology for Teacher-Student Engagement

A third theme for how instructors use technology is the teacher's engagement and open communication with the students. Anna is a sociology professor who has been in the university for more than a decade, and she thinks of technology as "an addition: it's an enhancement, a magnifier of human intent," especially as she uses technology to be more connected with her students and to meet them "where they are." This is why she set up her own *Schoology* class where students can enrol in, get their resources, take online quizzes, and submit assignments. It also tracks students' attendance and provides the students' running grades at any point in the semester. For Anna, Schoology was a more convenient "space" for readings, announcements, and submissions.

Other teachers agree about their use of technology to facilitate teacher-student engagement outside the classroom. Seven out of the ten participants used a learning management system where the teachers setup online classes and students enrol in them; Schoology and Google Classroom are the two most common examples. Lance, a philosophy faculty member, uses Schoology for sharing reading materials and sending out grades. Anthony from the chemistry department uses Google Classroom for class assignments while Susan of the theology department uses Schoology for students to reach her and schedule consultations, aside from the functions already mentioned by the first two professors. From the examples, we see how college instructors use technology to reach out to their students and facilitate communication outside the classroom.

In class, there are examples of teachers using technology to engage students for their insights and stories. One philosophy instructor, Lance, shares how he is a "lecture-type of instructor—but of course, facilitative." Since he wants to get ideas and insights from his students, he tried using *Mentimeter*, an online platform that allows students to answer open-ended questions or vote on poll questions. Students submit, and answers are presented visually in real time. By using this, he privileges students' answers and finds that "most stu-

dents… felt involved without feeling coerced or put on the spot." Having these technologies helped teachers connect more to students and create learning opportunities inside and outside the classroom.

4.4 Limitations of Technology

Although there were important successes in the action research on technology's use in higher education classes, there were also some limitations to the implementation. For example, Nina from the management school was unable to incorporate technology in her classes although she has been very deliberate in providing a student-centered learning environment. She reflected about how the lecture format has been her comfort zone and how she now shifts to engaging students and giving them opportunities to report and do case studies. This shift to SCL, however, did not translate to technology's being employed because of factors such as her health condition and her perceived inadequacy in technologies.

Other limitations with the use of technology are online glitches that can happen when class activities require all students to have devices connected to the Internet or weird questions when students are anonymous in online polls. Additionally, two professors said that there were some activities that were still better on paper like quizzes and mindmaps. These limitations are important to consider, especially since teachers want to be intentional and strategic in their use of technologies.

It is also important to consider that teachers thought of technologies not as ends but as means to greater learning. A physics professor said that even if she already has an online learner management system, she still finds online participation and discussion lacking. Rather than think of this as a failure of technology, it can be considered a good sign that teachers want to maximize how technologies can enhance students' learning and engagement of the subject matter.

5. Discussion and Conclusions

Shifting to student-centered learning entails important shifts and specific challenges for instructors in higher education. There are difficulties with time limitations, unmotivated students, and quick assessments (Borda et al. 2017; Lee & Hannafin, 2016; Patrick et al. 2016). Because of these, the research asks how university faculty can use technology to address some of these concerns, and through this action research, we find that there are significant avenues where technology can actually help the instructor in the students' learning process.

The action research involved ten university faculty learning about SCL and the different technologies that can help in facilitating this type of environment. The framework used was the TPACK framework where teachers integrate technological knowledge with their pedagogical and content knowledge since this interaction forms the basis of effective instruction (Koehler & Mishra 2009). This action research's focus is on the use of technological knowledge to promote SCL practice, and there were four important insights that can contribute to the literature.

Firstly, similar to previous literature there are salient differences in instructor's understanding of student-centered practices. There are some teachers who privilege group activi-

ties and interactions between students while some teachers think of SCL as providing quality teacher-student feedback and engagement. Different teachers focused on different activities, and these activities did not always need technology use. These differences may also come from differences in disciplines and from the necessity to be flexible about content and pedagogical style (Mancuso 2001). This emphasizes that teachers can provide a wide variety of engaging activities and that the effort to put students at the center of the learning process can have significant positive effects (Umbach & Wawrzynski 2005). Teachers have mentioned that they found students to be more engaged when there were activities that involved the students in the learning of a concept. Our action research shows how this effort at more student-centered practices can help both teachers and students.

Secondly, when given a venue to learn about technological tools that can help with learning, higher education faculty are actually open to changing their strategies in teaching their students. By having a whole-day workshop and subsequent coaching sessions, the teachers learned more about student-centered learning and the possible technologies that can be integrated. Literature has shown that teachers can be resistant to using technology since this produces feelings of inadequacy and teachers perceive a lack of benefit from its use (Hicks 2011). However, a programme that assists teachers to learn more about technology's use in the classroom actually helped teachers try out different tools. Except for one teacher, all the programme participants were able to integrate technologies in the way they taught their students. For the one teacher who struggled, she nonetheless was able to use SCL principles, which she admits was already a huge shift. In this regard, teachers should know the appropriate uses and actual value added of using technology in the teaching process (Howard, 2013), and the action research suggests that this can be most effectively achieved when teachers are shown and coached with the possible tools.

Thirdly, university faculty members actually use technology for student-centered learning in at least three broad ways: to increase student-to-student interaction, for teachers to have quick feedback on students' learning, and for teachers to be able to communicate efficiently with their students. Teachers actually use technologies that promote collaborative and active learning; these can come in the form of group activities or games that try to engage the whole class in the lesson. More importantly, the teachers are able to use technologies in order for them to get quick feedback on the students' quality of learning or their remaining questions. Online assessments and query platforms help teachers get a sense of where the students are at and continually clarify lessons so that students can learn more. Another way technology is used in a student-centered classroom is as a means of communication and engagement from the teacher to the student. Learning management systems help teachers cascade information to their students, and these tools also help students know their current grades, access class materials, and identify forthcoming activities. These three "categories" of interaction, feedback and engagement form the base of what the researchers discovered of how technologies can function in SCL classrooms.

Lastly, the research finds that even if teachers are coached, there are still limitations in the use of these educational technologies, particularly as some teachers are not confident in using them or how glitches in the execution can discourage them. Future programs that promote the use of technologies in higher education must work around these constraints of motivating teachers to try them out and not be discouraged by the initial hiccups. Inasmuch

as some teachers experience limitations in the use of technologies, it must be noted that teachers still agree on the importance of using technology to reach out to students, to promote their learning, and to create a secure learning environment. Thus, this means that the limitations are not signs for abandoning the use of technology but are rather helpful cautions of the ways technology can be received and perceived.

In summary, the action research finds that although higher education faculty members have differences in their understanding and practice of SCL, the provision of a coaching program has been helpful in motivating teachers to use technology for better student interaction, faster feedback on student learning, and more engaged ways of communicating outside class time. The findings suggest that proper understanding of technology's roles in education and timely coaching help encourage teachers to try out different strategies that engage their students further. They also suggest that there are different strategies in promoting student's learning and growth, and that technologies can help enhance these strategies. Thus, technology is not an end where the teacher is forced to use technology, but a means for promoting collaboration, getting feedback, and engaging communication—all in an effort to put the students at the front and center of their learning.

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