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Graduates Skills Developments for Libyan Labour Market

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ABSTRACT

Any educational program's outcomes can be described in terms of both knowledge and skills. Chemical engineering graduates' skills and abilities might include those unique to managing material and energy balances and problem-solving skills that are generic or transferrable. This paper is concerned mainly with personal or transferable skills. It is widely acknowledged that one of the most critical abilities for chemical engineering graduates is the ability to communicate well in several written and spoken formats. The ability to work effectively in groups; be proactive and initiative in problem-solving; be numerate and IT literate; and ability to manage oneself and continue to learn are all desirable qualities. In some particular instances, it is illustrated that within our chemical engineering programme at Elmergib University, there are various and different chances to acquire these abilities in order to satisfy the demands of Libyan industries. This research considers how transferable skills can be defined and prioritized and then developed within the chemical engineering curriculum. A systematic strategy was designed to determine where and how skills can be managed and integrated into the curriculum. Chemical engineering graduates from

Elmergib University were solely satisfied with their decision to pursue a degree in the field.

Keywords: *chemical engineering graduates; transferable' personal' skills; degree programs; engineering curriculum development; employer.*

1. Introduction

Chemical engineers have succeeded through history at leading advancements because they are educated to think about chemical, biological, and physical changes at the molecular level and the process and system levels. As a result, chemical engineering has continued to provide new and original ideas and discoveries as innovations have progressed from macroscopic to microscopic, Nano, and molecular scales. In chronological order, they have created the petrochemical industry, the plastics phenomenon, and antibiotic scale-up; the 1950s, car exhaust catalysts, clean air, and clean water; 1970s, and the biotechnology and biomedical revolution; 1970s-1980s [1]. Education as a chemical engineer necessitates translation abilities. As a result, colleges should assess their academic offerings through the prism of job and skills, as learners' interests and preferences are increasingly centred via this lens [2]. In a process known as skillifying curriculum, material from the curriculum, such as course descriptions and syllabi, is turned into a skill-based language that is already used as a common currency by businesses and job searchers. Skillifying starts with figuring out what kinds of work-relevant skills a university already teaches in its classes. Here are four examples of how this translation may assist academics in better serving today's students and competing in the current skill-based economy. First, the market must match with the programmes. To begin with, speaking about education in these words allows for a more direct connection to skill-based labour market signals. That needs a more thorough assessment of demand based on job postings, supply based on professional profiles, and the possibility for curricula to fill in the gaps. That needs the ability to deliver a more individualized curriculum that addresses these skill gaps. While posting for process and systems engineering employment, local employers may be searching for data visualization abilities and citing DWSIM, an industrial process simulation application, or COMSOL, a multiphysics simulation package. If these skills are taught in existing process simulation courses in chemical engineering degree programs, graduates will be lucky to get such jobs pretty much immediately. Second, engaging with employers is desirable since it is simpler to be on the same page when speaking the same language. The programme will be in a better position to interact and engage with industry partners after the curriculum has been skillified, demonstrating how the skills taught in the curriculum are preparing future job seekers or enabling upskilling and promotion chances for current employees. Partnerships, of course, are a two-way street. Employer feedback on the skills they value most is included in a skillified curriculum, allowing them to choose the most suitable courses to integrate their ideas swiftly and confidently. A scientific programme may even match necessary abilities from a job ad to skills taught in the programme portfolio to compile the credentials required by the target company quickly. Third, market programmes should be more effectively connected to students. Data continues to stream in, proving that today's students want education options that give job-relevant skill training and a measurable return on investment for their careers. The more people perceive the links between education and career progress, the more valuable a programme becomes. By directly communicating the skill content inherent in academic programmes, it is more successful in engaging these students, many of whom are working adults. If students pursue a skillified programme, they may discover that they do not have to choose between a college diploma and work-relevant training with real-world applicability. Students should be better ready to market themselves in the last set of circumstances. Everyone benefits when colleges and companies work together, including students. The curriculum is not only more relevant to a student's future profession, as indicated in the first part, but they are also better equipped to express the abilities they learn via their education. Translating a curriculum into a common language of skills is the first and most important step in any strategy.

2. Methodical Approaches to Engineering Skills Development

It has been argued that 'transferable skills' are formed during schooling and are helpful when moving on to another job [3]. This term is frequently used in the realm of education. The term, however, is overly broad, as it encompasses technical talents as well; a more accurate description is required to distinguish between transferable and technical skills. 'Necessary in any field and allowing people to participate in a flexible and adaptive workforce' [2] is another way to describe transferable skills. Transferable talents, which may be expressed in various ways, such as problem solving and project management, are job-related but not job-specific. Transferable skills are defined by the DfES [4] as one of the most thorough definitions, "those cognitive and interpersonal skills application of number, communication, information technology, problem-solving, personal skills, working with others, and improving own learning and performance in all industries and at all levels that are important to occupational competence." From now on, this term will be utilized to conceptualize transferable skills throughout this study. It should be emphasized that the transferable skills required of a chemical engineering graduate [5, 6] and the skills expected of graduates in general [7-9] are comparable, and significant variances would be unexpected.

Transferable skills are more likely to be learned if they are embedded in the curriculum than being taught in separate short training courses or workshops. Despite the fact that the chemical engineering curriculum varies per country, there is a well-known and distinct core of studies and activities. This may be defined as knowing and grasping principles like as balances and equilibria, thermodynamics, reactions, transfer processes, and separation processes, among other things. Then, using the concepts, apply them to a variety of process and system kinds and sizes. Finally, use design assignments and project work, laboratory work, and case studies to tackle a variety of problems. Within these themes and activities, there are several possibilities to integrate and build transferable skills. This might be performed by using written reports and presentations on laboratories, projects, and designs to demonstrate communication abilities. As a cooperation skill, conducting laboratories, design projects, case studies, and problem-solving seminars may all be beneficial. In addition, problem-solving and numeracy skills and the capacity to manage one's own learning by planning activities and sticking to deadlines would be integrated throughout the curriculum. Although there are several possibilities to acquire transferable skills, they are unlikely to be adequately developed unless there is a systematic strategy to identify the talents, manage their development, and integrate them into the curriculum. This methodical technique has been adopted by several departments worldwide. The traditional method of teaching and studying chemical engineering entails using concepts to solve issues. The one method to issue solving is well-defined uncomplicated ones with enough data and one proper answer.

On the contrary, the strength of the chemical engineering educational method is built on various viable approaches, insufficient data, and many possible answers as complex and open-ended issues. However, differentiate between the issue-solving technique and the approach where the problem drives the learning, known as problem-based learning (PBL). When students realize they need to learn something new, the problem-solving strategy entails applying and integrating previously gained knowledge. Although there is evidence that it might be more difficult for students, PBL develops a more profound understanding.

3. Libya's Higher Education and Employment Market Challenges

Many studies in developed countries show a gap between the knowledge that is included in the curriculum of university education, skills and experience required by the business environment. That has a negative impact on graduates' efficiency, and they are unable to respond to the dynamics of the job market after they graduate. Higher education is not well established in Libya to the extent to which it incurs appropriate attention to new scientific breakthroughs and labour market necessities by scientific and academic institutions, professional groups, labour unions, and numerous industries. In Libya, studies and research on this topic are few, and the conclusions, suggestions, and ideas of these studies and research have yielded little benefit. As a result, a recent study by Masli [10] attempted to fill a gap in the current literature by concentrating on the reality of higher education and the extent to which it is available. The effectiveness of the university education at Libyan universities and its inadequacies and capacity to fulfil labour market demands, and then to suggest steps that will improve the environment of higher education in Libya. Especially since it presents the perspectives of several categories related to the educational process in Libyan universities (university faculty members, students, graduates, directors, and heads of departments in labour market institutions) for the first time in Libya - as far as the researcher was aware. The study was of a descriptive-analytical method that entails compiling, analysing, and interpreting arguments and dispute on this issue in books, journals, and scientific magazines, and then analysing and interpreting the results. By conducting field research using a questionnaire paper meant to represent the perspectives of study participants directly linked to the study's subject, and then analyze and interpret the results of the research's findings. Since the study's primary goal [10] is to assess Libya's higher education system, the study community is debating how to stay up with technological innovations while still meeting the demands of the job market. Four categories that have significance or influence on the system of higher education are represented. Professors of higher education institutions, students of departments in higher education institutions, and graduates of departments who work in specific areas make up the Libyan population. Also, the study included many in the institutions of the labour market who have direct interaction with university graduates in Libya. Those who graduated and worked as managers and heads of departments in some sectors, institutions, and job markets were appointed less than five years after graduation. A sample chosen for the research field was only done for a random number of 135 of the categories specified. Though the researcher's confidence that obtaining a significant sample of ideas from these various categories will enrich the study, the views of this small sample of the groups specified by considerations of time and effort enrich the investigation of diverse points of view.

Based on the statistical analysis of the field investigation, the researcher Masli [10] came to the following conclusions. First, there are flaws in Libya's university education system, such as its reliance on indoctrination rather than innovation and a lack of interest in adequately training students to use computers effectively in university education. Second, where it should be programmes centred on information technology and communication in the educational process, new teaching aids that keep pace with contemporary advances are not accessible. Third, there is a climate of deficiency in the programmes to update the scientific curriculum; there are repeats of some themes and words in other university disciplines; these curricula do not suit, and there is a time restriction on bowling. Insufficient books, magazines, and scientific references in the library for both professors and students. Masli [10] also commented that libraries do not satisfy the aims of Libyan university education in the required manner. It does not meet the English references owing to the students' low command of the English language. With variances in teaching standards and assessment among instructors, there is no motivation for students to ask questions, inquire, answer, and ensure that students acquire the content properly. Although there is collaboration and facilities for students' university education to undertake this study, there is a lack of motivation in guiding the graduating occurrence towards the challenges and obstacles that economic units are subjected to. According to Masli observations in his statistical study [10], there aren't any office of reviews for students outside of lecture times, and there aren't any aides to help students with problems and practical applications. As for the knowledge and skills development framework for graduates, there is no collaboration with scientific departments of colleges and economic units in the Libyan job market. There is no link by anyhow for graduates from the Libyan schools and departments where they studied. Those graduates have received no invites to attend discussions on financial issues affecting economic units. The Libyan government has no structured programmes based on the development of faculty skills in modern university education methods and their applications. The promotion and development of creativity and e-learning are performed, encouraged scientific research, wrote books, and attended scientific research seminars. Current Libyan university curricula are primarily theoretical and insufficient to provide students with the skills and experience required by the labour market. In addition, there was a lack of collaborative programmes with the labour market to prepare students for the profession and connect them to work sites and industrial units, making it difficult for students to find a job.

4. Incorporating transferable skills into university Curriculum

Inquiry--based learning (IBL), a hands-on approach that enables students to design and answer their research questions, is becoming increasingly popular at universities worldwide. Collaboration and task delegation, such as generating video lectures, building new exercises, and teaching teams among instructors, resulted in higher-quality learning materials. According to the instructors ' authors of this research paper, the newly introduced teaching technique within the course curriculum had a considerable influence on the students' learning. Edali et al. [11-14] and [16-18], a chemical engineering instructors research team from Elmergib University, made an insightful statement when presenting their strategies for incorporating and teaching scientifically sound transferable skills competencies into curriculum. Students, they said, are hands-on professionals who want to make a significant change. At this age, university students do not comprehend that mathematics seems to be what stimulates them. In this article, the research group of Edali et al. motivates their students' interest by incorporating Multiphysics simulation and applications as a necessary component of numerical methods techniques, mass transfer, fluid mechanics, process computer aided design, reaction engineering, and heat transfer, and transport phenomena courses. While students work on their graded homework in the classroom, simulations serve as visualizations to stimulate and engage them. In this publication, five figures serve as just sample illustrations of some of the inquiry-based learning issues included in chemical engineering courses as curriculum modifications. First, students were taught how to employ numerical approaches to depict physical geometry using a mesh of finite elements that collectively meet the appropriate equations in a numerical methods class. The ideal method is using a single solution builder to set up, constrain, solve, and post-process results. Multiple models, each geometry, materials, restrictions, and physics, may be utilized in sequence or conjunction. As with any numerical approach, care must be taken to guarantee adequate convergence and accuracy of the result. Defining problem phases, including simplifying assumptions, identifying global constants and expressions, constructing physical geometry, including symmetries, and specifying domains and material attributes are standard processes in model construction. Other efforts, such as creating boundary conditions, meshing physical structures into finite elements, selecting physics for each domain, configuring study kinds, launching solver, and post-processing findings into more visualized forms, are also required to obtain model results. For a simple illustration, students should start by solving a square root and a linear equation; we utilized the strategy to solve it 'as is'; the approach [11] may also address more complex problems with no obvious solution. Under the Mathematics ODE and DAE Interface used in class, type in 'x' for the name and the governing equation of the water-gas shift reaction equation (148.4*(x2)/(1 - x)2) for an initial value for the root 'f' to utilize COMSOL Multiphysics, as illustrated in Figure 1 at the 0-D option.

Second, in the transport phenomena course, Professors at universities believe those teaching transportation phenomena is as difficult as it is essential. Students would agree that converting Fourier's law or Navier–Stokes equations into a mental representation of a system's heat and fluid flow patterns is a complex undertaking. Most transport equations are nonlinear, consisting of partial differential and integral equations with complex coupled systems. Temperature, pressure, and a variety of other factors influence the related material qualities.

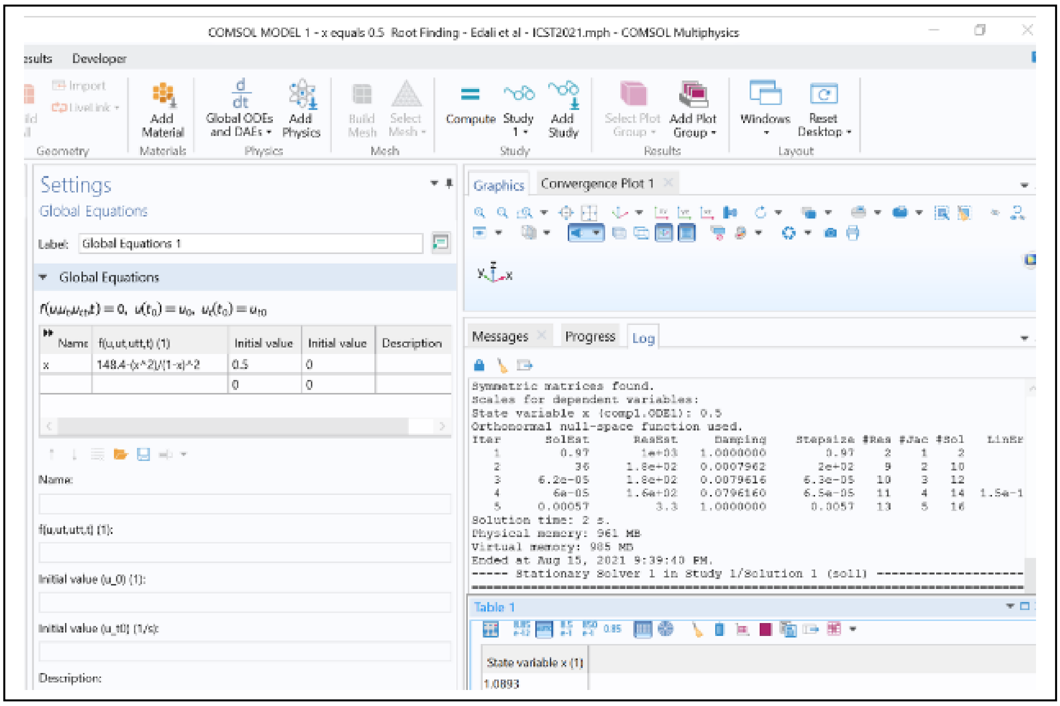

Figure 1: COMSOL 0-D Numerical model solution analysis for the governing equation of the water-gas shift reaction equation for an initial value of x=0.9

Figure 2A displays a brief section of a very long derivation of fundamental partial differential equations in the classroom, using simplifications such as linearizing, approximating, and recognized as solutions to address these transport Phenomena issues. Because of these simplifications, the answers are, to some extent, incorrect.

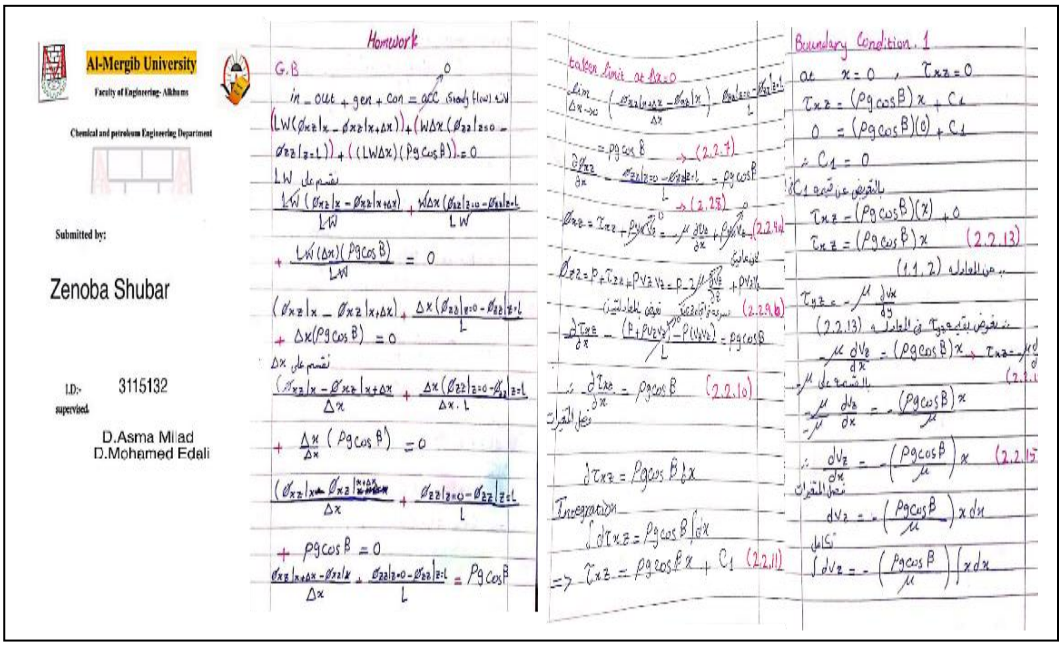

Figure 2A: Illustrating the physics and scientific laws using the normal teaching aids (class presentation, handouts, equations' manipulation simplification)

Nevertheless, that method is undoubtedly the most effective for gaining a fundamental grasp of solving numerical issues. The authors' team at Elmergib University [12] has developed a COMSOL Multiphysics programme that dramatically improves students' skills by allowing them to work with such a powerful numerical platform. That enables a student to quickly create models of various industry industrial models process technology components in teaching and research. The GUIs make it simple for researchers to investigate the effects of different design factors. These applications simplify model setup and computation time while emphasizing multiphysics in multi-dimensions, as illustrated in Figure 2B. Third, a COMSOL simulation 1-D app challenge set up was utilized to answer a mass transfer inquiry-based learning problem to students at transport phenomena class [13], and heat transfer class [14] where CO_2 absorption into a water laminar flow in a CO_2 chamber, as illustrated in Figure 3.

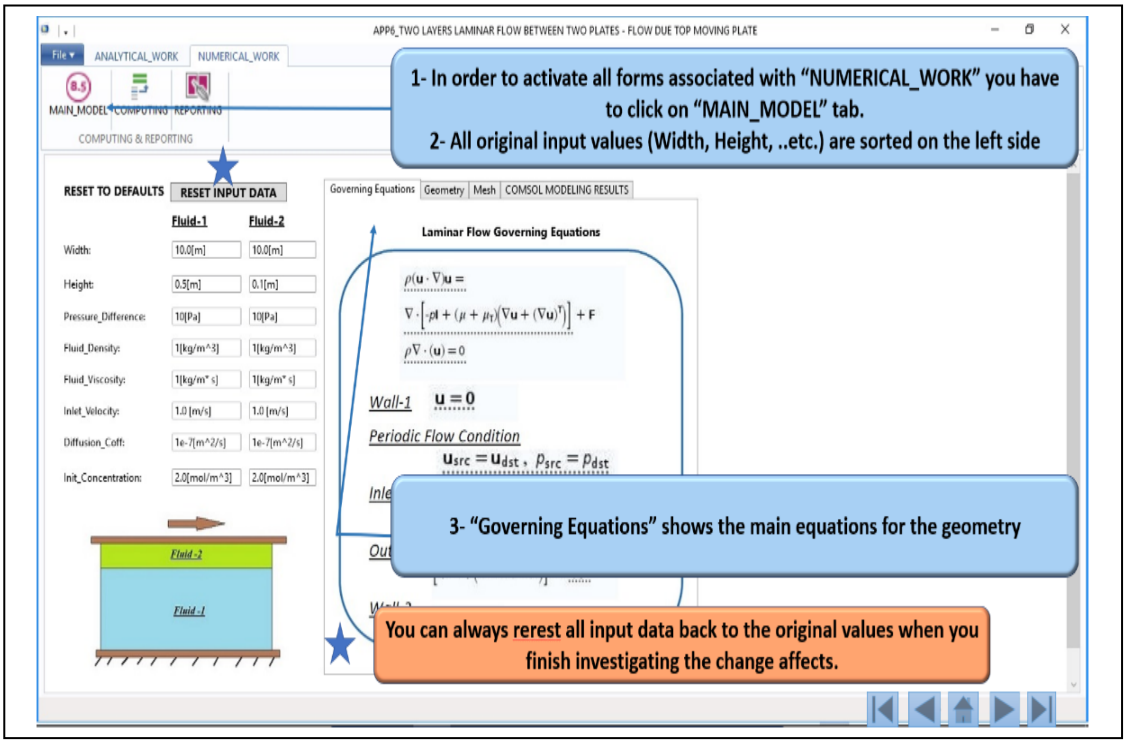

Figure 2B: Employing COMSOL within traditional lecture classes as a part of a project as to enhance the learning and exposure to cutting edge engineering tools

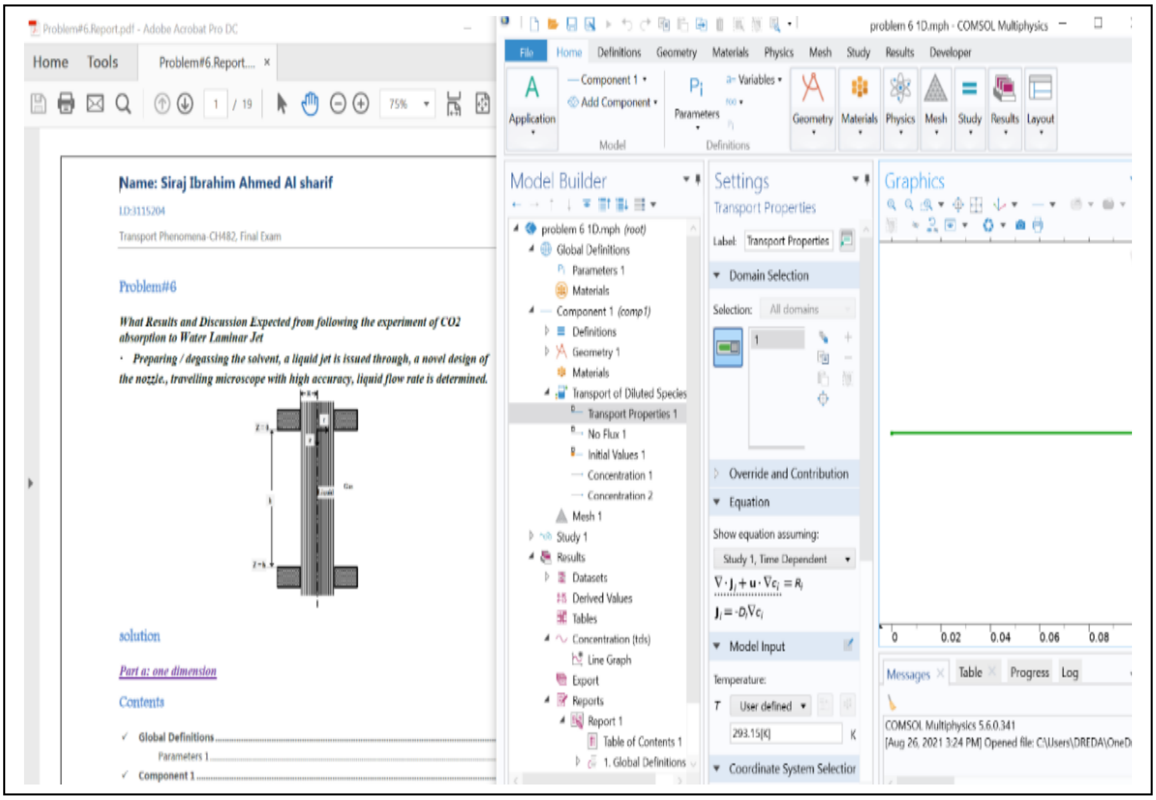

Figure 3: COMSOL Simulation 1-D App problem set up used for Mass Transfer of CO_2 Absorption Inquiry-Based Learning Problem in Transport Phenomena course at Elmergib University.

In the chemical engineering fluid mechanics course, curriculum development work [15], another example of employing Apps in teaching inquiry-based learning challenges as curriculum advancements are shown in Figure 4. The fluid flow in a channel of a class of materials is defined by a yield stress level below which the fluid does not shear and deforms like an elastic solid. After the applied stress approaches the yield stress, the fluid may display a constant shear viscosity, Bingham plastic fluid, or shear-thinning viscosity. A DWSIM process simulation app, as shown in Figure 5, was used as an inquiry-based learning problem implemented into the chemical engineering computer-aided design applications course [16] and into the process design engineering course [17] as curriculum development at Elmergib University. The problem is solving for a mixture of two inlets of two-phase feed followed by a flash separator.

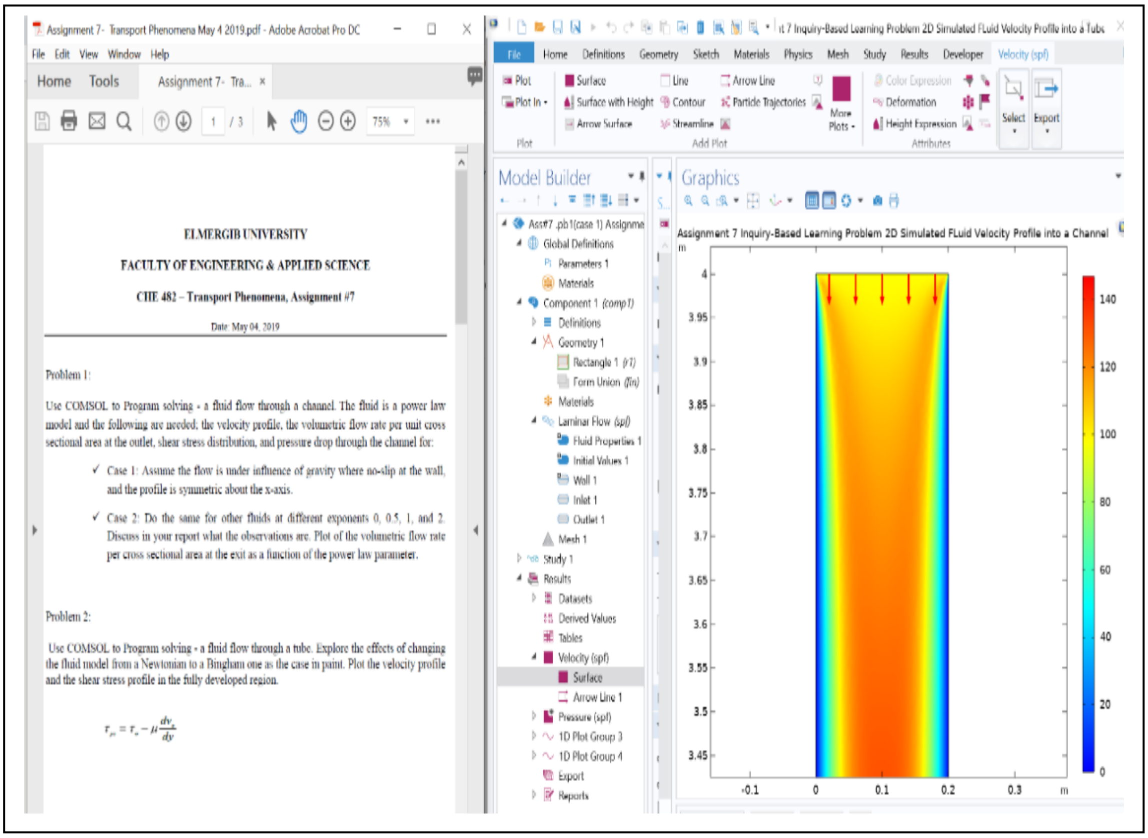

Figure 4: COMSOL Simulation 2-D App problem set up used as teaching assignment - Inquiry-Based Learning Problem - at Chemical Engineering Fluid Mechanics Course at Elmergib University.

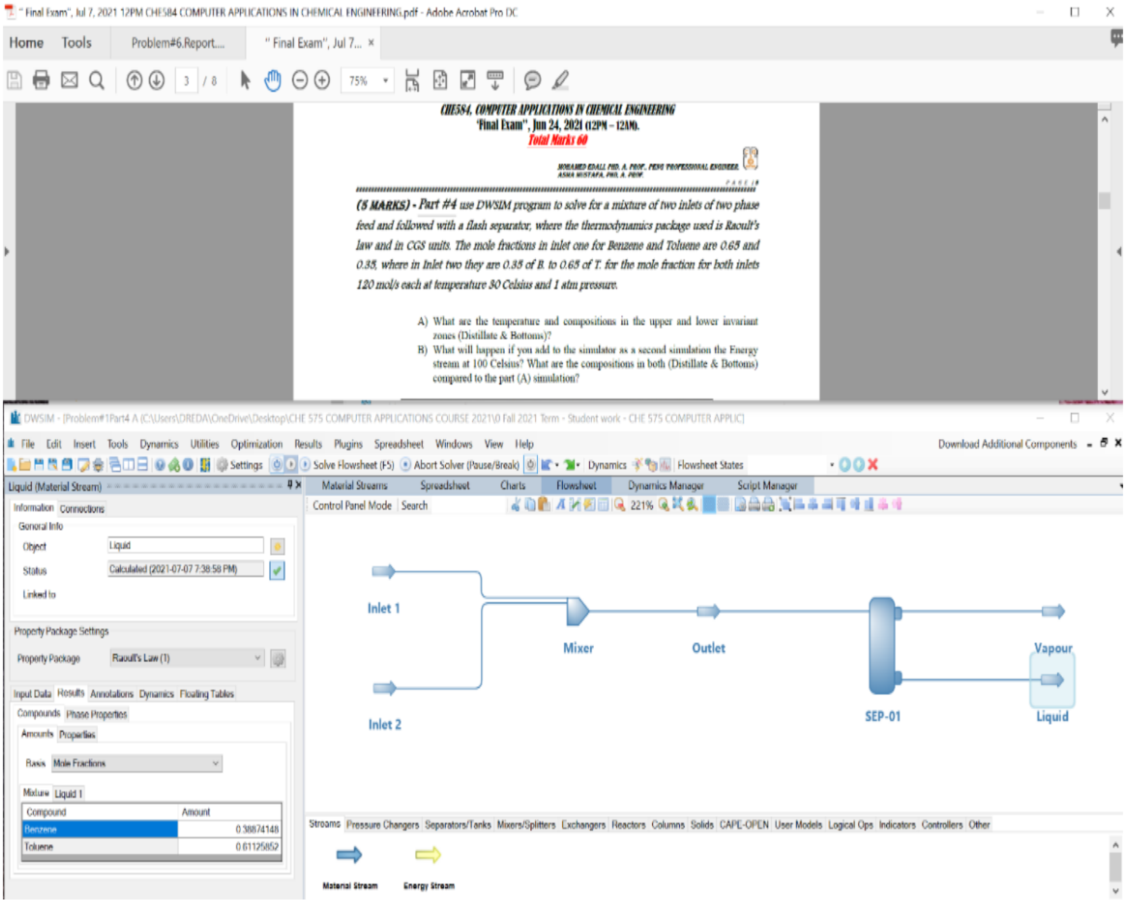

Figure 5: A DWSIM Process Simulation App used for solving for a mixture of two inlets of two-phase feed and followed with a flash separator Inquiry-Based Learning Problem at the chemical engineering process design course at Elmergib University.

5. Conclusions

The objective was to incorporate social and management skills and competencies into the chemical engineering curriculum. Then there's the option of reducing a few active approaches like lecturing and demonstrations. Methodologies such as project-based and cooperative learning were investigated. Whereas an effective learning management system was used to communicate with each class's students - Instructors group - they would enable students to learn technical and scientific knowledge while simultaneously acquiring social and managerial skills needed in real-world job contexts, such as problem-solving and teamwork with others. At Elmergib University, we use the Google Classroom learning management system (LMS) to teach our classes. Universities have made combining traditional lectures with full or partial web-based courses a simple process. To deliver the most effective services to its students and professors, educational institutions still seek to enhance their teaching-learning approaches. The method and operations of teaching-learning services are enhanced by using an e-learning system that encourages students and instructors to share knowledge. The critical motivators for students to pursue engineering degrees were identified as their talents and aptitude in math, science, and problem-solving. Students who complete the chemical engineering curriculum are skilful problem solvers. Consequently, students work in small groups to build a chemical plant as a full-year research graduation project in the fifth year. These projects, the climax of a thesis, serve as an introduction to research in many cases and allow the opportunity to apply the ideas established over the first four years of the programme to engineering issues of interest. For example, a thesis project might be an experimental laboratory inquiry, the design of a method, or a computer study of a complicated chemical system. Students who continue to aspire to the creative, high-impact engineering concepts are more likely to be enthusiastic about engineering. Students gained transferable skills that will allow them to work in various occupations that assist the transition to sustainable energy, reduce pollution, increase food production, and improve health care.

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