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ORIGINAL RESEARCH ARTICLE

Emergency remote CAD teaching using licensed software in apparel during the COVID-19 pandemic: a collaborative learning approach

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Computer-Aided Design (CAD) training has become essential in apparel education as it is widely applied in design and development activities in the industry. This study presents how physical CAD teaching converted to remote delivery during the emergency COVID-19 pandemic using online technologies. This study evaluated five distinct methods adopted in this period: online Zoom sessions, pre-recorded practical demonstrations, guided hand-outs, online collaborative learning methods and forum discussions using Moodle. TeamViewer application was utilised for real-time remote access and support during teaching. This study instrumented two online questionnaires intended to assess the effectiveness of online hands-on sessions and collaborative learning in a remote online environment. This study was conducted with 58 participants at a recognised Sri Lankan state university. More importantly, the results confirmed the feasibility of collaborative engagement within the online learning environment. This study discovered students' preferences for synchronous teaching and learning approaches. Also, it revealed the limitations of remote CAD teaching using online technologies. Finally, this study underlined the success of the collaborative learning approach and students' perspectives on flipped classroom model for apparel CAD training.

Keywords: apparel industry; CAD teaching; COVID-19; emergency remote teaching; online collaborative learning

Introduction

The COVID-19 pandemic hampered most educational programs, especially practical courses (Hoofman and Secord 2021). Educators and learners swiftly adapted their work to online educational platforms in this emergency. Although the apparel industry uses Computer-Aided Design (CAD) technologies in product development activities, the industry had to entirely depend on the virtual sampling process to receive customer feedback during the COVID-19 pandemic. In addition, virtual sampling can effectively employ in emerging mass-personalised apparel businesses

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(Uduwela, De Silva, and Rupasinghe 2020). Therefore, skilled CAD professionals are highly demanded in the apparel business.

Researchers in the field of education tested various instructional strategies for teaching CAD (Covill, Katz, and Morris 2008; Dosen *et al.* 2012; Kanetaki *et al.* 2020, 2021; Lee 2021; Vargas *et al.* 2019). For example, project-based learning was tested by Sola-Guirado, Guerrero-Vacas and Rodríguez-Alabanda (2022) in a distance mode for engineering students. Students in mechanical engineering were taught CAD using both MS Teams and Moodle, whilst Pieta (2009) used blended instruction in CAD for secondary education. Lee (2021) stated the feasibility of creating an efficient e-learning environment for fashion CAD education, where students could learn concepts and achieve academic competence without face-to-face instructions. This paper compares different Teaching, Learning & Assessment (TLA) methods in emergency remote teaching and suggests the most appropriate delivery of practical-based courses, where hands-on experience is needed.

Typically, students do not have opportunities to attend collaborative learning activities in online classes (Scott *et al.* 2018). Therefore, this paper highlights the application of collaborative learning in the online distance learning environment. Overall, this study evaluates the effectiveness of remote and online TLA for a licensed apparel CAD and shows the limitations of these methods in developing countries. Following techniques were started to instruct the students during the pandemic across the world: learning management systems (LMS), video conferencing software, broadcast technologies (TV and radio programmes), YouTube videos, virtual classrooms/labs and simulators (Bates 2015; Hayashi *et al.* 2020; Kanetaki *et al.* 2020, 2021; Keengwe 2008; Khalil *et al.* 2020).

All educational institutes in Sri Lanka were closed due to the COVID-19 pandemic in March 2020. Even though academic institutions switched to online delivery, it was not easy to conduct practical sessions (Bhutta *et al.* 2020; Hayashi *et al.* 2020; Khalil *et al.* 2020). Practical sessions are essential in apparel engineering education; therefore, alternative methods to conduct practical sessions were demanded. The lack of digital infrastructure in the country has made the transition to online remote learning mode difficult during the pandemic. However, Moodle LMS and Zoom were the tools our institution used; therefore, this study also used the same tools.

The research objectives of this study were as follows: (1) to evaluate the effectiveness of Moodle LMS, (2) to analyse the most effective learning approach of apparel CAD perceived by the students, (3) to measure the effectiveness of the online assessment strategy, (4) to identify limitations of online CAD learning and (5) to review online collaborative learning (OCL) using Moodle wiki tool, in emergency remote CAD teaching during COVID-19 pandemic.

Distance learning and teaching

Distance learning is also known as e-learning or online learning. There is a physical separation between teachers and students during instruction, and various technologies facilitate teacher–student communication (Bates 2015). Synchronous and asynchronous are the two modes used in distance learning design. Different technologies such as teleconferencing, interactive webinars, chat-based online discussions and phone calls are used in the synchronous approach. Asynchronous refers to online courses with weekly deadlines (Bates 2015). Students can access course content outside scheduled meetings or classes and participate in online discussions, quizzes or

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video comments. Online forums, wikis, audio and video recordings are common tools used in asynchronous distance learning (Littlefield 2020). Including both asynchronous and synchronous online teaching provides more equitable opportunities for those who cannot access face-to-face instruction (Peimani and Kamalipour 2021). In asynchronous mode, the student is self-directed and can access the materials when needed. LMS provides complete flexibility for asynchronous communication and self-directed learning opportunities (Deepak 2017; Ferreira De Farias, Spanhol, and Vieira De Souza 2016; Garcia-Robles *et al.* 2009; Shylesh 2017). However, the main drawback of e-learning is that it provides only theoretical and restricts the application of practical skills (Maatuk *et al.* 2021). Currently, academic institutions are blending and adapting their teaching methods (Affairs 2020; World Bank 2020), such as intelligent tutoring systems, artificial intelligence, pre-determined learning outcomes, problem-based learning and instructional design approaches to achieve learning objectives irrespective of environmental conditions.

The ability of students to connect socially with one another and their choice of communication methods is critical to the effectiveness of online course delivery. Therefore, the learning environment must foster a feeling of belongingness; consequently, students may develop the necessary skills for constructive interaction with each other (Bender and Vredevoogd 2006). Institutions will increasingly rely on dynamic video rather than talking heads for demonstrations, simulations and animations, amongst other purposes. Simon Fraser University has defined experiential learning as the strategic and active engagement of students to learn by doing and reflecting on those activities, which empowers them to apply their theoretical knowledge to practical endeavours in a multitude of settings inside and outside the classroom (Beairsto, Neufeld, and Chinnery 2017).

The collaborative learning environment and Moodle LMS

OCL is an educational paradigm that promotes and facilitates student collaboration. LMSs have been widely utilised at all levels of education for decades, and Moodle is one of the most used Open-Source platforms internationally (Kerimbayev *et al.* 2017). Moodle's group activities and forums have facilitated collaboration and communication between students and instructors in an online or hybrid learning environment. Moodle wikis enables students to explore topics and create content collaboratively, and it is an excellent collaborative writing and learning tool, which facilitates creating, editing and commenting on assigned tasks (Bold 2006; Greenhow, Robelia, and Hughes 2009; Lund and Smrdal 2006). Likewise, Moodle features allow course designers to embed and promote interactions between instructors and students.

According to Costa, Alvelos and Teixeira (2012), Moodle is primarily used to store materials and information, therefore no generalised evidence of a change in pedagogical practice. It also discovered that Moodle's collaborative tools were rarely used due to a lack of awareness. Especially, Forum or wiki activity enables students to contribute according to their convenience and their own pace. During a live session, students can use Moodle's Chat feature. Furthermore, the students can use Moodle's workshop activity to collect, review and peer-assessment of learning tasks. Students grade their peers' positions using a multi-criteria form (Jabbar and Hasmy 2020; Kasimatis et al. 2010). Therefore, this study includes the application of OCL in this emergency remote learning environment.

Background of this study

This study used 58 third-year students in a Textile and Apparel degree program at a Sri Lankan University. This student group learned manual pattern making during their first year at the university.

The students joined from all nine provinces of the country, and the average attendance for the online classes was 98%. All the sessions were conducted remotely and online during this COVID-19 pandemic. TeamViewer software was utilised for real-time remote access to the licensed CAD software, and the Zoom platform was used to host the online sessions where all the students connect with the teacher. Also, Moodle LMS created the learning environment for entire communication.

Four practical assignments were completed individually during the semester, and the duration of each assignment was 1 hour. Practical assignments of this apparel CAD course were mainly designed to (1) create patterns to the given garment specification using the licensed CAD software, (2) validate the garment measurements using the pattern measurements, (3) modify the pattern drafts and develop patterns to achieve required styling, (4) perform marker making and marker planning to calculate the fabric consumption and (5) to generate the required number of markers to process the production order.

Course activities have been redesigned during the pandemic to achieve the above learning objectives. A collaborative group assignment was conducted using Moodle wiki to explore current trends and future developments in apparel CAD applications. Since it was the students' first online collaborative effort, the course coordinator trained and motivated students. Groups of five students were formed, and they contributed to the wiki assignment over 6 weeks. Table 1 shows how this apparel CAD course was delivered remotely before the COVID-19 pandemic and during this emergency.

Table 1. The apparel CAD delivery before COVID-19 and during the COVID-19.

TLA	The delivery methods before COVID-19	The delivery methods during COVID-19
Teaching, assessment and feedback	Face-to-face instructions using PowerPoint presentations, software demonstrations using a multimedia projector and seminars conducted by solution providers in Sri Lanka.	Online delivery using Zoom, access to licensed CAD software using TeamViewer and forum discussion published in Moodle.
Learn and practice	Face-to-face using the lecturer's instructions. Peer-assisted learning during open access practical sessions.	Forum discussions in Moodle, pre-recorded video demonstrations of the CAD software, video files/ URL published in Moodle and remote access to CAD software for open access. Peer-assisted learning groups using Zoom breakout rooms.
Practical assessments	In-class practical test. Printed practical sheets are provided. CAD files are submitted to a network location.	In-class test online using licensed CAD software. Practical sheets are uploaded to Moodle, and assignments are submitted to Moodle.
Group assessment	In-person group discussions and face-to-face slide presentations	Collaborative group assignment using Moodle wiki.

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Methodology

There were two questionnaire instruments utilised to address all objectives of the study. The first questionnaire instrument consisted of quantitative and qualitative elements, posted as a Google form at the end of the semester. Quantitative questions used a 5-point Likert scale. This course was delivered for 14 weeks, from September to December 2021. The Open University of Sri Lanka granted ethics approval for the study and obtained informed consent from the participants. The first questionnaire contains 22 questions covering all research objectives. Questions 1–5 (Q1-Q5) were designed to obtain preliminary information from the participants, including gender, province, device availability and internet connectivity. Q6 had nine sub-questions that examined the effectiveness of Moodle LMS in emergency remote teaching. Q7-Q11 analysed the most effective learning approach perceived by students. Table 2 lists the five tested methods. Q12-Q18 measured the effectiveness of the online assessment strategy. Q19-Q22 discovered the limitations and overall feedback on this emergency remote CAD teaching.

The second questionnaire was instrumented to review online collaborative teaching and learning based on the given wiki assignment. Four questions were asked to determine five themes. These were coded as QW1 – wiki motivation, QW2 – wiki engagement, QW3 – wiki interest, QW4 – wiki discouragement and QW5 – wiki peer intervention.

Table 2. Five key approaches used during the distance learning period.

Approach (sync/ async)	Description of the approach	Objectives of each approach	Teaching aids
1 Synchronous	Real-time teacher and student communication using Zoom.	To deliver lessons using real-time student connectivity.	Zoom central live session, PowerPoint presentations and YouTube videos.
2 Synchronous and asynchronous	Pre-recorded video demonstrations for practical sessions.	To deliver instructions and practical demonstrations for scheduled practicals.	Moodle learning management system and video-recorded practical demonstrations. Gerber AccuMark software and TeamViewer.
3 Asynchronous	Printed handouts to guide the practical session.	To available only a written guide to delivering instructions to conduct the practical.	Moodle, written instructions to self-study the software. Gerber AccuMark software and TeamViewer.
4 Synchronous	Group activity – implement student-teacher to available mutual support learning support system.	To implement peer-assisted learning to support average and slow learners.	Moodle and Zoom breakout rooms. Gerber AccuMark software, TeamViewer and practical assignment sheet.
5 Asynchronous	Use forum discussions in Moodle.	To obtain students' feedback on how assessments supported learning of the practical component of this module.	Moodle – Forum.

Data analysis and key findings

The responses were imported to a spreadsheet and analysed according to the research objectives. Out of all 58 participants, 24 were male and 34 were female. A significant proportion of students (57%) have been connected to this course from western and southern provinces; comparatively, those provinces consist of an urban population with a proper internet connection. The balance of 43% of students is connected from seven provinces in the country; however, each province represents less than 10% of students. All 58 students used laptops to connect to the remote access CAD session using TeamViewer. Students connected to a Zoom meeting during the remote CAD session using the same laptop or smartphone. Out of all 58 students, 14 connected to Zoom using a separate smartphone, and the rest used the same laptops. Forty-seven households had Wi-Fi connections, and 33 had Mobile 4G connections. Q5 measured the overall course content and organisation in general. 93% of students were transparent with the course objectives. 96% of the students mentioned that the learning materials, including lesson plans and course notes, were relevant and valuable. 76% of the students believed the course was well organised and had timely access to materials and notification of changes.

Objective 1 – Evaluate the effectiveness of Moodle in emergency remote teaching

According to the mean values in Table 3, Moodle was recognised as an effective LMS with enormous benefits in sharing study materials, communicating with the students, submitting assignments and connecting with peers. However, some limitations were experienced in using Moodle, which is discussed under objective 5.

Objective 2 – Analyse the most effective learning approach perceived by the students

Q7 gathered responses related to different learning approaches, as discussed in Table 2 and illustrated in Figure 1. Most students preferred approaches 1 and 2, emphasising synchronous teaching. In the second approach, students tend to watch pre-recorded

Table 3. Feedback on Moodle LMS.

Feedback on LMS-Moodle	Mean	SDev	Variance
All online study materials were helpful	4.23	1.03	1.06
I can access learning activities at any time convenient to me	3.92	0.89	0.79
I faced difficulties working with Moodle	3.17	1.28	1.63
Online submissions were better than printed submissions	4.07	0.95	0.91
I found the various functions in Moodle were well-integrated	4.07	0.95	0.91
Moodle enabled me to get to know my peers	3.78	0.99	0.99
Moodle enabled me to participate in course discussions comfortably	3.95	0.98	0.96
I could explore new knowledge in this course due to Moodle activities	4.20	0.92	0.84
Forum discussion helped to collaborate with peers and share knowledge through Moodle	4.13	1.00	1.00

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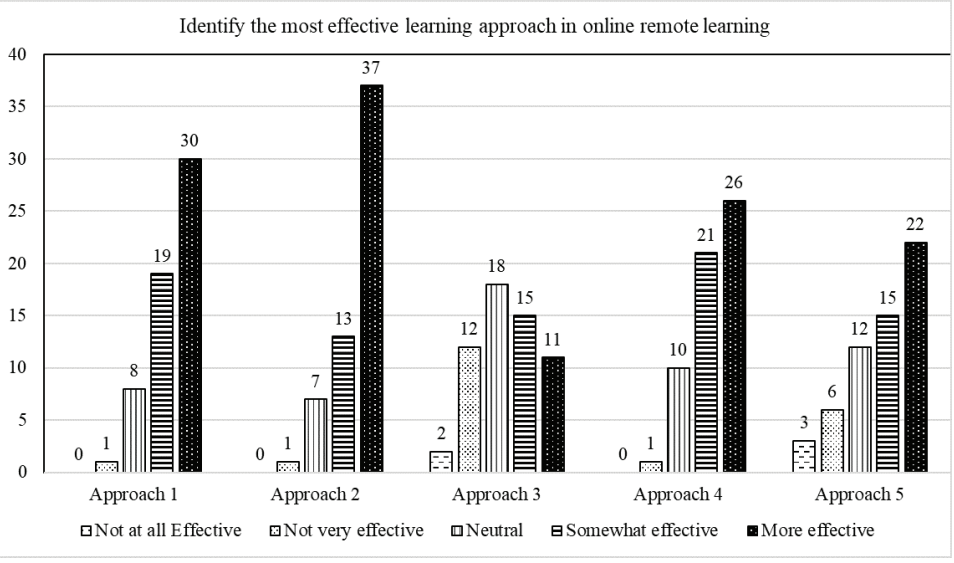

Figure 1. Responses for different learning approaches in online remote learning.

video sessions before the scheduled class; then at the scheduled class time, students tend to practice what they have seen in the video in class with support from peers and lecturers. Study results confirmed that the students were interested in such flipped classroom model. As per Q8, 90% of the students agreed that the online teaching materials adequately support practical sessions. With regard to Q9, half of the students decided that the online teacher interactions were sufficient to learn and practice CAD, and only 2% disagreed. According to Q10, only 5% of students found it easy to follow this CAD practical work; however, 16% found it extremely difficult to follow it using remote access online learning platforms. Moreover, 22% of students found it easy to follow this CAD practical work, whilst 38% found it challenging. The study's ultimate purpose is to examine the causes of such challenges.

As per the results of Q11, the students confirmed the benefits of the pre-recorded video tutorials uploaded to Moodle or shared as a YouTube link. Furthermore, two students suggested including pattern-making lessons in the same video content. As students highlighted, their lack of pattern-making knowledge hindered them from acquiring CAD skills. Moreover, few students requested printed material as a learning resource.

Objective 3 – Measure the effectiveness of the online assessment strategy

This study could use the practical assessment sheets that were used before the pandemic as the same workload could cover even within this emergency setting. However, the physical group project was replaced with the group wiki activity. According to Q12, 98% of students affirmed that continuous assessments (CA) aligned well with the intended learning outcomes (ILOs). According to Q13, 89% of students said they had been informed about the assessments at the beginning of the semester. Out of the 89% of students, 55% strongly agreed with their understanding of the assessment plan. According to the results of Q14, 42% of students were not satisfied with the allocated time for each in-class online practical assignment. Only 10% of students

strongly agreed with the given time for each assignment. Students received feedback at the end of each practical assignment, and prevalent mistakes were explained during the online demonstrations. As such, Q15 affirmed that 86% of the students mentioned that such assessment feedback was helpful.

According to Q16, 87.7% of students stated that in-class practical assignments helped improve their apparel CAD knowledge and skills in this learning environment. Q17 confirmed that 19.3% of students strongly agreed with how they have been assessed on practical CAD skills; furthermore, 56.1% of students somewhat decided on the same. Moreover, no one strongly disagreed with the evaluation methods.

Under Q18, qualitative feedback was obtained to analyse how online continuous practical assessments supported completing set ILOs of the course during this emergency remote teaching. Sub-themes motivated to compare practical online delivery to physical practical sessions and suggest additional resources should be in-built on par with this online practice. Five of 58 students reasoned that their lack of pattern-making knowledge led to the slow adaptation to this computerised product development system. A statement quoted as 'It is great if lecturer can provide additional pattern making tutorials within the current course'.

Underlining one of the main themes, students demanded more 'open access' lab hours to perform well in their practical assignments when learning new software. 23 of 58 students explained how additional practice led to higher scores for CA. They showed the limitations of using licensed software in this course as it restricts their practice time. This response will explore alternative solutions to offer a similar learning opportunity. Students' comments inferred that the students' duration for continuous practical assignments was insufficient. Therefore, students' submissions were further examined as most of the previous practical submissions were not completed; however, this timing issue improved towards the end of the semester. Therefore, four students commented on disregarding scores relevant to early assignments and provided some model tests before in-class practical assignments. Conversely, five students stated that current continuous assignments are more outcome-based; it acts as a positive drive to learn the subject and acquire practical skills efficiently.

On par with the collaborative learning approach, 7 of 58 students declare their enthusiasm for group projects. They highlighted the effectiveness of the peer-assisted learning session using Zoom breakout sessions. Two sessions were organised for group activities, systematically implementing 'peer-assisted learning' and 'student-teacher' immediately before the final practical assignment. A student quoted as 'properly structured, group projects can reinforce various skills while learning the subject'.

There was an indication from the core themes to establish practical course delivery in a hybrid model in the future. One student expressed the benefits of online practical assignments: 'Everyone can work independently without distractions. We could refer to our study materials and do the practical and the assignments without a hassle'. Through further analysis to evaluate the effectiveness of feedback, it is evident that continuous constructive feedback sessions predominately supported students' learning, which they should conduct before attempting the next assignment. Overall, assessments successfully guided students' CAD skill development and improved their confidence.

Objective 4 – Identify limitations of online CAD learning during the pandemic

The results of Q19-Q22 analysed obstacles encountered during the emergency remote CAD teaching using online technologies (see Figure 2).

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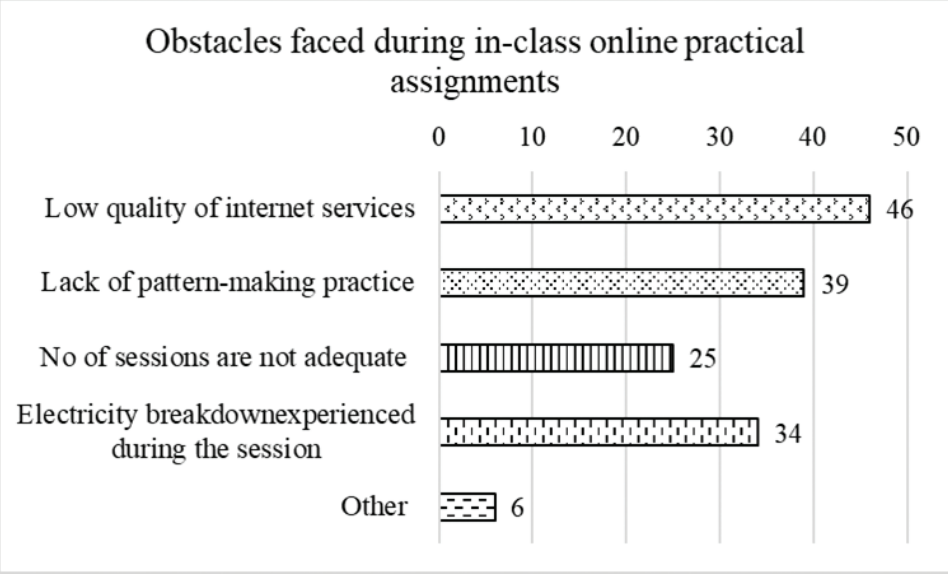

Figure 2. Obstacles faced during an in-class online session.

Table 4. Encouragement to work using wiki.

QW 1 – wiki participation	%	Mean	SDev	Variance
Wiki motivated me to participate actively and interact with colleagues	85	4.25	0.636	0.396
I could access content and resources through the wiki	85	4.25	0.636	0.396
Peer interactions are promoted through the wiki	82	4.08	0.895	0.785
Wiki creates opportunities to generate, present and disseminate knowledge	83	4.17	0.724	0.514

As depicted in Figure 2, the most glaring challenges were the poor quality of internet services and the student's inability to complete the practical session on time power failures. Low performance of some of their devices, lack of pattern-making knowledge and absence of open access sessions for additional practice were also identified as obstacles. In addition, they encountered numerous disturbances when connecting from their respective locations. Most students desired open lab access to practice this licensed CAD software. Importantly, they could obtain peer assistance effectively compared to this emergence of remote training.

Objective 5 – Review online collaborative learning using Moodle

As mentioned earlier, the second questionnaire was instrumented to address this objective. The percentage was computed using the weighted average of the mean and the 5-point Likert scale. 48 students completed the second survey. As shown in Table 4, learners strongly agreed, and the mean response exceeded three.

Table 5. Interest and discouragement in working with the wiki.

QW 2 – Motivation and enjoyment	%	Mean	SDev	Variance
I find each task in the online learning activities is easy to complete	78	3.90	0.778	0.593
I have received helpful feedback/comments on my contribution to the online learning activities from tutors	82	4.08	0.679	0.451
I have received helpful feedback/comments on my contribution to the online learning activities from other students	82	4.08	0.539	0.285
I enjoy using the wiki learning activity	79	3.96	0.849	0.707
QW3 – Demotivation				
I only use online learning activities because it is compulsory for the module	62	3.08	1.164	1.326
I feel reluctant to use the wiki activity	60	3.02	1.194	1.395
I do not like the fact that other people can see my work before it is finished	54	2.69	1.151	1.298
I still have concerns over possible vandalism and plagiarism of my work on the wiki	65	3.25	1.101	1.188

As shown in Table 4 and Figure 2, more than 82% of the students in the online survey agreed that the online environment and wiki encouraged them to participate actively and communicate with colleagues; get access to material and resources; foster peer relationships; and to offer chances for knowledge generation, presentation and dissemination.

As illustrated in the Figure 3 box plot, the mean pleasure score for collaborative wiki projects is more than 4, and the mean rating for all demotivating questions is less than 4. Students share their knowledge in real time with peers during the task because they may assume that receiving feedback on their understanding and engagement would enhance their knowledge and participation. The data analysis reveals that all mean values are more significant than 3.00, and standard deviations range from 0.78 to 1.145. Students found online collaboration more efficient than face-to-face collaboration; they learned more from their peers through online activities than through face-to-face collaboration. They were confident in providing and receiving feedback from/to other students via Moodle wikis.

Additionally, students were asked to evaluate their frequency of access to wiki activity on a scale of 1 to 5. Students engage in collaborative activities five to 10 times each week, as depicted in Table 6. As a result, the mean is 2.73. Additionally, students posted on their sites more than five times each week and commented on peer pages. Furthermore, 53% of students check their peers' work more than five times per week, which indicates that teachers should monitor students' involvement with learning materials and activities that assist them in meeting course goals.

Discussion

The key findings reflect students' interest in a synchronous learning environment similar to face-to-face teaching because students are familiar with conventional learning aspects from their primary and secondary education. This is similar to the key

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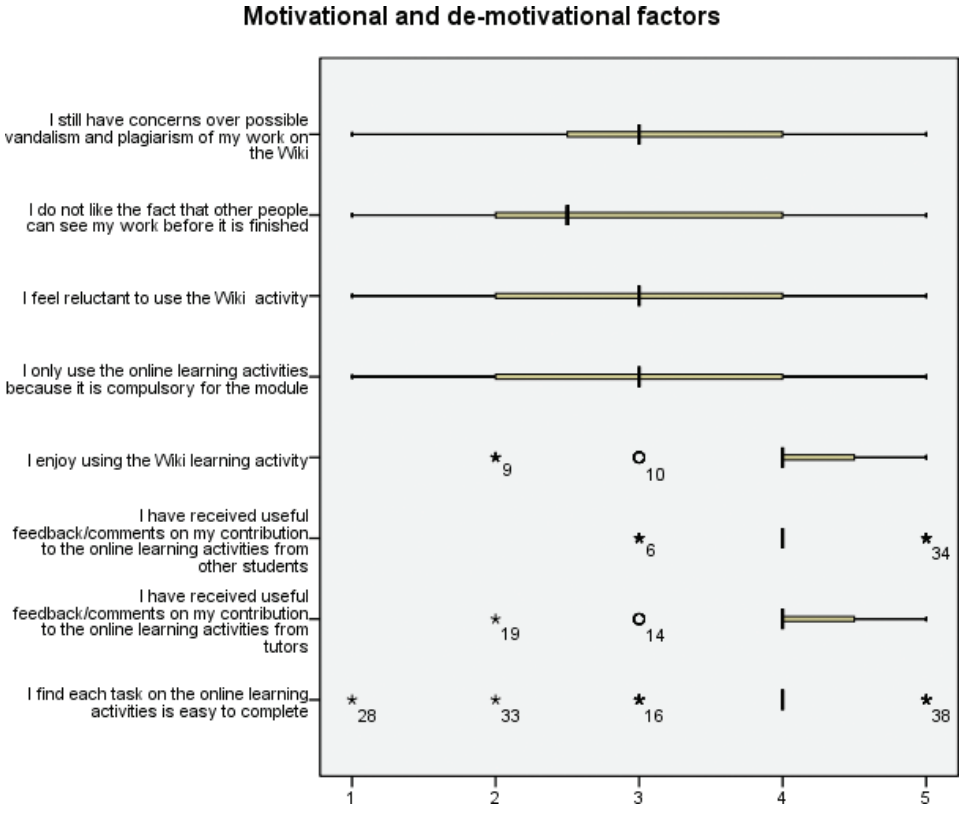

Figure 3. Factors affected by working with the wiki.

findings of the study by Kanetaki *et al*. (2021), which is a mixed approach of MS Teams (synchronous learning) and Moodle delightful for students. However, students seek modern, effective educational methods to fulfil their course requirements in an online environment. Besides live Zoom instructions, students strongly encouraged video-recorded practical demonstrations to be available before the practical sessions. Additionally, the authors' previous study discovered that video-recorded lectures encouraged participants to access the Moodle environment and catch up on missed lessons (Peramunugamage, Usoof, and Dias 2019; Peramunugamage *et al.* 2020). As per the results, students highlighted that lack of previous pattern-making knowledge was an obstacle to succeeding in CAD. Students expected different materials to refresh their pattern-making knowledge, which should have been included in the new learning system. As such, this study strongly recommends flipped classroom model to include in designing online teaching in the future.

Moodle immensely supported students to succeed in this emergency remote teaching with its elements such as assignment submissions, class links, announcements, chat, H5P plugin for interactive content, forum, wiki, URL, video and lesson notes, as reported in other studies (Jabbar and Hasmy 2020; Kanetaki *et al.* 2021; Khalil *et al.* 2020; Liyanagunawardena and Williams 2021). In this study, we found that students desired the collaborative learning techniques they had encountered in a traditional learning environment. Students are motivated to complete course assessments by their

Table 6. Wiki participation during a week.

QW2 – wiki engagement	%	Mean	SDev	Variance
How often do you access the wiki activity during the week?	55	2.73	0.765	0.572
How often do you write on your pages during a week?	48	2.42	0.846	0.701
How often do you write comments on colleagues' pages during a week?	43	2.19	0.724	0.514
On average, how frequently do you check the work of colleagues on Moodle	53	2.65	0.838	0.687

teachers and peers. Therefore, the Wiki activity provided an opportunity to explore the subject's contemporary developments engagingly than other Moodle elements.

The teacher created adequate content for students using Moodle to make working in the remote context easier. The results revealed that the online course materials were sufficient to support students in achieving the course ILOs. The results revealed the necessity of open access and self-directed studies to build confidence in using the system. Moreover, as shown in Figure 3, formative assessments with constructive feedback helped improve their scores for the final practical assignment.

Finally, the most critical issue was a lack of equal access to digital infrastructure across the country, which hampered online education in developing countries, as emphasised in UNESCO and the ADB reports during the pandemic (Hayashi *et al.* 2020; World Bank 2020). Many students said internet connectivity and internet speed issues; similar reflections can be seen in the study conducted by Hayashi *et al*. (2020) for the broader Sri Lankan audience. The internet issues interrupted students during the CAD activities in our study; our students were given extra time or another appointment to complete and submit their work. This highlights the need for educators to be flexible and has procedures to deal with digital infrastructure issues in their courses.

Conclusion and future recommendations

In times of global crisis, social priorities are dynamically reordered worldwide to meet varying demands. During this COVID-19 emergency, remote teaching with novel educational styles has been implemented globally temporarily and persistently (Benabdallah and Bourgault 2021; Khalil *et al.* 2020; Liyanagunawardena and Williams 2021; Snoussi *et al.* 2020).

Therefore, this study was an excellent example of teaching and learning practical courses online using Moodle LMS. Since this study showed various Moodle applications to enhance remote learning, lack of knowledge in Moodle applications could not provide the expected results. Out of all the applied approaches, students' highest preference was synchronous teaching methods and flipped classroom model. This study highlights the importance of embedding flipped classroom concepts in our courses, where students can view the pre-recorded demonstration before synchronous practical sessions. Moreover, this study showed how 'peer-assisted learning' and 'student-teacher' could apply in the online learning environment and consequently how they helped to improve students' grades.

All practical assessments were carried out online using remote access to the licensed software, and students received formative and summative feedback where necessary. Also, wiki exercise and collaborative feedback mechanisms proved the

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success of OCL. Through examination of sub-themes, it was found that the insufficient digital landscape hinders online delivery in developing countries. This study demonstrated the success of OCL, an educational paradigm that promotes and facilitates student collaboration.

This effort can assist course developers in developing a comprehensive learning solution for preparing apparel CAD or similar software that integrates with other subject-specific inputs. Most importantly, this flipped classroom and collaborative practice approach can be utilised to train a wider audience with proper learning materials, especially pre-recorded videos.

Effective e-learning platforms can overcome constraints. As Cabero-Almenara, Arancibia and Del Prete (2019) suggested, if the teacher is motivated and committed to designing and restructuring the course effectively even when the environment changes abruptly, such good designs can overcome constraints. As a whole, this whole project develops students' independent learning skills, which will aid them in their future studies. As a result, this implementation was an excellent example of a well-organised venture that resulted in real change through the effective integration of online tools.

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