**A PIONEER MODEL FOR BLENDED LEARNING**

**IN ENGINEERING EDUCATION: AN-NAJAH NATIONAL UNIVERSITY, PALESTINE**

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## *Abstract* - This paper highlights the model of using blended learning in engineering education. It starts with presenting to the status of e-learning at An-Najah National University, the largest university in Palestine, in general, and then moves to the case of the Faculty of Engineering and Information Technology, at specific. The faculty was pioneering in starting and introducing e-learning and networking technologies into its courses, despite all the e-learning related challenges. Currently, the faculty is considered as the best university faculty in e-learning practices, where the majority of its members are involved in e-learning activities, such as participating in training workshops, designing blended learning courses, and conducting research in this area. Facts and trends are presented to assist in assessing the development of the Faculty of Engineering and Information Technology as related to leading in e-learning. Interpretations are made to facilitate comparing the related achievements of the faculty in e-learning with those for other faculties. Finally, recommendations are presented to make the faculty continue its leading role and enhance its pilot model, as well as to disseminate its success to other university faculties, or other engineering faculties in other universities in the region.

**KEYWORDS:** E-Learning; Blended Learning; An-Najah National University; Engineering Education

**INTRODUCTION**

The new information and technology revolution has affected all aspects of teaching and learning processes. A shift from teacher-centered content-centered approach to learner-centered approach has been addressed in all recent researches. This shift encourages learners to become active learners instead of passive ones, by changing the roles of both teachers and learners and encouraging dialogues and interaction either in face-to-face classes or virtual ones.

The learner-centered approach is a response to educational decisions that did not fully consider what students need to know or what methods would be most effective in facilitating learning for individual students or groups of students. Ellis et al. [1] found that learner-centered approach not only increases learners' interactive abilities, but also affects positively their motivation for learning, self-satisfaction and commitment to education.

An-Najah National University (ANU), the largest university in Palestine, has already took a long-way to sensitize the faculty members about the importance of the learner-centered approach throughout the integrative approach in instruction, combining the traditional face-to-face courses with more personalized learning experience for students using different teaching and learning strategies such as blended learning, community-based learning and project-based learning. Currently, the university educates over 20,000 students and is the home of ten faculties offering a wide spectrum of undergraduate specializations, in addition to the Faculty of Graduate Studies.

ANU has effectively participated in many e-learning initiatives since 1999. The first initiative was through a grant from the European Union, which was managed by UNESCO, to develop a pilot multimedia blended-learning course in engineering. The course was unique and the first of its type not only in Palestine, but on the regional level. More initiatives in e-learning evolved after that. In 2012, the e-Learning Center was established to promote and manage e-learning at the university.

The descriptive as well as the qualitative analysis approaches are considered in this paper due to its nature. Desk research is used concentrating on content analysis of university documents, websites and statistical information. This is in addition to the experience of the researchers as practitioners in the field of e-learning. Their reflections and observations have been considered in the analysis and in the derivation of conclusions.

The paper presents first the relationship between blended learning and engineering education in the global context. Next, an overview on blended learningdevelopment at An-Najah, and the participation of its engineering faculty at specific, is illustrated. Engineering education at the university is highlighted, followed by a presentation and discussion of the strengths that makes engineering education considered as a pioneer model. Finally, the paper ends with conclusions and recommendations.

**BLENDED LEARNING AND ENGINEERING EDUCATION**

Blended learning has been implemented in engineering faculties in many higher education institutions around the world in different ways and in many forms [2]. Blended learning is defined differently according to different authors and sources but all agreed on the mix of traditional way of teaching in addition to using technology in a way or another.

Many researchers use different terminology to describe the enhancing of technology into teaching, learning and training. Some of these are online learning, e-Learning, blended learning, hybrid learning, distance learning, or enabled learning. Moore et al. [3] discussed the difference between these from different points of view and they found that in general distance learning is the umbrella for all, and the others depend on the learning environment and the degree to which technology has been enhanced.  In this study the term e-learning will be used to refer to the course delivery method which purely online, while blended learning will concentrate on the mixture between online and face-to-face.

Many researchers, such as Pitchian et al. [4], emphasized the need for blended learning to improve future engineers soft skills needed for ABET and consider it as a requirement for all engineering faculties in order to improve the quality of their courses and graduates.

Other studies emphasis the impact of e-learning on learners twenty first century skills which as essential for engineering education and engineers, Sminov and Bogun [5] considered e-learning as an opportunity to develop critical thinking and problem solving skills for engineering students, and they explained that this is expected due to the fact that online or blended learning courses will be designed in a more visual structure than traditional courses which concentrate on rote learning.

Banday et al. [2] stressed the same idea of visual modeling learning and also mentioned animations as an added value of blended learning courses. The importance of online communications between engineering students, teacher and e-resources was indicated. The importance of using multimedia and visual learning and their impact on future engineers learning is related to the development of the quality of blended learning courses [6].

Challenges of blended learning have been also identified; designing skills is required for faculty members to enable them to design high quality interactive courses, using different types of e-material such as text, videos, multimedia, animations, graphs, games, charts and others [2, 6]. Designing a blended course is time consuming and required teachers’ commitment to follow up regularly through availability online.

A number of studies have been conducted at ANU on blended learning; assessing the experience gained and exploring the impact of technology on engineering education, students’ achievements and attitudes. For example, Johari and Abu-Eisheh [7] found that there was a positive impact of blended courses on engineering students’ achievements and motivation comparing to traditional learning. Both groups of students who were taught in blended course and traditional course expressed their desire to learn in blended learning approach. Abaza et al. [8] recommended to consider the multimedia courseware developed at An-Najah as a model to develop further engineering courses since it has proven to enrich students’ knowledge in engineering courses and improves students’ interaction.

**BLENDED LEARNING AT THE UNIVERSITY AND THE INVOLVEMENT OF ENGINEERING FACULTY**

In its first Strategic Plan, prepared in 2006, the university had considered the objective of improvement of the quality of education and enhancing teaching and learning skills. The related strategies had included enhancing the provision and management of teaching/learning systems and the promotion of the use of computing technologies in teaching/learning [9]. This trend has continued and was reflected in the university's most recent Strategic Plan prepared in 2015 for the period from 2016-2020 [10].

Despite this, individual initiatives had started few years before this. The first was on developing interactive multimedia learning for engineering design. This was conducted during 1999 to 2003 as a pilot regional project managed by the UNESCO for upgrading science and engineering education in southern Mediterranean. ANU team was selected among others to develop such a courseware. The procedures and templates designed in this pilot course have been used for the preparation of other engineering courses [8].

Another engineering faculty member headed a team in 2005 to design and implement a LMS platform called Online Course Container (OCC). The decision was made at that time to develop such an in-house system to facilitate its use and integration with other university software tools such as registration and administration programs [11]. In 2008, the university decided to improve the capabilities of OCC to become compatible with well-known widely-used LMS tools, such as MOODLE. The university got a grant to upgrade the system by making it compliant with the Sharable Content Object Reference Model (SCORM) though the Quality Improvement Fund which aims to finance selected tertiary education initiatives in Palestine, funded by the World Bank and the EU [12].

In 2012, the e-Learning Center was established under the supervision of the Vice President of Academic Affairs. The aim of the center was to devise and implement strategies to satisfy the goal of the university strategic plan in the aspects related to enhancing the use of technology in teaching and learning in a systematic way.

As Affouneh [13] mentioned, the transformation into e-learning went through several stages, adapting Bates model of change [14]. The stages were the stage of “Lone Rangers” where only early adopters of e-learning were encouraged, while stage two was on “Encouragement”. Stage three was the “Chaos” stage where the number of faculty involved in e-learning was increased and different types of initiatives were developed. Then the university moved towards the “Planning” stage, were a three year plan was developed for e-learning, aiming to reach the “Sustainability” stage, where a stable system of e-learning is envisaged, which is cost effective and scalable.

**ENGINEERING EDUCATION AT ANU**

The Faculty of Engineering at ANU was established in the year 1979. The faculty offered one program at that time; the Bachelor of Science Degree in Civil Engineering. A year later, the Department of Architectural Engineering was established. For the past 25 years, the Faculty of Engineering continued to develop, adding new programs and graduating increasing numbers of new engineers, with the needed training and skills.

Three years ago, and as part of the restructuring of the academic programs efforts at the university, the Faculty of Information Technology was merged with the Faculty of Engineering, forming the Faculty of Engineering and Information Technology (FEIT). Currently, the faculty is comprised of thirteen engineering departments and four information technology departments. FEIT is considered as the university largest faculty, with a total number of students reaching 5,095 and forming about 25% of the university enrollment. FEIT also provides nine graduate programs leading to the Master’s Degree in various fields. However, the concentration in this paper is on the undergraduate programs.

Strategies have been devised by FEIT to achieve its goal of offering the highest quality of the offered programs. These include restructuring and developing the programs curricula, in terms of structure, content, and learning strategies. Among the adopted learning strategies, e-learning has been the focus of development in the past decade. The faculty has been exposed to an extensive orientation and capacity building program on e-learning, as many courses were developed or harmonized as e-learning or blended learning course.

The academic plans of FEIT programs have been developed in a way that meets the needs of the markets from both scientific and practical aspects. Nine of the offered undergraduate engineering programs has been accredited by ABET during the past four years. One of the points of strength found in the accreditation process was related to the adoption of e-learning strategies, which had resulted in enhanced quality of education.

This has encouraged the faculty to continue in this direction of utilization of e-learning in the delivery of courses reflected through more dependence on blended learning, and the students to adapt to the flexibility and merits that the blended learning offers them.

**WHY ENGINEERING EDUCATION IS PIONEERING IN BLENDED LEARNING?**

The involvement of the engineering faculty and students in blended learning activities has been noticed since the university set policies and strategies to enhance the quality of education through blended learning. This is reflected on a number of key indicators, including the total number of courses taught through the adopted MOODLE learning management system, as well as the number of faculty involved in teaching and the number of students participating in blended learning.

Considering the establishment of the e-Learning Center in 2012 as the benchmark, the key indicator values for the academic year 2012/2013, compared with those for 2015/2016 are obtained, which are presented in Table 1. These indicators show that the number of blended learning courses in FEIT increased from 53 to 305 during the indicated three year period (i.e., about a six-fold increase), while such courses increased in the university as a whole for the same period from 265 to 1062 (i.e., about a four-fold increase).

**Table 1.** Development in the involvement of FEIT in blended learning compared with the university.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Students** | | **Faculty members** | | **Blended courses** | | **Year** |
| **FEIT** | **University** | **FEIT** | **University** | **FEIT** | **University** |
| 1,047 | 3,179 | 42 | 153 | 53 | 265 | **2012/2013** |
| 3,310 | 16,390 | 95 | 392 | 305 | 1,062 | **2015/2016** |

Considering the total number of developed blended courses with respect to the total number of course offered during the relevant academic year, the number of accumulate FEIT blended learning courses developed by the end of 2012/2013 reached 53 out of 551 total offered courses (i.e., forming 10% of total). On the other hand, by the end of 2015/2016, the number of accumulated blended learning FEIT courses was 305 out of 647 total offered courses (i.e., forming 47% of total).

Similar comparisons are made to assess the involvement of faculty and students in blended learning. The results show that the number of FEIT faculty involved increased from 42 at the end of 2012/2013) to 95 at the end of 2015/2016. Compared with all FEIT faculty of 121 by the end of 2015/2016, the involvement in blended learning reached 79%, while for the whole university it reached 36% (i.e., 392 out of the total of 1080).

As for the students involved, the available statistics show that the number of FEIT students involved increased from 1047 during 2012/2013 to 3310 during 2015/2016. Compared all the FEIT students of 5095 by the end of 2015/2016, it is shown that FEIT student involvement in blended learning increased from 25% in 2012/2013 to 65% in 2015/2016.

Comparison of two of the key indicators is also conducted per faculty. Figures 1 and 2 show the number of blended learning courses and of the

**Figures 1.** The number of blended learning courses for each of the university faculties for 2012/2013 and 2015/2016.

**Figures 2.** The number of involved faculty in blended learning for each of the university faculties for 2012/2013 and 2015/2016.

involved faculty in blended learning, respectively, as for the academic years 2012/2013 and 2015/2016, for each of the 10 university faculties. Again, the results illustrate that FEIT has the broadest number of developed blended learning courses as well as faculty involvement.

As for training and capacity building of the faculty, Table 2 shows the FEIT accumulated number of the academic staff along with other faculties. The table shows that again the superiority of FEIT with respect to all the other faculties.

The above information and the comparative assessment illustrate that the key indicators related to the number of offered blended learning courses, as well as the involvement of faculty in developing blended learning and related capacity building and training activities, and the involvement of students in blended learning, show clearly that the engineering education is distinct with respect to blended learning in the university as a whole.

**Table 2.** The accumulated number of the academic staff involved in training and capacity building for the whole university by faculty.

|  |  |  |  |
| --- | --- | --- | --- |
| **Faculty** | **Total** | **Male** | **Female** |
| Engineering and Information Technology | 89 | 71 | 18 |
| Economics and Social Sciences | 70 | 56 | 14 |
| Humanities | 77 | 44 | 33 |
| Science | 54 | 40 | 14 |
| Medicine and Health Sciences | 56 | 27 | 29 |
| Educational Sciences and Teachers Training | 31 | 21 | 10 |
| Agriculture and Veterinary Medicine | 18 | 15 | 3 |
| Islamic Law | 13 | 12 | 1 |
| Fine Arts | 20 | 15 | 5 |
| Law | 6 | 2 | 4 |
| **Total** | **434** | **303** | **131** |

The list of the “Pioneers in e-Learning” as identified by the e-Learning Center, based on pre-specified criteria, includes those considered as leading in the development and delivery of blended learning courses in the university. Among the 30 faculty members identified as pioneers in e-learning in the university, six are from FEIT. Moreover, the first prize dedicated by the university to those distinguished in blended learning was granted to two faculty members from FEIT in 2015, which was the year in which the university started granting such prizes.

**CONCLUSIONS AND RECOMMENDATIONS**

Engineering education at ANU has proved to be leading in the establishment and development of the new learner-centered approach and in achieving quality education. Engineering faculty had developed the first blended learning courseware in the university, which was recognized regionally, and was considered as a model for developing other courses.

Assessment of key indicators reveal that FEIT has the highest number of offered blended learning courses in the university among other faculties, and where about 47% of the offered courses are now classified as blended learning courses. About 89% of the faculty members are involved in developing or utilizing blended learning courses, and about 75% of them had attended capacity building and training on e-learning.

The paper recommends building on the successes of developing blended learning courses for engineering education as a pioneer model. In one aspect, it is recommended to complete the transformation of the rest of engineering courses towards blended learning, thus achieving 100% by the end of the five-year strategic plan in 2020. Peer-to-peer faculty members' interaction is encouraged as a successful way of collaboration towards achieving this goal. More research is recommended to be conducted to measure direct and indirect impacts of blended learning on the engineering students' achievement and satisfaction on a wider-spectrum and across various disciplines.

On the local and regional levels, it is recommended that faculties of engineering are encouraged to consider developing blended learning courses, document their best practices, and disseminate their experience in this regard.

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