



An Efficient Merge of Online Teaching and Distance Learning Strategies in Chemical Engineering Computer Applications During the Covid Pandemic

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ABSTRACT

The goal of this research is to find evidence-based methods for converting hands-on computer programming lab instruction into a remote teaching technique that achieves targeted learning results without sacrificing soft skills. Both instructors and students were faced with a significant hurdle, which evidently requires a shift to distance learning and teaching a fifth-year chemical engineering computer applications course during the COVID-19 pandemic. We employed a mixed online technique to solve these problems in this undergraduate course at Elmergib University, which eased the transition from traditional face-to-face learning in the classroom to the setting of online programming training for chemical engineering applications instructions. The synchronous component of the education was performed using Google Meet video conferencing platforms. While the asynchronous part of the teaching was accomplished by broadcasting pre-recorded lecture videos into a learning management system, Google Classroom is an excellent choice (LMS), allowing students to go at their own pace when studying and progressing. Throughout this teaching process technique, instructors' assessments of students' learning and academic achievement served as an indicator of students' interest in self-monitoring skills. The study found that having a few hours of daily electricity outage combined with an inconsistent or poor internet connection had a favourable influence on students and teachers. Deep knowledge with widely available internet-based teaching resources, such as managing virtual classroom learning management systems and video-based lecturing tools through Google Meet, is a challenge for instructors

Keywords:

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1 INTRODUCTION

This project aims to begin teaching Excel Visual Basic for Applications (VBA) and programming in chemical engineering at Elmergib University, with a focus on relevant examples and projects from chemical engineering core courses. The chemical engineering computer applications course focuses on how to programme and solve problems, as well as how to turn a chemical engineering problem into a workable programme. If no good commercial free software package is available, computer programming is deemed significant. Elmergib University's current chemical engineering courses require students to master the VBA programming language as well as other commercial software packages like as ASPEN, DWSIM, and others. The latest VBA programming course was organised and conducted in a professional manner. Several chemical engineering challenges were chosen as projects or demonstration programmes so that students may see the benefits of Excel VBA programming. Students were compared to other programming languages they had previously been taught as well as current software solutions that did not need programming to discover the benefits and drawbacks of programming in Excel VBA. The goal of this initiative is to start teaching engineering students about problem-solving tools. This encourages students to investigate different computer software packages, computer programming, or other ways to handle an issue, as opposed to the computer science approach, which focuses solely on programming language syntax without relation to practical engineering challenges [1]. We focus on programming specifics such as language syntax, as opposed to other reported Excel VBA programming courses for chemical engineering students [2, 3]. We also try to teach problem-solving and train students on how to choose the best platform for problem-solving. These student projects all result in demonstration programmes focused on chemical engineering issues. The integration of Excel VBA with Coronell's suggested higher-level engineering courses [2] is also demonstrated through such projects and demonstration programmes. This course is also intended for students who are not computer science majors and does not cover advanced topics such as object-oriented programming, database programming, and so on. Structural programming using a divide-and-conquer approach is the programming paradigm utilised in this course. In VBA, you may use procedural and object-oriented features. The Excel VBA programming course was put to the test in senior chemical engineering undergraduate courses. Other examples and projects were drawn from chemical engineering core courses such as fluid dynamics and process engineering in order to stimulate students' interest in using programming to solve issues while simultaneously exposing them to important programming aspects and advanced abilities. Most chemical engineers spend at least half of their workday in front of a computer [2], with the majority of their responsibilities including user-friendly commercial software. Graduates of chemical engineering are seen to be more competent to contribute in an industrial setting than those who study how to write a computer programme in a language they may never use again. This is achieved by teaching students how to utilise Microsoft Excel and programming in Visual

Basic for Applications (VBA). It has also been discovered that because students are already familiar with Excel, it is an appropriate setting for them to develop programming abilities [2].

The majority of jobs can be accomplished using commercially available software, such as Microsoft Office for word processing, Excel for numerical problem solving, and DWSIM for computer-assisted plant design. DWSIM is a VB.NET-based chemical process simulator that is suitable for both novices and more experienced chemical scientists. Engineers can use the application to do advanced thermodynamic calculations, petroleum characterisation, and hypothetical component utilities, all of which are available through a graphical user interface.

2 STUDY CONTEXT

Covid-19 has spread across the continent since its first instances in February 2020, with Libya being one of the worst-affected countries. In many countries, the population is growing. Most, on the other hand, acted quickly to combat the pandemic, with extensive school closures occurring early on. Despite the fact that the virus is a huge threat to their countries and education, the current scenario presents a significant opportunity. Technology will undoubtedly play an important part in Libya's educational future, according to most experts. The Coronavirus infection acts as a wake-up call to face the future firmly in the face. In an effort to reduce viral transmission, the COVID-19 pandemic has had a huge impact on the global higher education system, with a considerable change in online instruction. Because a major percentage of the population has intermittent internet access and few electronic gadgets, many teachers and students were apprehensive about the abrupt shift to online instruction [4]. As a result, governments all over the world have begun to close educational institutions. With no warning, the entire approach to education through classroom teaching became unviable, with little planned to replace it. While the need for online learning was obvious from the start of the pandemic, reaching out to students effectively was more difficult. Universities were left to their own devices, with responses varying depending on their resources and ingenuity. Students and teachers, for the most part, have no prior experience teaching and learning outside of the classroom. Government reactions varied: many offered instructional programming on television and radio, sometimes in collaboration with the private sector, but none were well-organized. The absence of suitable training to design and administer distance learning programmes was the biggest constraint for university professors. This was exacerbated by a lack of infrastructure, such as electricity, internet access, and devices, as well as a shortage of appropriate learning resources, such as books, television, and internet-enabled devices. Despite these obstacles, many respondents believed that Covid-19 will open up new possibilities for educational systems, particularly in terms of integrating technology into learning.

3 APPROACHES TO DISTANCE LEARNING

Even though the colleges were closed, there was a broad understanding in all countries that education was important and had to continue. There was widespread consensus that successful distant learning was required, but delivering it proved to be more difficult. In terms of what

distant education might look like, there were significant national and sectoral variances. Government recommendations differed by country and by educational sector. Government actions were prompt, appropriate, and comprehensive in several circumstances. In other circumstances, little was offered, and teachers, schools, and lower administrative levels were allowed to make decisions. At the university level, institutions might make broad decisions on how to handle educational continuity. Many higher education institutions already have Virtual Learning Environments in place, which allowed them to continue teaching with minimal disruption. In practise, though, it was not always so simple. In other circumstances, schools recommended primarily synchronous video conferencing sessions for their pupils, using Google Meet or a comparable tool. However, not all students had access to these lessons. The absence of suitable training to conduct and incorporate distance learning in their teaching was a major barrier for many professors. One of the most major barriers to a successful response has been identified as issues with connectivity and internet access. Although connectivity is challenging without a dependable electrical supply, accessibility and cost of connectivity are just as vital.

With new outbreaks and lockdowns looming, many instructors have been compelled to look towards online training, which can be provided in one of three ways: synchronous, asynchronous, or mixed learning methodologies. Instructors and students gather online utilising video conferencing software during defined class hours, and instructors provide course lectures through with new outbreaks and lockdowns on the horizon, many instructors are turning to online training, which may be delivered in one of three formats: synchronous, asynchronous, or hybrid learning. During designated class hours, instructors and students meet online using video conferencing software, and instructors deliver course lectures via synchronous online real-time classrooms. During the sessions, students can ask questions either verbally or through live text chat. Instructors tape lecture videos and submit them to Google Classroom (LMS) for students to utilise whenever they want in asynchronous sessions. Because it combines the benefits of traditional and online learning, the mixed online learning strategy is considered the most practical. The main goal of using a mixed approach is to encourage students to participate actively in their own learning rather than simply listening to a synchronous conversation. The cognitive load hypothesis suggests that new learners are immediately overwhelmed with a large number of terminology and new concepts [5-7]. The flipped classroom's active learning pedagogy is a type of active learning pedagogy. [8, 9]. Pre-class activities such as watching brief, pre-recorded lecture films replace traditional lecture and homework in this learning technique. Class time reinforces the principles through problem-solving examples, engaging exercises, and in-depth discussions [10, 11]. However, in the traditional flipped classroom, synchronous online class sessions, often known as virtual classrooms, were used to engage students with activities and guided problem-solving discussions.

4 COURSE FORMAT DESCRIPTION

This project's computer applications course is a condensed course inside specialised chemical engineering courses that students take as part of their course preparations for a final graduation project course work. Because it is taught in fifth-year classes, most students have previously completed fundamental computer programming courses in their second year. As a result, we'll go through basic Excel VBA syntax, a case study on turning an engineering problem into a workable programme, and projects relating to chemical engineering difficulties in this programming course. There are also several demonstration programmes on specialised chemical engineering subjects drawn from basic chemical engineering courses. Students are taught programming as a practical skill through tutorials, projects, and demonstrations. For the whole semester, there are four hours of lectures and two hours of practise every week. As an undergraduate topic for non-computer science students, this course focuses on the following sorts of computing problems: obtaining a numerical solution via solving PDEs, ODEs, and matrices. Other abilities to learn include handling repeated, straightforward computations as well as calculating techniques that entail flexible alternatives or intricate decision-making. Instead of emphasising VBA's object-oriented programming capabilities, the course emphasises structural programming and the use of flow charts to create programmes. Elmergib University's current chemical engineering programme encourages students to learn various commercial software packages such as ASPEN and DWSIM in addition to Fortran. This Excel VBA course aims to provide students with a user-friendly programming environment rather than replacing other commercial software programmes. The demonstration programmes described in this paper do not require Excel VBA programming as a software solution. Nonetheless, these programmes are provided to students in order for them to have an understanding of a software solution that may be applied to a variety of challenges.

5 METHODOLOGY

Due to epidemics and approaching lockdowns, instructors of the class had to consider online education when delivering this computer programming course to tackle various Process Simulation Problems. There are three pedagogical approaches to teaching methodology: synchronous, asynchronous, and blended learning strategies. In real-time synchronous online courses, instructors and students meet online utilising Google Meet video conferencing software during set class hours. Instructors deliver classes in an asynchronous format, in which students engage in live text chat during lectures and express questions verbally. Instructors can also record huge lecture videos and publish them to OneDrive, where there is no need to worry about running out of storage capacity on a device. The OneDrive Files On-Demand functionality allows instructors and students to securely access and work on all of their OneDrive files without having to download them to their computers. Even as schools return to traditional classroom learning, using OneDrive to store data in the cloud relieves IT of the administrative load of backups, expensive storage systems, and disaster recovery. Students can access those files whenever they want through the Google Classroom learning management system (LMS). As mixed online learning tactics, the advantages of synchronous

and asynchronous strategies are deemed the most practical method to adapt. The fundamental aim for using a mixed method rather than a synchronous conversation was to encourage students to participate more actively in their learning. Economists [12] have written on the advantages of the flipped classroom. Reduced heterogeneity in teaching styles between classrooms and the implementation of a variety of activities to build an inclusive classroom climate enhanced student performance, according to Lage and colleagues [12]. Materials science courses [13], pharmacy courses [14], statistics courses [15], engineering education courses [16, 17], computer science courses [18, 19], and health science courses [20, 21] have all found similar effectiveness with flipped learning.

The instructors' next priority was to meet the course's learning objectives, as well as to organise and present the content to students. Teaching in developed nations is founded on the notion that all students have equal access to technology and cultural resources in order to absorb academic material. Unlike some rich countries, developing countries, such as Libya, must take into account all students' sociotechnical restrictions while creating course content and delegating tasks. In most Libyan universities, online lectures are unusual, and at our chemical engineering institute, lectures are normally conducted in a classroom setting. In our chemical engineering computer applications course, the COVID-19 module clearly hastened the transition to complete online training and created opportunities for successful online teaching.

During the pandemic, the goal was to integrate available technologies to meet higher education challenges for instructors and students. For this blended learning course, the concept of teaching to Discover, Learn, Practice, Collaborate, and Assess was used. It was created to assist teachers and students in better comprehending how the technique helped them overcome the challenges of online learning. Examining the strategy as a successful method for totally online teaching is required to achieve that goal. The authors' and students' work and study experiences during the epidemic were assembled using the resources and technologies available at the time.

Figure 1 depicts the five components of the discover, learn, practice, collaborate, and assess technique, along with a brief explanation of each part. As shown in Figure 1a, students were first asked to join Google Classroom as the learning management system tool (LMS). Then students were instructed to find all learning materials for the designated topic that had been submitted to the course Google Classroom LMS, as shown in Figure 1b. The approach Learning component is then expanded to include lecture handouts, progress trackers, lecture videos, a redesigned course syllabus, and web links to additional online resources. Students are then required to learn the terminologies, ideas, and computations utilising pre-recorded lecture videos and other materials, as indicated in Figure 1c. On a video streaming platform, lecture videos are made publicly available and free of charge. In addition, students can get visual announcements about the time frame for events. Students can use the practise section's self-assessment questions to put what they've learned into practise, as shown in Figure 1d.

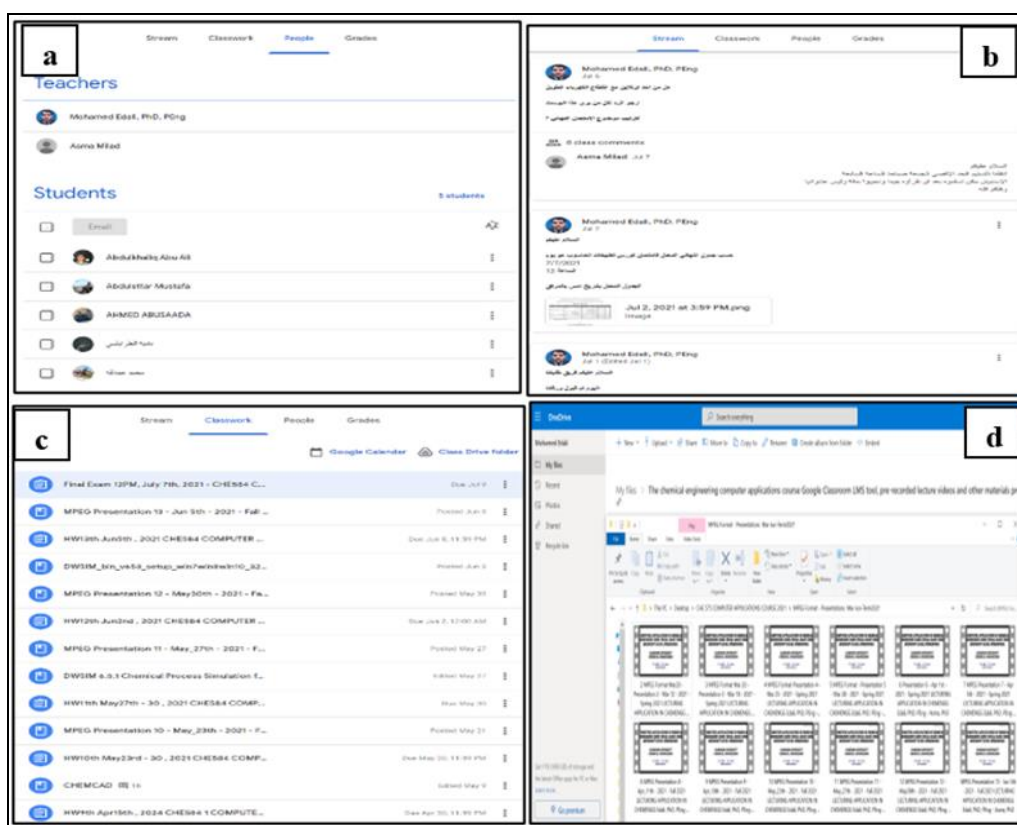


Figure 1 a: The chemical engineering computer applications course/Google classroom LMS tool, class joined professors and students, b: The discover stream part, c: learn part pre-recorded lecture videos, d: Practice part OneDrive course account pre-recorded MPEG videos.

Each topic has detailed explanations of word problems and self-assessment questions, as well as numerical problems assigned from the textbook. Students collaborate in interactive activities like as quizzes and discussions for the bulk of the time in class.

For the online class, a free and stable video conferencing technology was used, and synchronous sessions were recorded and uploaded to the course's Google Classroom. The synchronous online lessons went through and clarified certain elements of the ideas and mathematics that students struggled with. Furthermore, the cooperation aspect is predicted to have an impact on student involvement. Finally, assignments, quizzes, or examinations are given time to assess the student's understanding of the contents in light of the stated course learning outcomes. Multiple sets of online exams are used with a fixed amount of time to solve and submit solutions in engineering reporting format. A longer time range was suggested to give students, especially those with limited internet access, more thorough access.

6 RESULTS AND DISCUSSION

In this chemical engineering computer applications class, the educational theory evolution of the teaching strategy in online classroom instructions was reviewed. When establishing the optimal teaching strategy for merging computer application techniques and solving diverse chemical engineering problems, several elements were taken into account. Assessing the optimal pedagogical model to adopt is one way. Among the primary learning theories, cognitivism and constructivism are seen to work best in an online classroom context. Cognitivism [22] is a theory that focuses on improving a student's learning techniques. It outlines how pupils organise and process data in order to acquire and preserve new knowledge obtained via practical conversations and problem-solving. Constructivism, on the other hand, is founded on the idea that students learn better when they build on their existing knowledge and experience through a series of assignments and exams [23].

New material is presented in a module-based way in the discover, learn, practice, collaborate, and assess technique D-L-P-C-A plan, with concepts linked and built from prior modules. As a result, the discussions focus on the technical issue at hand as well as practical applications or real-world problems that may be solved utilising various industrial simulation software programmes such as DWSIM lectures set.

Assessments are conducted to test students' comprehension and problem-solving abilities. These strategies are thought to be sufficient in providing learning to pupils since they target the most relevant learning conception in this context. Negovan *et al* [24]. discovered that students value learning as comprehending, which includes growing one's knowledge, memorising, and applying what one has learned [24], whether in a face-to-face or distant learning situation. Through course content, delivery, and evaluations, the suggested D-L-P-C-A technique combines these theories and concepts to maximise learning for students.

Before attending the synchronous sessions, students are given a short overview of how to use the equipment and software needed to capture lecture videos as part of the D-L-P-C-A technique. For students, lecture videos were made easy, clear, aesthetically appealing, understood, and accessible. Microsoft PowerPoint was used to record the narrations and debates, which were then saved in MP4 format. Students were provided URLs to the lecture videos via the Google Classroom LMS, which were subsequently uploaded to OneDrive for convenient access.

It is not enough to study diverse pedagogies in order to build effective teaching and learning strategies; it is also necessary to consider the students' and instructors' actual social and technical conditions in the midst of the ongoing epidemic. The many limits and challenges faced by both students and instructors were initially highlighted. During the lockdown, students' technical and personal restrictions may hinder them from participating in online learning. These include a lack of computers/laptops, unstable internet access, power outages, a quiet and isolated study space, slow and ageing machines, and non-academic family responsibilities. All students must be able to access asynchronous teaching resources. The

availability and speed of the students' internet connections must be considered. A large number of calculations must be taught to students in a computer applications course. The ability to properly communicate concepts and theories to students may be hampered by the delivery of lectures via the internet. Due to the high number of students participating in online learning, internet networks are on the verge of becoming overburdened. As a result, choosing a stable, free, and widely available platform for online synchronous class discussions is critical. Students may find it difficult to return to the session rooms, which might cause tension. During the scheduled class hours in real-time synchronous mode, a Google Meet video conferencing programme was used through online lectures. Instructors and students meet online for synchronous lectures on the course, where students participate in the lectures via live text chat and can ask questions verbally.

Assessment procedures must be modified to reduce academic dishonesty while still providing students with the numerical and analytical abilities necessary to solve engineering challenges. As a result, it's critical to design exams that minimise collaboration and internet browsing. The assessment's complexity must be weighed against the time limits. Other factors, such as the time it takes to scan and save their solutions, as well as the upload speed of their internet connection, must also be considered. These aspects should not be overlooked if students are to be treated fairly.

Asynchronous and synchronous teaching-learning methodologies are used in the D-L-P-C-A strategy. A positive learning environment is promoted by asynchronous learning because it helps students to feel more engaged and accountable for their learning progress. This system, on the other hand, does not allow students to receive rapid feedback and comments from the instructor. As a result, students may become detached from their lecturers and less motivated. As a consequence, it's utilised in conjunction with a synchronous video conferencing session on a reliable platform. This enables for better communication between instructors and students, which is crucial for explanations, topic attention, and the instructor-student interaction, especially during the pandemic's difficult stage.

Elmergib University's computer application course in the department of chemical engineering has had its curricula changed. Senior students were rarely asked to use and apply their programming skills during the course. When students were given numerical problems to solve, they were frequently handed a commercial software package to use in a black-box manner, reinforcing the notion that their computer programming class was a waste of time. Technology and software advancements, as well as curriculum changes, have all contributed to a better understanding of the problem. Laptop computers are becoming more common in classrooms. Access to computing resources is now more accessible than it has ever been. Furthermore, the availability of programming languages such as VBA within the Excel environment, which include built-in solvers and graphics, makes applying computer programmes to engineering problems easier. A black-box paradigm is used in several commercial numerical software packages. This can encourage their use without needing the user to understand the numerical procedures that underpin them. In an academic setting, however, this may not meet all of the required educational objectives. Individual engineering departments, rather than the computer science department, might teach computer programming to promote numerical problem-solving in the undergraduate engineering curriculum. This approach has the advantage of being able to deliver discipline-specific teaching and applications. However, the impact of a more enlightened experience in a

beginning computer programming course fades fast if students do not consistently utilise their computer application skills in problem-solving.

Elmergib University's chemical engineering department has made similar changes to its curriculum to address the difficulties raised above. Visual Basic for Applications (VBA), Excel's integrated Macro language, was used to teach students programming concepts. The decision to utilise VBA was influenced by a number of considerations. For starters, employing a single software programme for the whole course lowered instructional overhead due to its ease of use and efficiency. Nonetheless, the impact of a more enlightened experience in a beginning computer programming course fades fast if students do not consistently employ their computer application skills in problem-solving.

Elmergib University's chemical engineering department has undertaken similar programme changes to address the aforementioned difficulties. Students have been taught programming ideas using Visual Basic for Applications (VBA), Excel's built-in Macro language. VBA was chosen for a variety of reasons. For starters, employing a single software programme for the entire course minimised instructional overhead due to its simplicity and efficiency. As a result, students would not have a tough time learning how to programme in another language if necessary. The fundamental educational issue that remains is divided into two parts. Providing students with greater opportunity to apply their computer application skills to numerical problem solving while avoiding instructional overhead is a top aim. The solution to this challenge requires the usage of a common numerical software package that is used throughout the curriculum. Furthermore, students must utilise the software to improve their comprehension of numerical algorithms while minimising real programming effort for the software to be most effective. The challenge's main goal was to create an Excel Add-In from the general-purpose programmes that the students created in this programming and computation for chemical engineer's course. They run their programmes in a software environment that is transparent. This is referred to as a glass box approach to numerical problem-solving, as opposed to the more familiar black-box approach.

The ultimate goal, of course, is to model the process using a simulation programme that accurately establishes the stream attributes and performance conditions of the individual components. An open-source process simulator was utilised in this training and was targeted to professional practise. Its use demands specialised training, the level of which is dictated by the commercial product's qualities. The engineer has strong calculation tools at his disposal before running process simulators, which make the analysis more approachable by using estimated values of compound and mixture properties and simplified equipment calculation procedures. The spreadsheet is the most widely used calculation tool in the engineering discipline, not just in professional practise but also in undergraduate education. As a result, all spreadsheet-based engineering instructional advancements advise a student-friendly environment and methods, as well as a review of the skills needed for future professional success. Running a material balance on a distillation column was a common problem practise given to students. In the first step of the comprehensive issue solution, students were expected to use an Excel Spreadsheet application as a glass box technique to compute the overhead flow rate and the mass flow rates of benzene and toluene combination in the bottom stream. At a rate of 2000 kg/h, a distillation column containing 45 percent benzene (B) and 55 percent toluene (T) by mass is supplied. A 95% (B) overhead stream is created, with 8% of the

benzene supplied to the column departing in the bottom stream, as illustrated in Figure 2a Problem 1 for part 1. In part 2 of the identical Figure 2a problem, students were told to utilise the DWSIM simulator software as a black-box approach (Figure 2b) to check the solution spreadsheet programmed findings as a glass-box strategy (Figure 2c and Figure 2d).

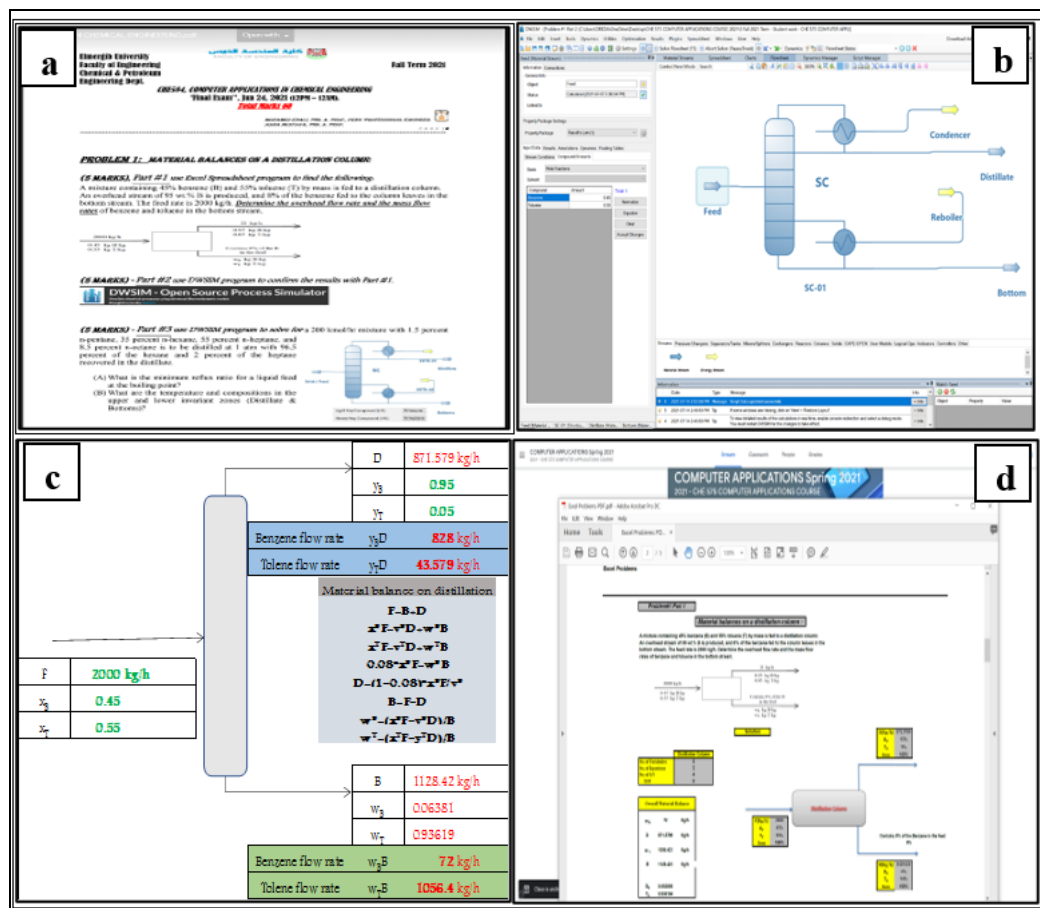


Figure 2 a: Typical material balance on a distillation column problem practice, b: DWSIM simulator program used as a Black-Box approach problem solving, c: Excel programmed spreadsheet solution, d: Comparable full results of spreadsheet as a Glass-Box approach.

Instructors also discussed their transition to online instruction and how the method aided in the continuation of chemical engineering computer applications education throughout the COVID-19 epidemic. Introducing new technology teaching tools for the instructors was one of the beneficial effects of employing the technique. As a result of the transition to online education, all teachers employed synchronous video conferencing facilities, online assessments, and pre-recorded lecture videos. In the long run, these changes have the potential to enhance instruction. Self-made lecture films, in particular, may be a long-lasting teaching tool, despite the fact that they are a time-consuming process. Future semesters will undoubtedly benefit from the pre-recorded lecture films, which will be utilised in conjunction with other creative learning activities. The decision of which online technology is best suited for lectures presents a significant problem as part of the transition to online learning. The myriad instructional venues and online materials available to instructors might easily

overwhelm them. The strategy, on the other hand, organised all of the available web resources. Collaboration and task delegation (e.g., generating video lectures, building new exercises, team teaching) among instructors were also part of the process, resulting in higher-quality learning materials. Assessment methodologies must be reorganised as illustrated in Figures 3a, 3b, and 3c to avoid academic dishonesty while still providing students with the needed numerical and analytical abilities in handling engineering difficulties.

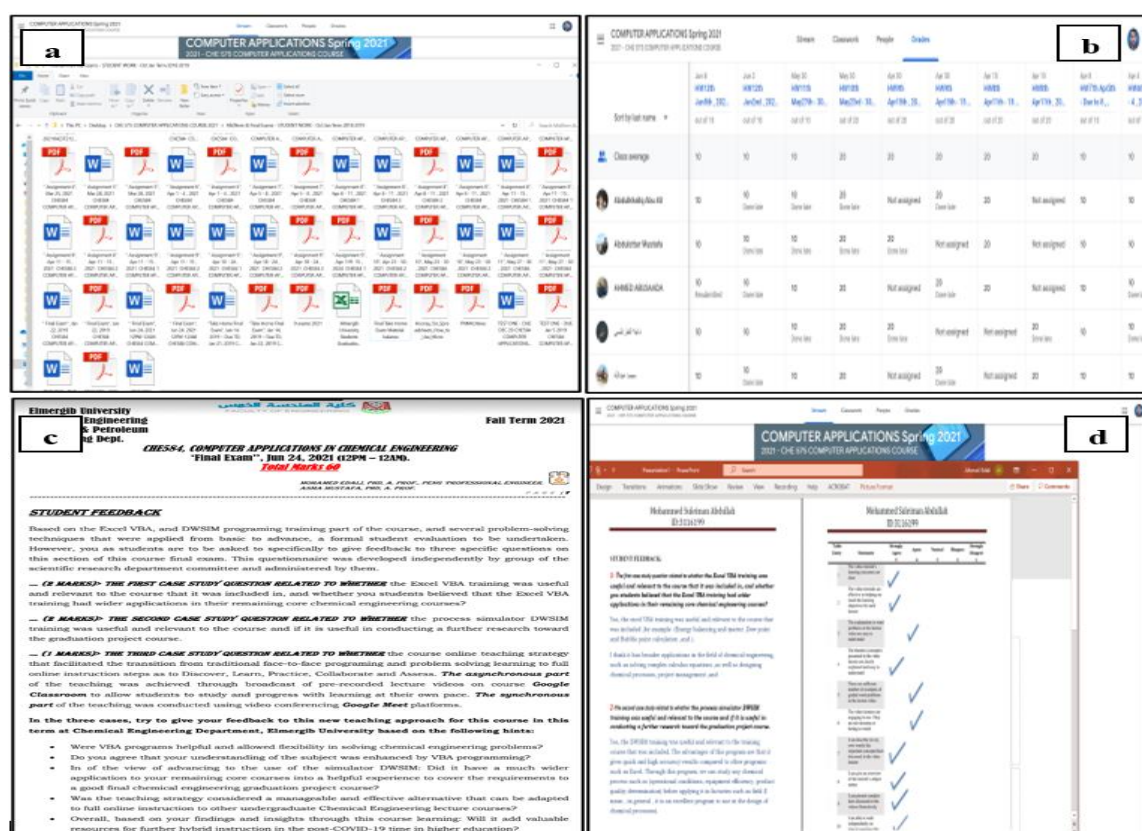


Figure 3 a: The chemical engineering course assignments and tutorials at Google classroom, b: Course Google classroom grading system, c: Course students assessment detailed inquiry, d: Student feedback reporting.

As a result, it's critical to design examinations that don't require too much teamwork or rely on the internet. The time constraints must be matched against the difficulty of the presented evaluation. Furthermore, the sharing of ideas aided instructors in better planning assessment administration [26-30]. The D-L-P-C-A technique had a big influence on the pupils' learning, too, according to the teachers. Students' progress in understanding the themes in their lecture courses has been hampered by online education, which has resulted in a variety of challenges.

7 STUDENT RESPONSES

A comprehensive quantitative student evaluation was conducted due to the Excel VBA and DWSIM instruction being a crucial component of the course. In this section, students will be required to reply to three specific questions. The questionnaire was created and administered separately by a group of members of the scientific research department committee. The first case study question inquired if students considered the Excel VBA training was useful and relevant to the course in which it was presented, and if they thought the Excel VBA training would be useful in their remaining core chemical engineering courses. The second case study issue was if the DWSIM training was beneficial and relevant to the class, and whether it could be used to undertake more research for the graduation project course. The final case study question asked if the course's online teaching technique assisted in the transition from conventional face-to-face learning to full-fledged online learning phases like discover, learn, practice, collaborate, and assess. Students were able to study and proceed with their learning at their own speed by broadcasting pre-recorded lecture videos on the course Google classroom. For the synchronous component of the instruction, video conferencing and Google Meet were employed. Students in all three situations attempted to provide feedback on the new teaching strategy for this course using the following tips. VBA programmes were useful in tackling chemical engineering issues because they provided flexibility. Second, agree that VBA programming has improved their comprehension of the topic. Third, prior to using the DWSIM simulator, it has a much broader application to their remaining core courses as a valuable experience in covering the prerequisites for an exceptional final chemical engineering graduation research project course. Finally, the teaching technique is seen to be a feasible and successful alternative that may be used to other undergraduate Chemical Engineering lecture courses via comprehensive online training. Overall, the facts and insights gathered from this course contribute essential resources for future hybrid instruction in higher education after COVID-19.

8 CONCLUSION

For instructors and students alike, the COVID epidemic has opened up new prospects for online learning. To educate online, teachers must transition from the traditional teaching paradigm to new technology-friendly teaching methods. Students should be surveyed about the teaching style to see if they are following along with the lecture and to offer improvements to various aspects of online education. This research highlighted the approach that paved the way for the transition from traditional face-to-face to online instruction during the pandemic. The technique includes asynchronous learning using pre-recorded videos and synchronous meetings with live exchanges. Students learned that asynchronous teaching with lecture videos helps them to advance at their own speed because they may access the videos at any moment during the lockout. Asynchronous evaluations were successful in resolving slow learners' issues. However, measures must be in place to prevent illegal student collaboration and web surfing. Furthermore, the time savings associated with the creation of pre-recorded lecture films outweigh the benefits of D-L-C-P-A. The ideas and findings presented in this

research might be used to create synchronous and asynchronous components for online, flipped, or hybrid classrooms. Furthermore, the D-L-P-C-A technique may be used in future occurrences such as class disruptions due to bad weather and circumstances in which a faculty member is unable to physically be present in a classroom due to illness.

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دمج فعال لاستراتيجيات التعليم عبر الإنترنت والتعلم عن بعد في تطبيقات الحاسوب في الهندسة الكيميائية خلال جائحة الكوفيد

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الملخص

الهدف من هذا البحث هو العثور على طرق قائمة على الأدلة لتحويل تعليمات معمل برمجة الحاسوب العملية إلى تقنية تدريس عن بعد تحقق نتائج تعليمية مستهدفة دون التضحية بالمهارات الشخصية. واجه كل من المدرسين والطلاب عقبة كبيرة، والتي من الواضح أنها تتطلب التحول إلى التعلم عن بعد وتعليم مقرر تطبيقات الحاسوب في الهندسة الكيميائية للسنة الخامسة خلال جائحة الكوفيد. لقد استخدمنا تقنية مختلطة عبر الإنترنت لحل هذه المشاكل في هذا المقرر الجامعي بجامعة المرقب، والتي خففت من الانتقال من التعلم التقليدي وجها لوجه في الفصول الدراسية إلى إعداد تدريب البرمجة عبر الإنترنت لبرمجيات تطبيقات الهندسة الكيميائية. تم تنفيذ المكون المتزامن للتعليم باستخدام منصات مؤتمرات الفيديو من قوئل مبيت في حين أن الجزء غير المتزامن من التدريس تم إنجازه من خلال بث مقاطع فيديو محاضرات مسجلة مسبقا في نظام إدارة التعلم، فإن فصل قوئل هو خيار ممتاز كمنظومة إدارة تعلم، مما يسمح للطلاب بالتعلم على وتيرتهم الخاصة عند الدراسة وإنجاز المطلوب. خلال هذه التقنية العملية التعليمية، كانت تقييمات المعلمين لتعلم الطلاب والتحصيل الأكاديمي بمثابة مؤشر على اهتمام الطلاب بمهارات التعلم الذاتية. ووجدت الدراسة أن وجود بضع ساعات من انقطاع الكهرباء اليومي جنبا إلى جنب مع اتصال إنترنت غير مستمر أو ضعيف كان له تأثير إيجابي على الطلاب والمعلمين. تشكل المعرفة العميقة بموارد التدريس المتاحة على الإنترنت على نطاق واسع، مثل إدارة أنظمة التعلم في الفصول الافتراضية وأدوات المحاضرات المستندة على الفيديو من خلال قوئل مبيت، تحديا للمعلمين.

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DWSIM.

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التعليم الهندسي.

نظم إدارة التعليم.

إدارة المحاكاة.

إدارة المحاضرات القائمة على الفيديو.