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Navigating the Digital Frontier of Online Accounting Education in IR 4.0: A Malaysian Public University Perspective

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Abstract

Research aim: This study explores how undergraduate accounting students at Universiti Sains Malaysia (USM) engage with and adapt to online learning environments, and examines the implications of technology-driven learning for academic engagement and peer networking within the context of the Fourth Industrial Revolution (IR4.0).
Design/ Methodology/ Approach: A qualitative case study approach was employed, using semi-structured interviews to capture students' reflections on online accounting courses. The analysis centres on challenges and affordances related to interaction, engagement, and professional development.
Research finding: The findings indicate that while online learning offers flexibility and convenience (i.e., particularly for theory-driven content) it also presents notable challenges. Students faced difficulties mastering complex topics, reduced opportunities for peer collaboration, and diminished networking experiences. Although interactive features supported academic performance, social and cognitive engagement were often constrained.
Theoretical contribution/Originality: Grounded in Vygotsky's social constructivism, the study highlights the central role of social interaction in cognitive development and professional readiness. It extends the theory by situating it within the Malaysian online accounting education context, offering original insights into student learning in digitally mediated environments.
Practitioner/Policy implication: The study offers practical guidance for educators and policymakers to enhance online learning design by integrating structured collaborative tools and peer interaction strategies, particularly in disciplines requiring applied understanding and professional networking.
Research limitation: The findings are based on a single-institution case study, which may limit generalisability. Future research should involve multiple institutions and compare varying online instructional models.

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1. Introduction

The Fourth Industrial Revolution (IR4.0), the integration of emerging technologies such as artificial intelligence (AI), cloud computing, big data analytics, automation, and the Internet of things into all areas of society, has transformed the global landscape, with education among the sectors experiencing profound changes. In accounting education specifically, technologies like cloud accounting platforms, robotic process automation, and blockchain are reshaping how students learn financial reporting, auditing, and business analytics. The infusion of such digital technologies into traditional pedagogical approaches has redefined how knowledge is created, shared, and assessed. Online learning in particular has become central to this transformation, enabling more flexible and accessible learning environments by removing geographical and temporal barriers. This shift gained unprecedented momentum during the Covid-19 pandemic, which forced higher education institutions worldwide to rapidly adopt remote teaching as an emergency response (Kahu & Nelson, 2018; Martins et al., 2024).

Despite the digital advancements brought by IR4.0, accounting education faces unique challenges in adapting due to its reliance on structured reasoning, ethical judgment, and the practical application of standards. While these developments have enabled greater access and continuity, they have also exposed the pedagogical limits of online learning, especially in disciplines like accounting that demand conceptual depth, technical precision, and applied skills. As a field rooted in technical accuracy, conceptual understanding, and professional competence, accounting demands a learning environment that goes beyond content delivery. Effective learning in this context requires interactive engagement, timely feedback, and collaborative learning opportunities. Studies have shown that many students find it difficult to grasp complex accounting concepts online, leading to reduced comprehension and increased academic disengagement (Aburous & Kamla, 2022; Covaleski, Dirsmith & Samuel, 2017; Hammond, Streeter & Musundwa, 2022).

In Malaysia, the shift toward digital learning, driven by IR4.0 and national education policies, has introduced a range of issues, particularly for content-heavy and practice-oriented disciplines like accounting. In 2020, the Ministry of Higher Education (MOHE) mandated hybrid and flexible learning approaches across all higher education institutions to promote technological readiness and ensure learning continuity (see Atan

et al., 2024; Othman, Mokhtar & Esa, 2022). While the policy accelerated the adoption of digital platforms and learning management systems (LMS), its implementation has yielded mixed results. Many universities continue to face challenges related to infrastructure and a lack of pedagogical support, which has led to uneven learning experiences across institutions. In particular, some studies suggest that such online environments may constrain accounting students' ability to develop critical analytical, technical, and interpersonal skills. These limitations are often attributed to asynchronous content delivery, fewer opportunities for experiential learning, and minimal real-time interaction—all of which may undermine students' academic confidence and professional readiness (Brown-Liburd & Joe, 2020; Covaleski, Dirsmith & Samuel, 2017; Musundwa, 2024). Although digital platforms offer flexibility, many students struggle with disengagement, isolation, and difficulty mastering complex accounting concepts without face-to-face scaffolding and peer learning opportunities (Muhammad et al., 2024; Wong & Deni, 2024).

These issues highlight a critical gap between the intended benefits of online learning and its actual impact on students' experiences—particularly in accounting, where interaction, dialogue, and scaffolded learning are essential for developing technical and analytical competence. Numerous conceptual, literature-based, and quantitative studies have examined online learning (Atan et al., 2024; Booker, Cook & Wu, 2023; Martins et al., 2024; Nithideechaiwarachok & Chano, 2024), including in Malaysian higher education (Atan et al., 2024; Othman, Mokhtar & Esa, 2022). Nevertheless, these studies often fall short in capturing students' situated experiences and day-to-day academic realities, especially in disciplines that demand active participation and applied understanding. In accounting education, where learning is socially constructed and practice-driven, this gap becomes more significant. There is therefore a need to understand how current pedagogical shifts affect students' preparedness for accounting careers, as the quality of learning during university shapes future professional competence.

To address the above gap, the present study focuses on undergraduate accounting students at Universiti Sains Malaysia (USM), aiming to explore how they navigate online learning in the context of IR4.0. Drawing on Vygotsky's social constructivism (see Rahman, 2024; Shah, 2022; Tasos, 2024), this study investigates student's experiences, academic engagement, and social learning processes in technology-driven environments. By adopting a qualitative case study approach, this research provides a deeper understanding of the challenges and opportunities that emerge in digital learning spaces, with the goal of contributing to broader conversations on the future of online accounting education in Malaysian public universities. Accordingly, this study is guided by the following research questions: How do USM undergraduate accounting students engage with and adapt to online learning in the context of IR4.0? What are the implications of technology-

driven online learning for academic engagement and peer networking among accounting students?

The following section will present a comprehensive literature review, followed by a detailed description of the methodology in Section 3, the results and discussion in Section 4, with Section 5 concluding the paper.

2. Literature Review

2.1 Higher education in the era of IR 4.0: Online learning

IR4.0 has ushered in significant technological advancements that have deeply impacted various sectors, including higher education. Technologies (e.g., AI, big data analytics, automation, and cloud computing) are increasingly integrated into accounting education through tools such as Power BI for data analytics and AI applications, cloud-based enterprise resource planning (ERP) systems (e.g., QuickBooks and SAP), and Microsoft Excel for financial modelling. These technologies are no longer supplementary, but have become core components in how accounting students are trained to interpret financial data, automate transactions, and manage real-time reporting. Accordingly, IR4.0 demands that accounting students develop both cognitive and technical competencies to succeed in digital learning environments. Cognitive skills include critical thinking, data interpretation, and problem-solving, especially when applying accounting concepts to dynamic business scenarios (Moll & Yigitbasioglu, 2019). Technical skills involve proficiency in digital tools such as spreadsheets, cloud-accounting platforms, and data visualisation software, as well as the ability to navigate virtual collaboration tools effectively (Henadirage & Gunarathne, 2023; Wong & Deni, 2024).

In response to the IR4.0, higher education institutions, particularly in Malaysia, have embraced blended and online learning platforms (Kahu & Nelson, 2018; Martins et al., 2024). These platforms aim to build digital literacy among accounting students, preparing them to meet industry expectations for system-based analysis, audit simulations, and cloud-accounting proficiency. The widespread adoption of online learning has been a defining characteristic of IR4.0 in higher education. Online platforms, including LMS and video conferencing tools like Zoom and Google Meet, have enabled universities to provide flexible and accessible learning experiences for students, i.e., different instructional models, ranging from fully online to blended and hybrid formats (Martins et al., 2024; Wong & Deni, 2024). In accounting education, this flexibility benefits students enrolled in theory-heavy or content-driven courses such as financial reporting or taxation, where materials can be reviewed asynchronously. These formats allow students—especially those in urban areas with stable internet access—to engage with recorded lectures and resources at their own

pace, supporting self-directed learning (Othman, Mokhtar & Esa, 2022; Wong & Deni, 2024).

A growing body of literature has examined the relationship between digital learning tools, student experience, and academic performance in higher education. For instance, Dumford and Miller (2018) discuss that the integration of mobile learning tools in higher education improved students' engagement and academic outcomes by promoting real-time access to learning materials and practice-based tasks. Similarly, Purike and Aslan (2025) demonstrate that students who actively used interactive features in LMS (e.g., quizzes, discussion boards, collaborative assignments) showed higher levels of academic achievement and knowledge retention. In the Malaysian context, Ali, Narayan and Sharma (2021) highlight that while digital platforms like Moodle and Zoom enhance flexibility, their positive impact on academic performance is conditional on student motivation, digital competence, and instructional quality. These studies suggest that the effectiveness of digital tools on academic performance is not automatic, but shaped by how well they are integrated into pedagogical strategies and how actively students engage with them.

However, the shift to technology-driven education, while beneficial, presents challenges (Henadirage & Gunarathne, 2023; Othman, Mokhtar & Esa, 2022). Accounting is a subject that often requires hands-on learning experiences to reinforce theoretical knowledge, such as financial statement analysis and complex financial calculations (Coetzee, van Rensburg, & Schmulian, 2016; Jayasinghe, 2021). Activities such as preparing journals, reconciling accounts, or performing variance analysis using real-time data require interactive learning that is difficult to replicate through static online content. While digital platforms can simulate certain processes, they often fall short in providing the scaffolded, feedback-rich environment necessary for applied accounting tasks. For instance, students in practice-oriented courses such as auditing, accounting information systems, and financial analysis, which rely on hands-on activities and real-time feedback. The digital divide between urban and rural areas further exacerbates inequality in access and learning outcomes. One significant issue is the digital literacy gap among students, where many, particularly in public universities, struggle with navigating complex e-learning systems and dealing with technological issues, such as poor internet connectivity (Henadirage & Gunarathne, 2023; Othman, Mokhtar & Esa, 2022). These technological barriers can prevent students from fully engaging with course content, which in turn impacts their academic performance.

Additionally, the lack of face-to-face interaction in asynchronous online courses can lead to a sense of isolation, which decreases motivation and engagement. Conversely, studies suggest that synchronous classes with live discussions can improve student engagement, but require more stable infrastructure and instructor support. Some studies, such as Aburous and

Kamla (2022), Jayasinghe (2021), and Musundwa (2024), argue that in disciplines like accounting, where peer collaboration and group discussions are integral to understanding complex topics, the absence of such interactions can hinder the development of critical thinking and practical application skills. Blended learning approaches, which combine online flexibility with scheduled in-person sessions, have been identified as more effective in preserving collaborative elements of accounting education.

2.2 *The implications of online learning for accounting education*

The transition to online learning in accounting education, accelerated by the demands of the IR4.0, introduces both substantial opportunities and notable challenges. While the shift to digital platforms offers increased flexibility, allowing students to engage with course content at their own pace and from various locations, it also presents challenges that may impact learning outcomes and engagement (Nithideechaiwarachok & Chano, 2024). These challenges are particularly significant in accounting education, where traditional methods of interaction and hands-on application are central to mastering complex concepts and skills.

One of the primary concerns in online learning is the reduction of face-to-face interactions, which are crucial for effective learning, particularly in the field of accounting (Henadirage & Gunarathne, 2023; Wong & Deni, 2024). Accounting education thrives on collaborative learning, where peer discussions and real-time feedback from instructors are essential for reinforcing complex concepts. The absence of spontaneous, informal interactions in virtual settings can lead to feelings of isolation among students, which may decrease their motivation and hinder engagement with the material. As Henadirage and Gunarathne (2023) suggest, the lack of social interaction in online environments disrupts the collaborative learning processes necessary for deep understanding, especially in accounting, where conceptual clarity often arises from peer-to-peer dialogue.

In addition to the challenges of social interaction, accounting education requires substantial practical application, such as financial analysis, the preparation of financial statements, and the use of accounting software. While online platforms are effective in delivering theoretical knowledge, they often struggle to replicate the hands-on experiences necessary for developing the skills required in the accounting profession. Many studies (Kahu & Nelson, 2018; Nithideechaiwarachok & Chano, 2024; Wong & Deni, 2024) argue that the limitations of online learning in facilitating interactive, experiential learning pose significant barriers to students' ability to apply academic concepts in real-world settings. This gap is particularly critical in accounting, where practical application is integral to professional competence.

2.3 Technology and student engagement in the digital age: A guiding theory

The integration of technology into higher education, particularly within online learning environments, has significantly altered how students engage with peers and instructors, a shift that is especially pertinent to accounting education. Vygotsky's social constructivism, which posits that learning is a social process mediated through interactions with others, provides a valuable lens through which to understand these changes (see Rahman, 2024; Shah, 2022; Tasos, 2024). Key concepts such as the zone of proximal development (ZPD) and scaffolding highlight the importance of timely assistance from instructors or more capable peers to help students progress through tasks they cannot accomplish independently. Online platforms like Zoom, Google Meet, and Microsoft Teams facilitate both synchronous and asynchronous communication, enabling students to engage in discussions and collaborate on complex accounting concepts. However, as the research questions suggest, students often perceive online learning as inadequate in fostering deeper academic engagement, particularly in fields like accounting that require hands-on, practical application and collaborative learning. This study applies Vygotsky's framework to explore whether current online learning environments support the kind of structured interaction and assistance students need to navigate complex accounting content.

The lack of face-to-face interactions in online education diminishes the informal, spontaneous exchanges that typically occur in traditional classrooms. These interactions, which are central to collaborative learning, are often absent in virtual environments, leading to feelings of isolation and disengagement. Past studies, such as Rahman (2024) and Shah (2022), highlight that such limitations can reduce students' motivation and hinder their ability to fully engage with the material. This finding aligns with the research questions, as students struggle to develop meaningful connections and engage in real-time dialogue, which is essential for mastering complex accounting concepts. The absence of these interactions directly impacts the quality of the learning experience, particularly in accounting, where peer discussion and instructor guidance are critical for comprehension. In prior studies, social constructivism has been useful in identifying how peer collaboration, instructor presence, and dialogic engagement help students move through their ZPD in both traditional and digital learning settings.

Despite these challenges, online learning platforms offer opportunities for broader networking, allowing students to connect with peers and professionals across the globe. According to studies following Vygotsky's concepts (Rahman, 2024; Tasos, 2024), these extended social interactions can enrich the learning process by exposing students to diverse perspectives, which is crucial in a globalised field like accounting. However, the success

of these interactions is contingent on students' active participation. Less engaged students may face isolation, while the lack of non-verbal cues in online communication can lead to misunderstandings, further hindering engagement and collaboration. As Nithideechaiwarachok and Chano (2024) and Wong and Deni (2024) note, the absence of non-verbal communication in online learning can diminish the sense of presence and hinder the depth of student interactions. Thus, while technology facilitates global networking, its limitations in fostering meaningful peer engagement must be addressed to ensure effective learning in accounting education. Ultimately, by grounding the analysis in social constructivism, this study not only highlights structural gaps in online delivery, but also provides theoretical insight into how learning environments can be improved to support cognitive and social development in accounting students.

3. Methodology

3.1 Research method

This study employs a qualitative interpretive case study approach, which is particularly suited for understanding complex phenomena (i.e., allowing detailed investigation of real-world educational practices and student experiences) within a specific context (i.e., the university setting) (Yin, 2015, 2017). The interpretive case study methodology allows for an in-depth exploration of how students experience and make sense of online learning in the context of accounting education at USM. It enables the researcher to uncover research insights by considering multiple perspectives and sources of data, including student narratives, company practices, and technological infrastructure. This approach is grounded in the assumption that knowledge is socially constructed, making it ideal for capturing students' subjective experiences and perceptions of the digital learning environment.

USM was selected as the case study institution due to its prominence in Malaysia's higher education landscape, as well as its adoption of online learning platforms as part of its response to the challenges and opportunities presented by IR 4.0 technologies. USM's integration of Moodle (e-Learn@ USM) and Webex for virtual classrooms reflects the university's commitment to enhancing digital learning in response to technological advancements, making it an appropriate context for examining the impact of online learning on accounting students. Additionally, the transition to online learning at USM has created a dynamic environment where students face both opportunities and challenges, thus providing rich data for understanding the implications of digital learning on student engagement, peer interaction, and academic performance. By focusing on a single case, the study can explore context-specific factors in greater depth and provide grounded, practice-

informed insights that may inform similar institutions facing comparable transitions.

3.2 Data collection method

Data for this study was collected using semi-structured interviews informed by Vygotsky's social constructivism and prior literature on online learning and accounting education. This qualitative research enables in-depth exploration of participants' experiences and perspectives (Schultze & Avital, 2011). Semi-structured interviews were chosen over unstructured interviews or focus groups because they offer a balance between guided questioning and conversational flexibility, allowing for consistency across participants while still enabling the exploration of individual experiences in depth. This format allows for open-ended questions and follow-up inquiries, providing participants with the opportunity to articulate their thoughts in a detailed and nuanced manner (see Appendix for the sample questions). Interviews were conducted face-to-face, scheduled via WhatsApp, with each session lasting between 10 to 15 minutes. Although brief, the focused nature of the interviews (i.e., guided by targeted questions aligned with the study objectives) enabled the collection of meaningful, concise responses. Additionally, the saturation point was reached early due to the repetitive emergence of core themes across participants.

The interviews were designed to capture a range of perspectives on key topics such as students' experiences with online learning platforms, the impact of digital tools on engagement, and the effects of online learning on peer interactions and academic performance. The use of open-ended questions encouraged participants to reflect on both the positive and negative aspects of online learning, thus providing rich insights into the multifaceted nature of their experiences.

3.2.1 Participant selection and data saturation

Fourteen undergraduate accounting students from USM participated in the study. Participants were selected using purposive sampling to ensure that those interviewed had adequate and relevant experience with online learning. The demographic profile of the participants, including gender, year of study, and duration of online learning experience, is detailed in Table 1. Participants were recruited through direct invitation via WhatsApp and email, with assistance from course instructors who identified eligible students.

Table 1: List of Participants

No.	Gender	Field of study	Year of study	Duration of online study	Interview duration (mins)
1	Female	Accounting	Year 4	> 3 years	15
2	Female	Accounting	Year 2	1 - 2 years	15
3	Female	Accounting	Year 4	1 - 2 years	14
4	Female	Accounting	Year 4	2 - 3 years	12
5	Female	Accounting	Year 2	1 - 2 years	13
6	Female	Accounting	Year 4	1 - 2 years	15
7	Male	Accounting	Year 4	1 - 2 years	10
8	Female	Accounting	Year 4	1 - 2 years	15
9	Female	Accounting	Year 4	2 - 3 years	15
10	Female	Accounting	Year 4	1 - 2 years	15
11	Female	Accounting	Year 4	1 - 2 years	14
12	Male	Accounting	Year 4	1 - 2 years	13
13	Male	Accounting	Year 4	> 3 years	12
14	Female	Accounting	Year 4	> 3 years	15

Notes: The table shows the list of participants involved in the study, including demographic details and confirmation of interview participation.

Final-year students were specifically chosen as the primary participants due to their extended exposure to various forms of online and blended learning throughout their academic journey. These students had experienced the transition from traditional to online learning, particularly during and after the Covid-19 period, making them well-positioned to reflect on both pedagogical approaches. Differences in subject matter and instructor preferences (with some opting for face-to-face methods while others adopted online formats) introduced variation in how online learning was experienced, even within the same cohort. This variation allowed the study to explore how students with similar academic levels but different learning exposures constructed their experiences.

Interviews were conducted face-to-face in a designated discussion room at the School of Management, USM. Each session lasted approximately 10 to 15 minutes, and the full data collection process was completed over a span of two weeks. Although the interviews were relatively short, data saturation was considered achieved after the 14th session, as no new significant themes or insights emerged (Alam, 2021). Saturation was assessed based on the study's focused research questions and interpretive case study design, which values thematic depth over participant quantity. The consistency of responses across students with varying backgrounds further justified the

sufficiency of the dataset.

To ensure representational depth, two students from Year 2 were also included. Their perspectives echoed the thematic patterns found among final-year participants, suggesting that across different academic stages, students encountered similar issues and employed comparable strategies. This thematic convergence (i.e., despite variation in academic year, course content, and instructor approach) reinforced the decision to conclude data saturation.

3.2.2 Data verification for reliability and validity

Ensuring the reliability and validity of qualitative data is crucial for maintaining the trustworthiness of the study's findings. To enhance validity, member checking was conducted shortly after each interview as a strategy for verifying the accuracy and credibility of the data. Participants were emailed or messaged a summary of their responses within 24 to 48 hours, and were invited to provide feedback on the accuracy and clarity of their statements. Minor clarifications were received from three participants, primarily concerning the phrasing of their views on peer interaction and course difficulty, which were updated accordingly (Avery et al., 2011; Silverman, 2013). This process helped to address potential researcher biases and confirm that the data reflected participants' true perspectives.

Additionally, data triangulation was employed to strengthen the study's reliability (Flick, 2018; Leech & Onwuegbuzie, 2007). This involved cross-referencing the interview data with university documents, such as USM's official online learning guidelines, course outlines, and Moodle platform usage reports, to ensure consistency and enrich the contextual understanding of students' experiences. The researcher also maintained a reflective journal throughout the data collection period, noting emerging patterns, personal assumptions, and analytical memos, which supported ongoing reflexivity and contributed to a more objective interpretation of the findings.

3.3 Ethical considerations and confidentiality

Ethical considerations were central to this study (Parker, 2004). All participants were informed about the purpose of the research, their right to confidentiality, and their voluntary participation. Informed consent was obtained from each participant before the interviews, ensuring that they understood their role in the study and the measures taken to protect their privacy and confidentiality. Participants were made aware of their right to withdraw from the study at any time without consequences.

Confidentiality was strictly maintained throughout the research process. Participants' personal information and interview responses were kept private

and secure, with identifying details omitted in the reporting of findings to ensure anonymity. The data collected were used solely for the purposes of this study, and all participants were assured that their involvement would remain confidential.

The researcher ensured the interviews were conducted with integrity, respecting participants' time, perspectives, and confidentiality throughout the process. These ethical practices ensured that the study adhered to the highest standards of research ethics and that participants felt comfortable and respected throughout their involvement.

4. Empirical Analysis

The qualitative data collected through semi-structured interviews were analysed using thematic analysis, following Braun and Clarke's (2006) six-phase framework: familiarisation with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. The transcripts were read multiple times to ensure deep familiarity with the content. Initial codes were generated manually through both inductive and deductive approaches. Inductive coding was based on patterns that emerged directly from the participants' responses, while deductive coding was guided by the study's research objectives and the theoretical lens of social constructivism.

Codes that shared conceptual similarities were grouped together to form preliminary themes. These themes were then reviewed and refined through an iterative process to ensure internal consistency and relevance across the dataset. To enhance rigour, the researcher maintained analytic memos and reflective notes throughout the coding process to support transparency and reduce the potential for interpretive bias. The final themes were selected based on recurrence, salience to the research questions, and their ability to represent both commonalities and variations in how students experienced online learning in the context of IR4.0.

4.1 USM accounting students' online learning experiences: Technological influences and challenges

This section explores how USM accounting students navigated their transition to online learning in response to the digital demands of IR4.0. Interview data revealed that students' experiences were largely shaped by the accessibility, flexibility, and usability of online platforms such as eLearn@USM (Moodle) and Webex. Many students appreciated the ease of accessing content anytime and from any location, especially for theory-based subjects.

However, as the learning environment shifted away from physical interaction, technological disruptions (such as poor internet connectivity,

unfamiliarity with certain digital tools, and limited real-time support) created barriers to deeper engagement and comprehension. These factors significantly influenced how students adjusted their learning strategies and managed their academic responsibilities in the digital setting. Students interpreted 'usability' in terms of ease of accessing materials, clarity of user interface, reliability of tools during live sessions, and the availability of timely support when technical issues arose. These usability concerns affected not only the effectiveness of content delivery, but also students' ability to stay engaged, participate in class discussions, and complete tasks efficiently.

Consequently, these digital constraints required students to modify their learning strategies relying more on peer support, revisiting recorded sessions, or using supplementary platforms, such as WhatsApp groups, to clarify misunderstandings while also adjusting how they managed their academic responsibilities in a less structured online environment.

4.1.1 Positive initial impressions

A significant number of students reported favourable impressions of online learning, particularly in the initial stages of their educational transition to digital platforms. These early perceptions were generally shaped by the convenience of accessing materials from home, the reduced need for physical preparation, and the time-saving aspects of not having to commute. For instance, one participant emphasised the simplicity and ease of the online learning environment:

> *I had a good impression and felt that it was easy and convenient as I don't have to prepare much.* (R1)

This quote reflects a surface-level appreciation of the logistical advantages of online learning, highlighting how students initially equated convenience with learning effectiveness. The absence of logistical barriers, such as travel and rigid scheduling, contributed to a perception of increased autonomy and efficiency.

This sentiment was echoed by another respondent, who noted that the theoretical nature of the accounting subject made online learning a manageable and enjoyable experience:

> *As a theory-based course, I am initially fine with learning accounting online. I found that it is an interesting and fun experience.* (R13)

These quotes suggest that online learning was well-received in courses where conceptual understanding, rather than technical mastery, was emphasised. The engagement aspect, often driven by multimedia tools available on online platforms, also contributed to the positive initial reception.

Collectively, these quotes reveal that students' positive first impressions were not solely rooted in pedagogical effectiveness, but in the alignment between course format and delivery method. The lack of practical or hands-on requirements in early courses likely contributed to a smoother transition, masking deeper engagement issues that surfaced later in more application-oriented modules.

4.1.2 Challenges with complex topics

However, as the students progressed with their online education, many expressed difficulties in understanding more complex or technical subjects, particularly when these subjects required sustained focus and critical thinking. A recurring theme among these students was the challenge of engaging with material that demanded high concentration or mastery of calculations and numbers. For example, one student reflected:

> *I find it very hard to understand and manage since it involves high concentration. Sometimes, as the subject needs me to think critically and I felt that I am unable to do that due to online learning as I am not able to understand the lecture thoroughly.* (R2)

This was particularly evident in subjects that required complex mathematical or analytical thinking, which may not have been as easily conveyed or absorbed through online platforms. Another student shared similar frustrations, particularly in relation to accounting practices that necessitate calculation-based comprehension:

> *I find it difficult to understand especially if it is related to calculations and numbers. Sometimes, I take extra time to fully comprehend the lecture since I am involved in online learning compared to physical classes.* (R5)

These responses highlight a crucial issue in the efficacy of online learning for certain subjects, where hands-on guidance and immediate feedback may be more readily available in a physical classroom setting.

4.1.3 Suitability of online learning

When probed further about the overall suitability of online learning for accounting education, student opinions were divided. While some students recognised that online learning could be effective if the appropriate tools and platforms were used, others expressed a clear preference for traditional in-person learning, citing its ability to offer more direct engagement with both instructors and peers. One respondent noted the conditional suitability of online learning for accounting:

> *Yes. If I am already familiar with that topic or with proper implementation of tools and platform. Then I can comprehend what the lecturer is teaching. Other than that, I felt like I need to be physically present to understand better.* (R4)

This response suggests that for students who have a foundational understanding of the course material or are familiar with the digital tools in use, online learning can indeed be a viable mode of delivery. However, for more complex subjects or when new material is being introduced, students felt a more immersive or interactive environment, such as traditional in-person classes, would be more beneficial.

Similarly, another student expressed that although online learning could be effective under certain conditions, they felt more comfortable in a physical classroom setting:

> *I would say that I partially agree with it, but I prefer physical classes. I can understand better while being present physically compared to online learning. I felt like the traditional learning method suited my learning style better than online because I'm more familiar with it.* (R14)

This perspective reveals that learning styles—whether they are more auditory, visual, or kinaesthetic—play a significant role in how students adapt to online learning environments. The shift to online learning may not suit all students equally, especially those who thrive in more interactive and immediate settings provided by physical classrooms.

From the above theme, USM accounting students' experiences with online learning reflected a dynamic process of adaptation shaped by both enabling and limiting technological factors. While digital platforms offered initial convenience and supported basic learning tasks, their effectiveness diminished when students encountered complex accounting topics that required interactive, real-time guidance. The extent to which students successfully navigated online learning depended on individual learning preferences, familiarity with digital tools, and the pedagogical design of the course. These insights suggest that effective online accounting education must go beyond content delivery by incorporating more responsive, interactive, and scaffolded support systems tailored to diverse learner needs in the context of IR4.0.

4.2 Influence of engagement with online learning platforms on academic performance

The engagement of students, defined as the combination of behavioural (participation in learning activities), emotional (interest, motivation, and attitudes), and cognitive (mental investment and processing of learning

content) dimensions, with online learning platforms emerged as a critical determinant influencing academic performance. The findings suggest that the integration of interactive tools and flexible digital environments significantly shapes how students engage with course materials and instructors, thereby affecting their academic outcomes.

These three facets of engagement are reflected across the subsequent sub-sections. Cognitive engagement is evident in how technological tools enhanced students' understanding and interaction with content; behavioural engagement is demonstrated through students' responses to the flexibility and accessibility of online learning; and emotional engagement becomes apparent in the ways students navigated challenges related to self-discipline, motivation, and learning autonomy. While many students viewed digital tools as beneficial in supporting their academic development, difficulties in maintaining focus and self-motivation also emerged as critical factors influencing success in an online learning environment.

4.2.1 Technological tools enhancing learning

One of the key benefits highlighted by students was the ability to interact with digital tools and platforms, which they viewed as integral to their learning processes. These tools, including quizzes, games, and interactive platforms, were seen as effective in deepening understanding and increasing engagement with the course material. For example, one student shared:

> *Definitely! Online accounting education offers flexibility and accessibility to the student and lecturer. I can search for everything through the apps. I am able to enhance my understanding of a certain topic by searching through internet sources. In addition, the interesting platforms that allow us to play games and quizzes such as Kahoot had further assisted me to fully achieve my learning objectives.* (R9)

The integration of gamification elements, such as Kahoot! quizzes, not only made the learning experience more engaging but also contributed to reinforcing key concepts in an interactive manner. This highlights how online learning platforms can serve as powerful tools to motivate students and facilitate knowledge retention. Additionally, the use of such technologies contributed to a more engaging and dynamic learning environment, as students were able to assess their own progress and receive immediate feedback.

4.2.2 Flexibility in learning

The flexibility offered by online learning was another significant factor influencing student performance. The ability to learn at one's own pace,

revisit course materials, and access recorded sessions provided a sense of autonomy that enhanced student engagement. For some students, this flexibility allowed them to balance their academic commitments with personal responsibilities. One student explained:

> *Online accounting classes require students to use video conferencing technologies like Webex and other digital platforms. Interacting with these sites increases digital literacy and familiarity with technology. It enables me to stay updated on the latest accounting principles, regulations, and technologies from the comfort of my own space.* (R12)

The comfort of studying at home also played a key role, as it provided students with a conducive learning environment free from external distractions. Furthermore, online learning was particularly beneficial for students from rural areas, who could review materials at their own pace and access recorded lectures when unable to attend live sessions. Another participant stated:

> *When considering our friends from rural areas, it helps too since they can review the material again if they aren't able to join the class in the first place. Adding to that, online learning had also helped me to spare my money on rental and transportation cost as I am able to join the lectures at home.* (R12)

This demonstrates how the flexibility inherent in online learning can serve as an equaliser, particularly for students who face logistical or financial constraints that might otherwise impede their educational participation.

4.2.3 Self-discipline and motivation

Despite the numerous advantages of online learning, the self-discipline required to succeed in this mode of education emerged as a crucial factor affecting academic performance. The absence of physical supervision and the flexibility to schedule learning around personal commitments led some students to struggle with focus and motivation. One student admitted:

> *Yes. I am more reluctant to be productive due to no supervision. I am also less focused due to the fact that I am staying at home. Sometimes, I used AI to answer assignment questions. Online learning has allowed me to search for answers at an instant. I would say that my work credibility has improved in both positive and negative aspects.* (R3)

Another participant expressed similar challenges, revealing how distractions at home affected their academic productivity:

> *Yes. I felt distracted learning online as I am staying at home. Sometimes, there are a lot of other things that attract my attention. I felt the urge that no supervision has allowed*

> *me to be less disciplined and carefree. I used the available sources on the internet to do my assignments. Isn't that normal? I believe everyone used it. But I never copy answers blindly, I just take it as a reference.* (R8)

These responses indicate that while the accessibility of information through online platforms can enhance learning, it can also lead to a laxer approach to completing assignments. The ability to search for answers online without immediate oversight raises concerns about the integrity and quality of the work produced, which may compromise academic standards.

However, not all students faced such challenges. Some students were able to maintain a high level of discipline and motivation, despite the potential for distractions. One respondent noted:

> *No. I will keep my schedule free even if it's an online lecture. I will ensure that I am not distracted by anything in order to make my learning experience worth.* (R13)

Similarly, another student emphasised the importance of maintaining a structured routine, even in an online learning setting:

> *No. I still keep discipline and I will make sure I am physically available although it's online. I will make sure that I am not distracted so that I can learn properly.* (R14)

These examples illustrate how some students were able to successfully navigate the challenges of online learning by establishing personal routines and ensuring they were fully engaged in the learning process. Their ability to remain disciplined suggests that time management skills and self-regulation were vital factors in achieving academic success in an online learning environment.

The findings following this sub-theme suggest that engagement with online learning platforms plays a critical role in shaping students' academic performance. While interactive tools and the flexibility of online learning platforms contributed positively to students' learning experiences, the self-discipline required for success in such environments cannot be overstated. The ability to maintain focus, avoid distractions, and engage meaningfully with the learning materials emerged as key determinants in achieving academic success. Students who were able to effectively manage their time and maintain motivation were more likely to report positive academic outcomes, while those who struggled with these aspects experienced more difficulties. Therefore, for online learning to truly support academic achievement, students must develop strong self-regulation skills, while educators and institutions should consider providing additional support mechanisms to help students maintain focus and discipline in a virtual learning environment.

4.3 Impact of online learning on peer interaction and networking among accounting students

The shift to online learning, while offering flexibility and convenience, has had a noticeable impact on peer interaction and networking among accounting students. While some students found online learning to be an efficient mode of education, many reported feeling disconnected from their peers, resulting in reduced opportunities for collaboration and social engagement. The findings suggest that the limitations imposed by online learning platforms hindered the development of meaningful academic relationships and peer support networks, which are essential elements of the traditional classroom experience.

4.3.1 Limited social interaction

A recurring theme in the data was the lack of face-to-face interaction, which many students found to be a significant barrier to both learning and socialisation. Traditional in-person classes naturally foster spontaneous interactions, discussions, and immediate feedback, all of which are vital in building student engagement and a sense of belonging within the academic community. One student expressed:

> *Exactly. Online learning has altered my study mood and engagement to lectures. I felt lesser connection to our school and classes. Sometimes, it is hard to ask questions to the lecturer as I cannot meet them physically. This situation has directly made me burdened and overwhelmed with my studies especially to topics that I am having trouble.* (R10)

The absence of physical presence in the online environment made it difficult for students to engage with their instructors in real time, which not only hindered their ability to seek immediate clarification but also diminished the overall sense of academic connection. As the comment suggests, the lack of face-to-face engagement caused feelings of isolation and overwhelm, especially when students encountered difficulties with complex material.

Moreover, the reduced interaction with peers in an online format left students feeling disconnected from the classroom community. A respondent highlighted:

> *I feel like sometimes the interaction with my friends and colleagues has been limited due to the online environment. I don't feel the sense of collaboration like I would have in a physical class.* (R2)

This sentiment was echoed by other students who noted that without the casual opportunities for socialisation that physical campuses provide—such

as chatting during breaks or engaging in spontaneous discussions before and after lectures—they were unable to form the same sense of camaraderie and collaborative atmosphere. These interactions, which typically promote knowledge exchange and academic collaboration, were notably absent in online learning environments.

4.3.2 Reduced collaboration and networking opportunities

Beyond the direct impact on personal interactions, the move to online learning has also reduced students' ability to collaborate and network with their peers. Traditional classroom environments often facilitate collaborative learning experiences, such as group discussions, projects, and informal study sessions, which are essential for building academic relationships and a professional network. However, in an online setting, these opportunities were significantly curtailed. One participant observed:

> *I didn't really make any new friends, as we can't just randomly talk to people during class breaks or in the hallways. I feel like I am disconnected from the community now.* (R6)

This lack of spontaneous networking and peer collaboration has led to a sense of isolation for some students, especially those who would have traditionally relied on in-person interactions to build friendships and academic support networks. The absence of these informal interactions highlights a significant gap in online learning, where peer support—a critical element in traditional education—is often lacking.

Furthermore, while virtual group work and online discussions have attempted to fill this gap, students noted that these interactions did not always replicate the richness of in-person communication. As one participant explained, the absence of physical cues and informal conversations significantly impacted the effectiveness of group collaboration:

> *I feel that the group work is not as effective. There is no face-to-face communication, and sometimes when we use messaging platforms, it feels like work is just being divided rather than collaborated on. The connection is not the same.* (R11)

These findings underscore the importance of direct peer engagement and informal networking opportunities, which are difficult to replicate in the purely online environment. The impersonal nature of digital communication can hinder the development of trust and deeper connections among peers, thus affecting the overall learning experience.

4.3.3 Balancing flexibility with social engagement

While the flexibility of online learning was often praised for allowing students to learn at their own pace and from the comfort of their homes, the lack of peer interaction and networking opportunities presents a challenge that cannot be overlooked. The findings suggest that while online learning is efficient for individual study and content delivery, it may hinder the development of social capital, which is essential for both academic and professional success in the accounting field. As one student remarked:

> *Online learning is convenient because I can learn at my own pace and from home. I feel that it is a good fit for me, but the absence of regular interaction with my peers makes it hard to form any strong relationships or networks. It's like I'm studying alone.* (R7)

Another participant echoed this sentiment, noting the lack of social interaction as a barrier to connecting with peers:

> *I do enjoy the flexibility of online learning, but I miss talking to people face-to-face. I feel disconnected from the community, and it's harder to form academic relationships or get help when I need it.* (R5)

Accounting students, in particular, may find it difficult to establish the professional networks and collaborative relationships that are crucial for future career advancement. One participant stated:

> *As an accounting student, networking is really important. I need to connect with others in the field, but with online learning, I just don't have those opportunities. It's not just about learning the material; it's about building relationships for my career.* (R3)

Therefore, it is clear that online learning platforms must go beyond just delivering content and consider implementing features that foster peer interaction and collaborative learning. Students suggested various improvements that could enhance their learning experience. For instance, one student suggested:

> *Online platforms should have virtual networking events where we can meet other students from different universities, or have breakout rooms for group discussions. This would help us build connections and discuss topics that go beyond the lectures.* (R6)

Another student recommended implementing peer mentoring programmes:

> *I think peer mentoring would be very helpful. Having a system where we can pair up with more experienced students could enhance both our learning and networking opportunities.* (R11)

These suggestions highlight the need for online learning environments to integrate more interactive and community-building strategies, to help students engage with their peers and instructors more meaningfully.

Ultimately, the transition to online learning has had a profound impact on peer interaction and networking among accounting students. While students appreciated the flexibility and convenience of online education, many expressed frustrations over the lack of face-to-face interaction and the limitations it imposed on collaboration and networking opportunities. The absence of casual interactions and the inability to engage spontaneously with peers and instructors hindered students' ability to form the same academic relationships and professional networks that are nurtured in traditional classroom settings. For online learning to be fully effective, institutions must develop strategies to foster peer interaction and collaboration, ensuring that students do not miss out on these critical aspects of their educational experience. This will be crucial in providing a holistic and well-rounded learning environment for accounting students in the future.

4.4 Discussion

4.4.1 Making sense of and navigating online learning in the context of IR4.0

This study reveals that USM undergraduate accounting students generally make sense of their online learning experiences by recognising the benefits of flexibility and convenience but also by acknowledging significant challenges. Many students appreciate the ability to learn at their own pace and from home, which aligns with existing literature on the advantages of online education for theory-based subjects like accounting (Jayasinghe, 2021; Martins et al., 2024; Wong & Deni, 2024). However, students also report difficulties in navigating more complex aspects of accounting, particularly those requiring critical thinking and technical engagement. This finding aligns with research suggesting that online learning can be less effective in disciplines that require high levels of interaction and applied understanding, such as accounting (Henadirage & Gunarathne, 2023). In this context, students expressed that they struggle to master accounting concepts online without the face-to-face interaction necessary for deep engagement.

To make sense of these challenges, students have developed coping strategies, such as relying on supplementary online resources, seeking additional support through virtual study groups, or engaging in one-on-one discussions with instructors. However, despite these efforts, the study indicates that students still find it difficult to navigate the full depth of accounting knowledge in an online environment. This suggests a need for more specialised tools, strategies, and pedagogical approaches to support students in overcoming these challenges.

These findings can be understood through the lens of social constructivism, particularly Vygotsky's emphasis on learning through social interaction and scaffolding. The study extends this framework by showing that, in the absence of face-to-face engagement, Malaysian accounting students engaged in alternative forms of digitally mediated scaffolding, such as WhatsApp group discussions, peer tutoring via messaging apps, and asynchronous feedback through eLearn@USM. These practices suggest a reconfiguration of the 'more knowledgeable other' to include collective, tech-enabled peer support structures. Such student-driven scaffolding, while unstructured, still supported cognitive development, especially for students with high levels of digital agency.

Moreover, the study emphasises that cognitive development in the online environment is shaped not only by interaction, but also by emotional and motivational engagement. Many students reported emotional disengagement due to lack of presence and social connection, an affective dimension often underdeveloped in traditional social constructivist discussions. This reinforces the need to reconceptualise online learning as a space that requires emotional, cognitive, and behavioural support to foster effective knowledge construction.

4.4.2 Implications of technology-driven online learning on academic engagement, practical skill development, and peer networking

The study also highlights the implications of technology-driven online learning for academic engagement and peer networking. Regarding academic engagement, the flexibility of online learning is seen as both an advantage and a challenge. Students appreciate the ability to engage with content at their own pace, which supports deeper learning for theory-based content. However, the lack of structured interaction in online courses diminishes opportunities for active learning, which is crucial for a subject like accounting, where practice and problem-solving are essential for developing technical competence. This finding is consistent with existing literature that suggests technology-driven learning can engage students to a certain degree, but may fall short when it comes to interactive, practice-oriented subjects (Jayasinghe, 2021; Muhammad et al., 2024; Musundwa, 2024).

Informed by social constructivism, these findings highlight that meaningful engagement (particularly in accounting education) requires not just access to content, but also social mechanisms for co-construction of knowledge. Students who actively participated in group work, even in asynchronous formats, demonstrated higher levels of understanding and confidence. However, for many, the lack of informal, spontaneous academic dialogue (a core feature of traditional classrooms) made it difficult to engage with peers or seek clarification on complex accounting topics.

Peer networking, a crucial component of professional development in accounting, is notably affected by the transition to online learning. While some students managed to maintain connections through virtual study groups, many expressed a sense of isolation. The absence of informal interactions—such as spontaneous conversations before or after class—was viewed as a barrier to forming meaningful relationships with peers and instructors. In accounting education, where collaboration and networking are essential for career success, this limitation presents significant challenges. The study thus suggests that while online learning platforms provide structured educational experiences, they fall short in facilitating the organic, spontaneous interactions that are key to building professional networks and peer relationships.

This context-specific finding contributes a Malaysian-based perspective to the mostly Western-centric body of research on online education. Unlike in high-bandwidth, digitally mature environments, Malaysian students often face infrastructure challenges and rely more heavily on mobile-based applications and self-organised peer learning. These adaptations point to a form of localised, socio-technical constructivism that expands the applicability of Vygotsky's theory beyond its traditional institutional and cultural settings.

Furthermore, the emotional cost of reduced peer interaction was felt deeply by students, many of whom reported disengagement, loneliness, and a sense of being disconnected from the academic community. This again underscores the need for online platforms not only to deliver content, but also to simulate the social-emotional ecosystem of the classroom. Structured interaction tools, peer mentoring systems, and virtual collaboration spaces could play a more intentional role in facilitating this.

Taken together, these insights challenge the assumption that digital platforms alone are sufficient for deep learning. Instead, they call for a more integrated design of online learning experiences, where emotional connectivity, peer interaction, and cognitive scaffolding are embedded into platform architecture and instructional design. This reconceptualisation of social constructivism within the Malaysian accounting education context affirms the need for culturally responsive, interaction-rich, and emotionally supportive digital learning environments.

5. Conclusion

This study provides in-depth insights into how USM accounting students experience and navigate online learning in the context of IR4.0. While students appreciated the flexibility and accessibility of digital platforms for theory-based content, they faced challenges in developing deeper understanding and maintaining meaningful academic interactions.

Difficulties included reduced peer collaboration, limited networking opportunities, and struggles with complex content without real-time engagement. Drawing on Vygotsky's social constructivism, these findings highlight the need for structured social interaction in online accounting education. Effective learning requires not just access to content, but opportunities for dialogue, feedback, and collaborative problem-solving—elements often lacking in current online formats.

This also calls for a revisioning of social constructivism in asynchronous, digitally mediated contexts. We argue that a digital ZPD may emerge in online environments where scaffolding is facilitated through peer-led mentoring, AI-generated feedback, and platform-enabled interaction. This conceptual extension is particularly relevant for accounting education, where collaborative reasoning and timely application are essential to mastering complex concepts.

The study contributes Malaysian-based empirical insights to a field still dominated by Western-centric perspectives. In doing so, it highlights localised challenges, such as uneven Internet access, cultural learning preferences, and limited digital pedagogical support within Malaysia's higher education ecosystem. These insights align with and support national strategic priorities outlined in the Malaysian Education Blueprint (2015–2025) and the MyDigital initiative, which emphasise inclusivity, employability, and technology-driven transformation.

The findings contribute to the growing body of literature on online education in accounting, emphasising the need for environments tailored to the unique demands of the discipline. To enhance effectiveness, institutions must integrate interactive and collaborative tools that foster active engagement. Rather than general calls for engagement, this study recommends operational strategies, including: structured breakout room discussions via Webex or Microsoft Teams; use of gamification tools such as Kahoot! and Quizizz for formative assessment; implementation of digital dashboards (e.g., Padlet, Jamboard) to encourage visual collaboration; and peer mentoring or buddy systems that are formally supported by faculty. These practices should be embedded into course design, not treated as optional extras.

Furthermore, institutions should recognise that students' self-discipline and motivation are deeply affected by home-based distractions and a lack of structure. Clear learning schedules, weekly engagement targets, instructor check-ins, and formative assessment loops can serve as practical mechanisms to maintain student accountability and motivation in online contexts. From a workforce readiness perspective, the study reveals that students' limited exposure to collaborative learning during online study may hinder their preparedness for accounting jobs that require communication, teamwork, and situational problem-solving. To address this, industry engagement

should be incorporated through virtual internships, collaborative case competitions, or guest lectures integrated directly into LMS platforms.

Academically, the study opens pathways for further theoretical development. First, it invites scholars to rethink social constructivism in digital, asynchronous, and AI-mediated settings. Second, it encourages the development of a conceptual typology of online learners (e.g., autonomous, collaborative, passive), based on behavioural, emotional, and cognitive engagement profiles. Third, this research underscores the methodological value of qualitative, student-centred approaches in accounting pedagogy, highlighting how student voice can inform curriculum design, platform innovation, and digital learning support.

However, several limitations must be acknowledged. First, this study relied solely on students' self-reported data, which may be affected by recall or desirability bias. More critically, the study does not include the perspectives of educators or administrators, whose roles are equally vital in shaping the online learning ecosystem. A holistic understanding of online accounting education requires triangulating student experiences with educator practices and institutional strategy. Future studies should include multi-actor perspectives to address this gap. The sample was also limited to one institution, potentially limiting generalisability. The study did not examine instructional design, platform usability analytics, or infrastructure disparities, all of which may influence students' experiences.

In conclusion, while online learning has the potential to reshape accounting education in the era of IR4.0, its success depends on addressing the underlying challenges of social interaction, motivation, and pedagogical structure. To unlock this potential, institutions must move beyond content delivery and invest in socially enriched, well-supported digital environments that mirror the collaborative nature of accounting practice. By integrating interactive tools, fostering peer support, aligning with national policy frameworks, and engaging educators as active co-designers of digital learning, a more inclusive, engaging, and future-ready online accounting education can be achieved.

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Appendix

Interview Guide

Note: These questions are intended as prompts to begin an open conversation. Participants are encouraged to share freely, and the interviewer will follow up based on each student's responses.

1. Can you tell me about your overall experience with online learning during your accounting studies?
2. How did you manage your learning process in an online environment?
3. What kinds of challenges did you face when learning accounting online?
4. Were there any specific tools, platforms, or methods that helped you understand the course materials better?
5. How did online learning affect your interaction with lecturers and classmates?
6. Can you describe any group work or collaborative learning experiences you had online?
7. Did you find it easy or difficult to stay motivated and focused while learning online? Why?
8. In what ways did online learning influence your ability to develop practical accounting skills?
9. How has online learning affected your ability to build academic or professional networks?
10. Looking back, what would you have needed to make your online learning experience more effective?