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# Digital workplace skills: Designing the integrated learning of accounting and Microsoft Excel

**ABSTRACT**

The ubiquitous use of Microsoft Excel among accountants has resulted in calls for students to become capable in its use to enhance their success when entering the accounting profession. The research question and objective of this paper is to investigate if, and how, an integrated learning approach can be designed to develop accounting students' Microsoft Excel skills as part of their learning experience within first-year financial accounting modules. The study deployed a design-based research (DBR) methodology, which is newly-emerging within accounting education. The study involved 68 first-year accounting undergraduates in the participatory design of a blended learning intervention across three design iterations, which included the integrated learning of financial accounting and Microsoft Excel. The results demonstrate that perceived Microsoft Excel skill levels among participants improved as a result of the intervention, coupled with an expression of high confidence levels in use of the software. The students valued the authentic learning experience obtained and felt it would benefit them in future employment. The research findings provide guidance to accounting educators wishing to augment their students' understanding with digital workplace skills and competency.

Keywords: accounting education; integrated learning; constructivist learning theory, design-based research; digital skills; Microsoft Excel.

## Introduction

The dynamic digital work environment coupled with continual technological advancements have emphasised the need for accounting graduates to exhibit competence in digital skills. In particular, competence in Microsoft Excel (hereafter referred to as Excel) has been identified as an essential skill for accounting graduates by both employers and academics (Daff, 2021; Rackliffe & Ragland, 2016; Spraakman *et al*., 2015; Tysiac, 2019). Accounting educators worldwide have called for integration of technology and Excel use across accounting curricula to increase graduate employability (Al-Htaybat *et al*., 2018; Kotb *et al*., 2019; Lafond *et al.*, 2016; Rackliffe & Ragland, 2016). However, this has been impeded by a lack of professional body accreditation for information technology (IT) related content, crowded syllabi and issues relating to faculty competence in the use of Excel (Kotb *et al*., 2019).

Traditionally, the teaching of software packages, such as Excel, takes place as stand-alone modules on accounting programmes. This approach is questioned by Rackliffe and Ragland (2016, p. 161) who recommend ‘incorporating Excel in a comprehensive, integrative, and pedagogically consistent manner in the accounting curriculum to possibly improve students’ proficiency in Excel technology’ while preparing students for their future careers. Sangster *et al*. (2020, p. 447) call for studies to provide ‘evidence-based good practice guides and practice exemplars’ for technology use within accounting education. Prior research shows that accounting and finance students expressed a preference for use of Excel within the classroom as a teaching aid for presentation of learning material during lectures (Dania *et al*., 2019). Another study investigates the teaching of Excel to accounting undergraduates within an information technology module, suggesting a project-type exercise for improving students’ Excel skills (Willis, 2016). However, within the extant research there is an absence of studies on how Excel may be taught simultaneously with accounting in an integrative manner as recommended by Rackliffe and Ragland (2016).

This study addresses the gap by integrating the teaching of Excel within undergraduate financial accounting modules, as recommended by Rackliffe and Ragland (2016), and investigating the experiences of students who were taught financial accounting using the technology-integrated approach. Harel and Papert (1990, p. 29) propose the *integrated learning* principle which states that ‘learning more can be easier than learning less’. They observed that students learning mathematics and software design in an integrated fashion achieved more effective learning than had the learning content been taught separately. The objective of this study is to investigate if, and how, *integrated learning* may be designed within a financial accounting class in order to develop the accounting-related IT skills that students would require when entering the workplace, while also enhancing their learning experience within financial accounting.

Educational research has been heavily criticised for its lack of practical impact in classrooms, as the scientific knowledge it generates is often an insufficient representation of the phenomena it alleges to address (Brown, 1992; Sandoval & Bell, 2004). This is due to a focus on isolating single variables to establish causal effects using experiments which are conducted in controlled laboratories, removed from real-life educational settings (Gravemeijer & Cobb, 2013; McKenney, 2017; Plomp, 2013). However, experimental control is difficult to achieve in real-life classrooms where there are multiple dependent variables at play in producing learning outcomes, such as learners' prior experiences and skill levels (Entwistle *et al*., 2010). In contrast, this study applies a design-based research (DBR) methodology which is newly-emerging within the accounting education field. DBR addresses the complexity of educational environments by designing elements of a 'learning ecology' and studying how they work together to aid learning (Cobb *et al*., 2003). DBR seeks analytical generalization, in the form of obtaining a greater understanding of learning ecologies with a view to supporting others in using design products to obtain learning benefits in other settings, rather than focusing on isolated variables to achieve a statistical generalization (Herrington *et al*., 2007; Gravemeijer & Cobb, 2013; Plomp, 2013).

DBR supports a broad inclusive perspective on learning with participants co-creating a blended learning pedagogical approach through iterative cycles of design, implementation and evaluation. This paper depicts how one element of the blended learning intervention, the integrated learning of MS Excel within financial accouting modules, was practically designed, implemented and refined with first year accounting undergraduate students over three design iterations spanning academic years 2017 to 2020. Educational research has been criticised for its narrow focus on 'learning of content and skills as the only measure of worth' when evaluating inteventions (Collins *et al*., 2004, p.18). Thus, this study aims to go beyond narrow measures of learning by focusing on learners’ perceptions in relation to their integrated learning experience rather than aiming to test students' skill levels.

The contribution of the research is as follows. This study extends prior research by providing a practice exemplar of effective learning design and implementation where Excel is taught in an integrated fashion within accounting modules. Thus, this study makes a meaningful contribution to learning theory in the area of accounting education. In addition, the research demonstrates that students’ perceived Excel skill levels can be enhanced through the integrated learning of Excel and financial accounting. The study findings and narrative account of the design provides guidance to accounting educators who wish to design learning environments to provide students with digital skillsets in preparation for the workplace.

The remainder of the paper is organised as follows. First, the literature review considers the pedagogical considerations for teaching with technology, based on constructivist learning principles. Second, details of the study context and participants are presented. Third, the research methodology section outlines the DBR methodology deployed. The fourth section reports on the implementation and findings pertaining to the integrated learning approach. The process used to integrate the learning and teaching of financial accounting and Excel across the three design cycles is elaborated upon, presenting the findings from each cycle and their impact on subsequent cycles. Finally, the discussion and conclusions section considers the findings and their implications for accounting educators.

## Literature review

Within this study, a review of the literature identified important pedagogical considerations when integrating technology with learning and teaching. Constructivist learning environments with their emphasis on active learning and authentic tasks were explored. The need to scaffold learners within a constructivist learning environment was identified. Furthermore, the review of the literature ascertained the importance of a change of pedagogical approach when integrating technology use among students within the classroom.

Constructivist theory posits that learners participate actively in the learning process rather than receiving knowledge passively, building their own knowledge and forming their own understandings in relation to the world around them (Fosnot, 2005). Constructivist learning environments are designed to include elements of ‘real world’ settings, where learners are allowed to actively construct their own meaning as they work collaboratively using conversation involving planning, negotiating and problem-solving (Jonassen *et al*., 1995; Kirschner, 2001). Herrington and Oliver (2000) suggest that students’ self-learning and self-regulation skills can be fostered within authentic learning environments using authentic activities that have real world relevance rather than decontextualized classroom tasks. Use of authentic tasks gives students an opportunity to build knowledge, while linking with past experiences and identifying the real-life relevance of that knowledge (Woo & Reeves, 2007), resulting in knowledge gained being more effectively applied when solving future real-life problems (Herrington & Oliver, 2000). Projects which have an authentic focus leads to higher levels of satisfaction for students when compared to working on artificial problems (Kearsley & Shneiderman, 1998).

Soloway *et al.* (1994, 1996) propose use of active constructive learning where the learning environment also contains elements of socioculturalism. Learning, according to socioculturalism, is enculturation which involves learners engaged in collaborative meaning-making using the practices and tools of the professional domain being studied. Enculturation is achieved through use of authentic activities from the work domain with learning supported through use of scaffolding.

> when learning is divorced from doing a meaningful task – as are many arbitrary, decontextualized activities in the classroom – then learning becomes just another chore, low on the priority stack (Soloway, Guzdial and Hay, 1994, p. 40)

Scaffolding refers to the support provided to students by the teacher or others to assist them in the mastery of tasks. The term *scaffolding* was applied originally by Luria (Luria & Vygotsky, 1930) and Bernstein (1947) in relation to motor development. It was later transferred by Wood, Bruner and Ross (1976) to the teaching and learning process. Scaffolding may be achieved by initially 'controlling' the task elements which are beyond the learner's competency, allowing him to concentrate on the elements that are within his ability level, eventually facilitating successful completion of the task. The scaffolding is gradually faded until the learner can perform the task completely independently of others. The tutor plays a key role in the scaffolding process, as the nature of the task and learner characteristics must be considered when planning the learning activities. Under constructivism, scaffolding can take place through: relating new information to previously acquired information; use of relevant and meaningful tasks; encouraging reflection and metacognitive awareness; and expressing the task as a series of steps, to reduce its complexity, thereby reducing cognitive overload (Soloway *et al*., 1996). Cognitive overload occurs when working memory becomes overwhelmed when dealing with large amounts of complex information (Sweller, 1988).

Mishra and Koehler (2006, p.1045) advocate for 'learning environments that allow students and teachers to explore technologies in relationship to subject matter in authentic contexts'. They developed the TPACK framework, utilising a design experiments research methodology, for use by teachers when designing learning environments which integrate technology and pedagogy. The framework builds on the seminal work of Shulman (1986, 1987) on pedagogical content knowledge (PCK), which is the way in which subject matter is changed by teachers into a form that is easily understandable by learners. The TPACK model, as illustrated in Figure 1, recognises that knowledge of a technology does not instinctively produce good teaching with the technology, as ‘merely knowing how to use technology is not the same as knowing how to teach with it’ (Mishra and Koehler, 2006, p. 2033). Teachers must consider how to combine technology with subject matter and pedagogy to create an effective learning environment. Technology use can place constraints on content delivery and affect pedagogical decisions. For example, software is typically designed for business rather than education, so it may not always be suitable for use in an educational context. This view is echoed by Sangster *et al*. (2020) who recognise the need to focus on pedagogcial matters when teaching with technology in an accounting education context.

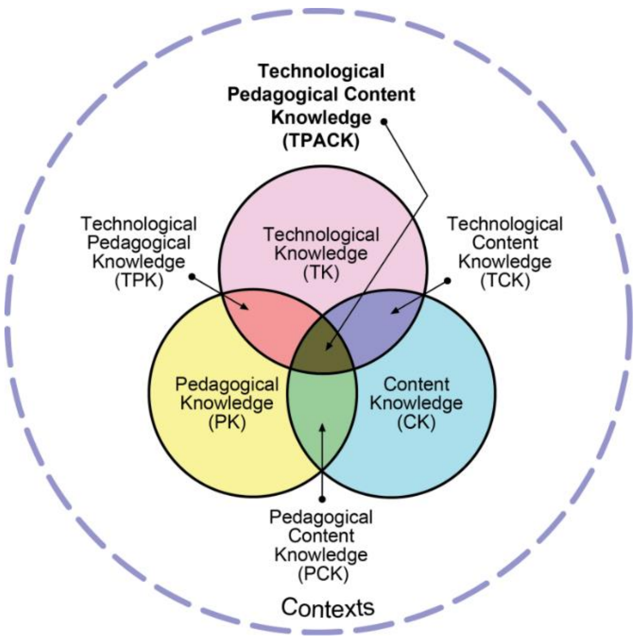


Figure 1. The TPACK framework and its knowledge components (http://tpack.org)
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Elements of the model as depicted in Figure 1 are outlined in Table 1.

Table 1. Elements of the TPACK model (Koehler & Mishra, 2009; Mishra & Koehler, 2006).

| **TPACK model elements** | **Description** |
|---|---|

| | |
|---|---|
| Content knowledge (CK) | Teacher’s knowledge of subject matter being taught and learned |
| Pedagogical knowledge (PK) | Knowledge of teaching practices and methods and application of learning theories including lesson planning, classroom management and student assessment |
| Pedagogical content knowledge (PCK) | Knowledge of suitable methods to transform subject matter for teaching and learning purposes |
| Technology knowledge (TK) | Knowledge of and skills in technology use which changes over time as new technologies evolve |
| Technological content knowledge (TCK) | Knowledge of how technology supports and constrains the subject matter being taught |
| Technological pedagogical knowledge (TPK) | Teacher’s knowledge of how teaching and learning can change when specific technological tools are used in certain ways |
| Technological pedagogical content knowledge (TPACK) | Interweaves knowledge of technology, pedagogy and content so that the teacher can use technology in constructive ways to teach content using sound pedagogical practices |

When integrating technology into the classroom, there is no single approach that works for every tutor or programme, rather technology integration should take place through the teacher’s creative ability to positively exploit the complex interactions between content, pedagogy, and technology which are displayed in Figure 1 and are specific to the learning and teaching context (Koehler & Mishra, 2009). The three components (content, pedagogy, and technology) cannot be viewed in isolation as a dynamic relationship exists between the three of them. Introduction of a new technology affects the equilibrium between the three elements of the TPACK model and forces the teacher to re-calibrate by looking at content and pedagogy and change the teaching and learning approach (Koehler & Mishra, 2009;

Mishra & Koehler, 2006).

The next section introduces the research context along with details of the participants who engaged in the study.

**Study context and participants**

This study took place in an Irish higher education institution. Study participants were enrolled on year 1 of Bachelor of Arts in Accounting and Bachelor of Arts in Accounting and Law programmes. Participants were engaging in introductory financial accounting modules across two semesters with the researcher (and first author) as instructor. The study took place over three design cycles, with a total of 68 student participants, with a different set of first year students participating in each design cycle. A profile of participants is given in Table 2.

Table 2. Participant profile

| | Cycle 1 (2017-18) | | Cycle 2 (2018-19) | | Cycle 3 (2019-20) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| **Gender** | | | | | | | | |
| Male | 15 | 54% | 9 | 37% | 9 | 56% | 33 | 49% |
| Female | 13 | 46% | 15 | 63% | 7 | 44% | 35 | 51% |
| Total | 28 | 100% | 24 | 100% | 16 | 100% | 68 | 100% |
| **Age profile** | | | | | | | | |
| 18 – 22 years | 19 | 68% | 20 | 83% | 15 | 94% | 54 | 79% |
| Mature students (aged 23 years and over) | 9 | 32% | 4 | 17% | 1 | 6% | 14 | 21% |
| Total | 28 | 100% | 24 | 100% | 16 | 100% | 68 | 100% |
| **Nationality** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| International students (students from abroad studying in Ireland) | 4 | 14% | 8 | 33% | 3 | 19% | 15 | 22% |
| Irish-resident students | 24 | 86% | 16 | 67% | 13 | 81% | 53 | 78% |
| Total | 28 | 100% | 24 | 100% | 16 | 100% | 68 | 100% |

The majority of study participants were school leavers, aged under 23 years. Over the course of the three design cycles there was a relatively even proportion of males and females. International students comprised 22% of the total participants across the three cycles. Prior to partaking on this intervention, study participants had not encountered Excel as part of their undergraduate programme. However, some students had previous experience of Excel, further detail of which is given in the implementation and findings section.

**Research methodology**

Design research can be considered as a common label assigned to ‘a family of related research’ (Van den Akker et al, 2006, p.4), examples of such include design experiments (Brown, 1992; Collins, 1990), design-based research (The Design-Based Collective, 2003) and design studies (Shavelson et al., 2003). The DBR methodology applied in the study was chosen due to its ability to address the complexity of educational practice (Sandoval, 2014). During DBR the classroom becomes a ‘living laboratory’ where educational interventions are implemented and researched in a local context (Brown, 1992). The researcher believed a DBR methodology was most suited to the study as it would allow the design of the learning intervention while also providing a vital yielding theoretical understanding (McKenney & Reeves 2013), applicable in this context to the accounting education field.

> Design-based research is premised on the notion that we can learn important things about the nature and conditions of learning by attempting to engineer and sustain educational innovation in everyday settings (Bell, 2004, p. 243).

During the study, the researcher progressively tested and refined a pedagogical approach involving the simultaneous teaching of financial accounting and Excel through a series of successive implementations. Using the DBR methodology, iterative cycles of the integrated learning approach were enacted, with design changes implemented in collaboration with key stakeholders (Hogan *et al*., 2017). After each implementation cycle, evaluation took place and changes were made to further improve the learning intervention and its ability to enhance the learning experience of the students (Kelly, 2020; Kelly *et al*., 2022).

While DBR has been established as an effective methodology for contemporary and novel learning environments (The Design-Based Research Collective, 2003), it has been acknowledged that difficulties can arise due to the multivariate nature of real-world situations along with the large amounts of data typically generated during a DBR study (Collins *et al*., 2004).

A mixed methods approach was employed with the collection of quantitative and qualitative data from various sources, including surveys, student learning logs, group interviews and instructor field notes. Pre- and post-implementation surveys were administered at the commencement and end of each design cycle respectively. Quantitative survey data were analysed using SPSS, while qualitative survey data were integrated with qualitative data from student learning logs and group interviews. Additionally, students were encouraged to externalise their thoughts, feelings, opinions and perceptions using learning logs available on the financial accounting Moodle page. They were provided with an open-ended learning log format which was available throughout each design cycle. Completion of learning logs also allowed students an opportunity to reflect on their learning, offering an added benefit of scaffolding learners by building their metacognitive awareness, as posited by Soloway *et al*. (1996). At the conclusion of each cycle, a one-hour group interview was conducted by the researcher with a small number of consenting participants to probe complex issues and gain a thorough understanding of participants' opinions. Interviews followed a semi-structured format using an interview guide with an evolving set of questions which offered flexibility to allow interviewees elaborate on points of interest. Each interview was audio-recorded with the prior consent of interviewees. Transcription was conducted by the researcher, offering the benefit of bringing her closer to the data.

Qualitative data was input to Excel and coded using concept mapping, posited by Metcalfe (2007, p. 149) as a 'rational method for emerging appropriate concepts from discussions with stakeholders'. This involved coding student statements against statements which were similar or identical in meaning. The coding data were then entered into an interaction matrix (Metcalfe, 2007) and imported into UCINET6 social network analysis software (Borgatti, Everett and Freeman, 2002) which produced clusters of data items, each representing a pragmatic concept. Concept mapping allowed the research to produce a graphical output showing the connections between idea clusters which helped to identify relationships between the underlying concepts/themes (Trochim, 1989). The researcher used the 'following a thread' model advanced by Moran-Ellis, Alexander, Cronin, Dickinson, Fielding, Sleney and Thomas (2006) to integrate the multiple datasets.

Ethical approval was obtained from the relevant institutional research ethics committees in advance of the study. The researcher was also guided by the British Educational Research Association's (2018) Ethical Guidelines for Educational Research. Informed consent was obtained from all participants. It was clearly outlined to students that participation was voluntary and that they may withdraw from the research at any time without explanation or fear of adverse consequences. Due to the researcher's dual role of lecturer-researcher within the study, she was aware of the need to be reflexive to ensure the research was conducted in an ethical manner. In addition, to establish credibility, regular conversations took place with a 'critical friend' employed within the same workplace but outside of the faculty where the study was located to probe issues relating to methodology, researcher bias and emerging conclusions (Foulger, 2010).

## Integrated learning: Implementation and findings

This section describes the process used to integrate the learning and teaching of financial accounting and Excel across the three design iterations, with the objective of developing students' accounting-related IT skills while also enhancing their learning experience within financial accounting. The findings from each iteration are presented and the manner in which they informed design changes for each subsequent design cycle are put forward. Finally, a summary of the study findings pertaining to the research objective are presented.

### *Design cycle one*

In this study, the integrated learning principle was applied by integrating the teaching of the Excel spreadsheet application with financial accounting (Harel & Papert, 1990). As Excel is a digital workplace tool used commonly by accountants in practice and industry, its use within the classroom constitutes incorporation of an authentic activity from the work domain within the learning environment, in line with constructivist learning theory (Soloway *et al.,* 1994, 1996). This was facilitated by timetabling some of the face-to-face class hours in a computer laboratory rather than a traditional classroom in introductory financial accounting modules.

During these classes, the lecturer used her PCK to identify suitable pedagogical practices for teaching the specific accounting subject matter. Topic material was first illustrated the PC and projector at the top of the room. Examples were illustrated in a step-like fashion, to reduce complexity and lessen the cognitive load. New material was introduced on a gradual basis via worked examples of increasing complexity, so that learners could relate it to previously acquired information. In this way students were scaffolded through the learning process (Soloway *et al*., 1996). As students became more familiar with learning material, they were encouraged to work on solutions to problems in their question manual using Excel, while the lecturer circled the room to provide assistance where necessary. In this way, the scaffolding was faded to allow the learners to independently complete problem solutions.

The researcher observed a slower pace of learning in the computer laboratory due to varying levels of skill in Excel. This was confirmed by one student during the group interview, stating: ‘I feel less is done in the computer class’ (2017-18 Student 26, group interview). The researcher also noted within her field notes that certain question types, particularly those which relied heavily on preparation of ledger accounts, proved difficult for students to work on within Excel. Bearing in mind that ‘not every topic can be shoehorned into any technology and, correspondingly, any given technology is not necessarily appropriate for every topic’ (Mishra & Koehler, 2006, p. 1040), the lecturer needed to use her TCK when considering carefully the suitability of each accounting topic for delivery using Excel.

Unlike a traditional lecture room where all students sat facing the top of the room, the computer laboratory seating arrangement resulted in some students facing towards the sides and back of the room. This caused difficulties when the lecturer needed to address the whole class. Furthermore, the space between computers caused a ‘separateness’ among students, which inhibited group exercises, with the researcher also observing an absence of double-checking of answers among peers within the computer laboratory setting. As one student noted, the end-of-semester exam consisted of a written paper rather than an exam conducted via Excel:

> It's different when you're typing and then you go into the exam and you're writing. (2017-18 Student 15, group interview)

This reinforced the thoughts of the researcher and emphasised the need to focus on pedagogical matters (Sangster *et al*., 2020), as it was essential that improvements in technological skills were not acquired at the expense of impeding learning in accounting.

Mishra and Koehler (2006) note that technology use within the classroom can place constraints on content delivery and affect pedagogical decisions. Within this study, scheduling face-to-face classes within a computer laboratory setting with the concomitant use of Excel as a learning tool required the researcher to employ TPACK in reviewing her teaching content and adapting her pedagogical approach to suit the technology use. As Excel was not designed for educational use, it was incumbent on the lecturer as researcher to employ her TPK to re-purpose the software to serve a pedagogical purpose. Using Excel when learning financial accounting could potentially lead to cognitive overload for students, if pedagogical adaptations were not made, evident from this student's comment:

> Trying to keep up with the typing and look at what you are doing at the same time wouldn't be my strong point … You're trying to balance the book, you're trying to type, you're trying to look. It's too much! (2017-18 Student 2, group interview)

Thus, using her TPK, the researcher decided to adapt her pedagogical approach going forward by preparing Excel templates for use during class to accommodate the different levels of Excel competency and scaffold students in the use of technology. Students typed their problem solutions into the Excel template. Each Excel template comprised a proforma solution which was pre-populated with headings, text and borders. This allowed students to input their answers speedily without being constrained by slow typing speeds.

Despite their cognisance of the limitations imposed by classes in the computer laboratory setting, students in the group interviews accepted the benefits offered in the opportunity to improve their Excel skill levels. One student suggested reverting to a traditional classroom setting for course material which was less suitable for delivery:

> I think it should be brought in for the blended learning but I don't think every week. I think we're losing a bit if we're having it every week. (2017-18 Student 26, group interview)

***Design cycle two***

In cycle two, the researcher utilised her TPACK to choose pedagogical practices which used the technology in ways to support student learning of the subject matter (Mishra & Koehler, 2006). She adapted her pedagogical approach by using LanSchool classroom management software for demonstrating questions and solutions during class and provided templates using Excel to accelerate data entry where appropriate. Excel templates facilitated students in completing the solution using technology without having to struggle too much if they were less experienced in using the software, and thus acted as a supporting scaffold for them. Students input their own formulae, where required, while completing the solution. Moreover, when providing solution templates in Excel during this cycle, the lecturer also provided a copy of the question in Excel format. This allowed parts of the question to be illustrated to students using LanSchool and enabled them to click back and forth between the question and solution as they worked, if necessary. In addition, LanSchool allowed the lecturer to take control of the students' screens when demonstrating topic material, which helped to overcome constraints pertaining to the computer laboratory seating layout. These design changes aimed to achieve an enhanced learning experience during classes scheduled in the computer laboratory.

The introduction of LanSchool for demonstrating solutions to problems in computer laboratory classes was noted by the researcher as a successful change, reflected also in this student's comment:

> I particularly like when the screen is taken over as I can look at what you are showing us and taking in what is being said at the same time. (2018-19 Student 19, survey response)

Scaffolding provided by the Excel templates during computer laboratory classes (Soloway *et al*., 1996) was commended by the students, for example:

> I had never used Excel before but it is not difficult as the template is already there. Once you get used to Excel it is very easy and practical to use. (2018-19 Student 17, semester 1 student log)

However, a couple of group interview participants indicated a preference for writing out the full solution layout when working on problems, rather than working from an Excel template:

> You'd prefer to be writing out the layouts of them because you're going to need to for your exam. (2018-19 Student 18, group interview

Contrasting views were presented by others who valued the authenticity offered by using a digital tool employed in the workplace:

> I think it's helpful doing it on Excel though, because if you think about it like when you go on to be an accountant, everything is done on computers really. You're not going to be writing it out. (2018-19 Student 12, group interview)

> I liked the fact that after completing the question we brought it one step further and used the computer because it made it more relatable to the work we will be doing in the future. (2018-19 Student 22, semester 1 student log)

Another student recommended further scaffolding through use of a tutorial class on Excel at the commencement of the programme:

> I also feel I have a greater knowledge of the Excel program from this activity, but I think having one tutorial on all aspects of Excel at the start of the year would be highly beneficial for many students. (2018-19 Student 8, semester 1 student log)

The lecturer was conscious of the fact that the final exam would be in pen and paper format, so was eager to ensure that students were also capable of completing problem solutions without the use of an Excel template. This point was also stressed by cycle one participants; hence the lecturer used her TCK to identify learning content which was unsuited to computer laboratory delivery, returning to the traditional classroom setting for delivery of such content and as the end-of-semester exam approached.

Another change during design cycle two, motivated by constructivist learning theories, required students to complete a financial accounting assignment which involved students completing an authentic bank reconciliation question in groups of four. The task mirrored a real-life bank reconciliation exercise rather than the decontextualized bank reconciliation questions which typically appear in accounting textbooks. The authentic bank reconciliation task included ‘authentic’ bank statements coupled with cashbook details for the previous month, which would be available to an accounts department employee but which are not typically made available to a college student while attempting a bank reconciliation question. This allowed students to work collaboratively on an authentic task which had real world relevance, in line with constructivist learning theory, adding authenticity to the learning environment (Herrington & Oliver, 2000; Kearsley & Shneiderman, 1998; Soloway *et al*., 1996; Woo & Reeves, 2007). Students were subsequently required to submit their answer individually in electronic form using Excel via Moodle outside of class time. Students were not provided with an Excel template for the task and were free to use whatever format or formulae they wished. Incorporation of Excel as part of the assignment was designed to match a real world task of professionals in practice in order to engage and motivate learners (Kearsley & Shneiderman, 1998).

Students valued the use of authentic class questions, particularly the exercise used during the bank reconciliation topic which provided an authentic bank statement and a more comprehensive cashbook which provided historical detail:

> I found questions that were based around real-life scenarios aided me in understanding what it is I'm actually doing. This will help in exam situations as I will understand what I'm meant to do, I won't just be following a learned formula. (2018-19 Student 8, semester 1 student log)

> Real-life question was easier as we could see the previous month and easily find which numbers are part of the opening reconciliation. (2018-19 Student 24, semester 1 student log)

The researcher observed a large number of students in the group using Excel formulae when submitting the financial accounting assignment in Excel format during semester 1, despite the fact that use of Excel formulae was not a requirement of the task, evidence that students' knowledge of Excel had been enhanced.

***Design cycle three***

The design elements and changes from cycle two were retained in cycle three. In addition, the lecturer held a tutorial class in the use of Excel at the commencement of the programme to familiarise students with use of simple Excel formulae. The tutorial was introduced in response to student feedback from design cycle two where some students expressed a preference for using pen and paper rather than Excel. Use of Excel software while teaching accounting increases the authenticity of education but can pose challenges for some students who may lack IT experience. The tutorial was designed to scaffold students so that they would not struggle later in the semester when trying to use Excel while also encountering new financial accounting material. This involved the tutor scaffolding the learners by considering the nature of the task and the characteristics of the learners when designing the learning environment (Wood *et al*., 1976). Students were provided with a handout illustrating the various formulae and worked on exercises which focused specifically on use of the formulae and formatting within Excel. Despite the fact that most of the students indicated that they had not used Excel formulae prior to this, students worked confidently on the tasks assigned during this class.

Similar to design cycle two, students were required to upload a financial accounting assignment solution to Moodle using Excel early in semester 1. In general, students reported no problems in the use of Excel, despite the fact that a number of students indicated in their semester 1 logs that they had low levels of expertise:

> Typing my answer in Excel was OK but I need more practice using Excel so hopefully next time I'll be a lot better using it. (2019-20 Student 11, semester 1 student log)

Many of the students indicated in their student logs that they had used Excel previously; however, not all use would have taken place in an accounting context:

> I felt that putting the answers in Excel was a good option as it made it clearer when writing the answers and it was also a back up to the calculations as it can be easy to make a mistake. I have used Excel before through work but mainly for tables and not calculations. (2019-20 Student 2, semester 1 student log)

Nonetheless, one student who felt skilled in using Excel, still expressed a preference for writing on paper:

> Typing in Excel was no problem at all as I have used it before. … This assessment was good as Excel is easier for spotting mistakes before we upload the assignment to Moodle. I preferred doing the bank reconciliation questions in class because I would find it slightly easier to do these exercises on paper rather than on the computer. (2019-20 Student 13, semester 1 student log)

In line with design cycle two findings, survey responses showed that participants valued the opportunity to apply their accounting knowledge when using Excel, appreciative of the authentic real-world knowledge that they were gaining:

> Excel is probably used quite often among some accountants. It is important that we learn how to use these kind of programs in college as it prepares us for when we start working. (2019-20 Student 13, survey response)

Group interview participants expressed a view that 'textbook questions' may not be representative of tasks which they might be required to perform in the workplace, as it is a 'different situation'. They were aware of the importance of being able to apply knowledge learned in college when they arrive in the workplace:

> You don't want to land in on your first day at work and they hand you a bank rec sheet and you're like, what's this? (2019-20 Student 5, group interview)

They appreciated the opportunity to work on tasks that resembled 'real life examples', stating that it made the subject more 'realistic' for them:

> You can apply it to your own life, like when your own bank statement comes in you're like 'oh, this is like what we did in class!' (2019-20 Student 14, group interview)

One student described how he felt like he was doing 'actual work' while another student drew connections between the authentic bank reconciliation statement questions and the use of Excel throughout the module, indicating that they both acted as preparation for the world of work.

There was no evidence of difficulties in using Excel within the various datasets collected during the cycle. The Excel tutorial introduced in cycle three at the commencement of the programme, informed by student feedback and designed based on the lecturer's TPK, is likely to have provided scaffolding to students, enabling them to progress quickly onto independent tasks using Excel, leading to positive student perceptions in relation to use of Excel as a learning tool during accounting classes. The lecturer observed an air of confidence among students when working in the computer laboratory from early on in semester 1. Furthermore, as the year progressed, students worked competently inputting their own formulae where required. All group interview participants were affirmative in relation to an increased confidence in the use of Excel following the financial accounting modules:

> It just made you feel more comfortable using Excel. You'd be typing in like 3000 + 4000 + 7000 whereas you can just go click + click + click = and you have it done! (2019-20 Student 7, group interview)

The use of Excel templates provided by the lecturer to assist them during class was also commended.

Students remarked positively in relation to their experience of LanSchool in the computer laboratory commenting on how it allowed them to see the lecturer’s workings clearly. One novice learner affirmed:

> I think it is pretty effective, especially when the lecturer takes over our screens and gives us demonstrations on how to complete questions. (2019-20 Student 15, survey response)

This shows evidence of how TPACK impacted positively on the design of the integrated learning intervention. However, during the group interview a couple of students with high levels of prior accounting experience expressed frustration about their screens being taken over to demonstrate material with which they were already familiar:

> You just could be like doing something and then the screen would be taken and then you’d lose focus and you’d just start drifting out, zoning out … it annoys me that … let’s say some people might not understand but you understand it perfectly. (2019-20 Student 7, group interview)

Students indicated that offering LanSchool as an option which students could avail of, if they so wished, would be preferable. While this shows evidence of the challenge posed when teaching students with mixed prior levels of knowledge, it also reveals a desire among students to work independently at their own pace and become more self-directed in their learning. This underlines the importance of considering issues relating to the learning context, such as learner characteristics, when designing novel learning interventions as depicted in the TPACK model, illustrated in Figure 1 (Mishra and Koehler, 2006).

***Summary of findings***

Students rated their perceived skill levels in using Excel within a pre-implementation survey at the commencement of each cycle of the blended learning experience. As part of the post-implementation survey, students were asked to rate their perceived skills levels once again. The post-implementation survey took place at the end of each design cycle, prior to the group interview and end-of-semester examination.

In general, students expressed low confidence levels in relation to their Excel skills at the commencement of the programme, with survey results showing higher perceived levels of improvement at the end of their integrated learning experience across all three design cycles. For example, in design cycle one, 63% of students indicated they had a small or no degree of skill at the commencement of the programme. This percentage decreased to 25% by the end of the course, with 75% stating moderate to extremely high levels of perceived skill. Results for all three design cycles are displayed in Table 3. It appears plausible that partaking in this integrated learning experience led to perceptions of higher Excel skill levels among students.

Table 3. Students' perceived skill levels in using Excel, across three design cycles

| | **Cycle 1** (N=28) | | **Cycle 2** (N=24) | | **Cycle 3** (N=16) | |
|---|---|---|---|---|---|---|
| Survey response rate | 86% | | 88% | | 94% | |
| | **% of respondents** | | | | | |
| **Perceived Excel skill level** | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** |
| Not skilled | 21% | 4% | 9% | 0% | 20% | 0% |
| Small degree of skill | 42% | 21% | 48% | 28% | 13% | 0% |
| Moderate degree of skill | 29% | 46% | 29% | 24% | 47% | 66% |
| Highly skilled | 8% | 25% | 14% | 43% | 20% | 27% |
| Extremely highly skilled | 0% | 4% | 0% | 5% | 0% | 7% |
| | 100% | 100% | 100% | 100% | 100% | 100% |

| **Perceived Excel skill improvement** | **Cycle 1** | **Cycle 2** | **Cycle 3** |
|---|---|---|---|
| None to small | 29% | 24% | 7% |
| Moderate to very high | 71% | 76% | 93% |
| | 100% | 100% | 100% |

When surveyed on their perceived improvement in level of skill when using Excel, 71% of students in cycle one stated that they had achieved moderate to very high levels of improvement. When a comparison is made of perceived improvement in Excel skill across the three design iterations, it is evident that the majority of respondents indicated moderate to very high levels of perceived skill improvement across all three cycles. In addition, levels of perceived improvement increased as the study progressed, as displayed in Table 3. In design cycle three, 93% of respondents indicated moderate to very high levels of perceived skill improvement. Only one student in design cycle three indicated a small improvement in Excel skill attributing her response to the fact that she had a high standard of prior Excel knowledge on commencing the course.

Within the post-implementation survey at the end of each design cycle, students were asked two questions relating to their self-efficacy pertaining to Excel use. These questions were based on an instrument developed and validated by Torkzadeh and van Dyke (2001) and adapted for use within this study. Question responses were based on a Likert type scale, from *Strongly Disagree* to *Strongly Agree* and scored from one to five accordingly. Mean response scores for each question item are displayed in Table 4. Mean scores relating to students' confidence levels in using Excel improved in cycle two, with cycle three findings remaining largely in line with those in cycle two, indicating that design changes implemented from cycle two onwards are likely to have had positive effects on learner confidence.

Table 4. Mean self-efficacy scores by question item, across three design cycles

| | **Cycle 1** N=28 | | **Cycle 2** N=24 | | **Cycle 3** N=16 | |
|---|---|---|---|---|---|---|
| | **R = 1 - 5** | | **R = 1 - 5** | | **R = 1 - 5** | |
| Survey response rate | 86% | | 88% | | 94% | |
| | **M** | **SD** | **M** | **SD** | **M** | **SD** |
| Accounting classes in the computer laboratory have increased my confidence in the use of Excel. | 3.79 | 0.88 | 4.00 | 0.95 | 4.00 | 0.66 |
| I feel confident using Excel during financial accounting classes. | 3.75 | 1.03 | 4.05 | 0.81 | 4.00 | 0.66 |

These findings were corroborated by qualitative survey item responses which indicated that students benefited from classes in the computer lab. Respondents pointed out that it augmented their IT skills, increased their familiarity with Moodle and introduced them to Excel which will be of benefit in their future careers. Students were affirmative in relation to improvements in their Excel skill levels:

> I didn't know how to use Excel before I came to college and now I feel really comfortable using it. (2018-19 Student 8, group interview)

When surveyed on their experiences of learning financial accounting using the blended learning design, levels of agreement on question items showed a general improvement by the third iteration, as displayed in Table 5.

Table 5. Levels of agreement on financial accounting question items – three design cycles

| | Levels of agreement | | |
|---|---|---|---|
| | **Cycle 1** N=28 | **Cycle 2** N=24 | **Cycle 3** N=16 |
| Survey response rate | 86% | 88% | 94% |
| Blended learning led to better understanding of course content | 79% | 95% | 87% |
| Blended learning led to more confidence in ability in financial accounting | 79% | 90% | 87% |
| Blended learning led to greater interest in the financial accounting subject | 54% | 81% | 80% |

Improvements took place in design cycle two in particular, when the main changes influencing the design were implemented. Thus, there was evidence that learning activities provided within the design facilitated greater understanding, yielded increased confidence, and nurtured a greater interest in the financial accounting subject, thus enhancing the student learning experience. It is likely that the levels of scaffolding provided within the computer laboratory setting acted to reduce cognitive overload, contributing to the enhanced learning experience. It is acknowledged that the survey questions pertained to the students' overall experience of the blended learning design, not specifically to their experiences in relation to the integrated learning of financial accounting with Excel. Nonetheless, these findings demonstrate that the integrated learning of Excel and financial accounting is likely to have positively affected their overall learning experience within the financial accounting modules, while also augmenting their accounting-related IT skills.

## Discussion and conclusions

This study contributes to theory-building in designing future-focused accounting education through the novel use of a participatory DBR methodology, whereby the integrated learning of Excel and financial accounting took place based on constructivist learning principles, with the aim of providing first-year accounting students with key accounting-related IT skills while also enhancing their learning experience. Kolb's (2007) learning theory is linked to the particular teaching approach, similarly Flanagan and Stewart (1991) ascertains that teaching and learning are inextricably connected, but not the same. In developing this DBR model and ultimately the teaching approach, consideration was given to how students learn, and the contribution that blended learning can make to enhancing the  learning of accounting concepts. We concur with the work of Bromson et al. (1994) that not all accounting academics may have developed scholarship in learning theory research and the contribution it can make to effective teaching and learning. The research advances our understanding of how we can implement concepts of learning in accounting education through DBR, illustrating how financial accounting can be enhanced through the integration of technology, in order to equip students with digital workplace skills. The learning intervention was implemented and evaluated across three design cycles and student perceptions of learning Excel during financial accounting classes using the integrated approach were examined. Improvements were enacted across each subsequent cycle, informed by student feedback and educational theories. Other accounting educators and researchers can take the innovative DBR concepts and methods deployed in this research and adapt them to develop engaging and impactful pedagogical interventions in their respective educational and teaching contexts.

This study portrays the benefits which accrue from exposing students to authentic activities from the work domain using a constructivist learning style. Learning financial accounting while using Excel, a digital workplace tool, introduced a real-world element into the learning environment, viewed by Kearsley & Shneiderman (1998) as a way to engage and motivate learners. Use of a collaborative financial accounting assignment with an authentic focus, informed by Herrington and Oliver (2000), allowed learners the opportunity to engage in a task which was relevant and meaningful. Students were scaffolded by expressing tasks in a series of steps (Soloway *et al*., 1996). Scaffolding was gradually faded until students were able to complete a problem solution independently. These design elements were all informed by constructivist learning theories.

Results indicate that learners' perceived Excel skill levels improved, having been exposed to the integrated learning approach. Confidence levels in relation to Excel use among questionnaire respondents were generally high at the end of each design iteration, following a learning experience which integrated financial accounting and Excel within the computer laboratory setting. These outcomes suggest that, in support of Harel and Papert's (1990) integrated learning principle, financial accounting classes held in a computer laboratory setting can nurture the acquisition of Excel skills as students learn financial accounting. In addition, it has been shown the inclusion of tasks with real-world relevance added to learner satisfaction, in line with the view put forward by Kearsley & Shneiderman (1998).

However, the integrated learning and teaching of Excel and financial accounting requires careful pedagogical planning, with a need for the instructor to adapt her teaching approach and deploy her TPACK to facilitate learning within the computer laboratory setting (Mishra & Koehler, 2006). As the study progressed, the researcher's pedagogical approach evolved in response to the dynamic interconnections between content, pedagogy and technology within the learning environment. These pedagogical amendments appeared to contribute to increased satisfaction levels among students as the design cycles progressed and changes were implemented based on student feedback. Within this study, increasing levels of perceived skill improvements corresponded with the introduction of LanSchool classroom management software and increased use of Excel templates from design cycle two onwards, informed by the TPACK model (Mishra & Koehler, 2006). Furthermore, it appears plausible that the addition of an Excel tutorial at the commencement of the academic year in design cycle three acted to scaffold students (Bernstein, 1947; Luria & Vygotsky, 1930; Wood *et al*., 1976).

This study is distinguished by the participatory nature of the design process, whereby learners' voices were listened to, with their feedback used to positively influence the design as the iterations progressed. Thus, the study illustrates the potential offered by DBR methodology in the design of learning environments within accounting education. A minority of students expressed a preference for traditional pen-and-paper methods, cognisant of the fact that their final exam take places in pen-and-paper format. However, study results show that, in general, students valued the authenticity offered by using a digital workplace tool during financial accounting classes, appreciative of the real-world knowledge they were gaining. Students were able to build knowledge identifying the real-life relevance of that knowledge within a constructivist learning environment (Woo & Reeves, 2007). Thus, integrated learning of financial accounting and Excel can add value by exposing students to software which will be used ubiquitously in their future careers, while also enhancing their learning experience within accounting (Herrington & Oliver, 2000).

In terms of limitations, while the small group size during each design cycle were easily facilitated within a computer laboratory setting, this study may be difficult to replicate with larger group sizes. The researcher was cognisant that scheduling classes within a computer laboratory is governed by timetabling constraints within the local institutional context and may not be as achievable within all educational settings. Future research could address integrated learning of accounting and Excel, whereby students use their own technological devices in an accounting classroom rather than a computer laboratory setting. In addition, instructor confidence in use of Excel is acknowledged as a factor contributing to successful implementation. However, the detailed design and implementation process within this study should give direction to practitioners when integrating the teaching of technology with accounting within their own learning context. Thus, this study makes a valuable contribution in providing guidance to accounting educators wishing to equip their students with the necessary skillset in preparation for entering the digital workplace.

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