A case study of factors influencing the learning of engineering students

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ABSTRACT: The objective of this study was to examine the factors influencing the learning by engineering majors at the Chongqing Three Gorges University (CTGU). Students were asked to assess teaching quality, learning resources and the learning environment. Used in the research were questionnaires and interviews for collecting the primary data and descriptive statistics. Frequency distributions were used to analyse the data. The research sample included 50 undergraduates selected from five departments at CTGU, to ensure generality and the validity of results. The results indicated that teaching quality was considered the most important factor contributing to undergraduates' learning, while the four sub-factors making an important contribution to learning efficiency were: lecture material (86%); tutor's feedback (84%), library resources (84%) and the learning atmosphere on campus (82%). Finally, it is recommended that teachers should frequently refresh teaching material, improve teaching methods and establish good student-tutor communications.

INTRODUCTION

The focus of engineering education is to produce trained high-level professional engineers. The university mission is to provide services and an excellent learning environment in which to prepare students to meet the industrial and market demand of the 21st Century.

To fulfil this goal, Chinese universities have employed many strategies, but the key factors influencing engineering students have not been identified. Previous researchers have stated that educational reform without proper knowledge and the tools for evaluating students' real demands solves no problems [1]. Helgesen et al identified multiple influence factors, e.g. learning environment, teaching quality and library resources [2]. Coskun identified key factors contributing to engineering students' learning efficiency and, finally, concluded that the most important factors were in three categories: learning resources, teaching quality and learning environment [3]. Their findings provide a solid foundation for this research.

RESEARCH AIM AND QUESTIONS

The aim of this article is to determine the factors influencing the learning efficiency of engineering majors at the Chongqing Three Gorges University (CTGU). It aims to sort these factors by degree of importance. The research aim and questions addressed in this article are presented in Table 1.

Table 1: Research aims and questions.

Research aim	Research questions
To determine the factors influencing CTGU engineering students' learning efficiency	Question 1: Are learning resources important for learning efficiency on engineering courses?
	Question 2: Is teaching quality important for learning efficiency on engineering courses?
	Question 3: Is the learning environment important for learning efficiency on engineering courses?
	Question 4: Among the above three factors, which is the most important for engineering students' learning efficiency?

RESEARCH METHODOLOGY

In this research, both qualitative and quantitative data were used. Specifically, both questionnaires and interviews were used to determine the most important factors affecting CTGU students' learning efficiency. Self-administered questionnaires were selected as the main method and qualitative interviews were conducted to enrich the data from the survey [4].

Research Sample

The respondents were undergraduate students enrolled in the Engineering Department of CTGU. To guarantee data validity, students were selected from five majors, viz. safety engineering, architectural engineering, environmental science and engineering, electrical and information engineering, and mechatronics engineering.

Research Instruments

Based on Coskun [3], the questionnaire had three dimensions, viz. learning resources, teaching quality and learning environment. The first part appraised learning resources, including textbooks, on-line and library resources. The second part about teaching quality considered lecturing materials and tutor-student relationships. The third part focused on the learning environments, specifically, the library and classroom facilities.

The questionnaire was comprised of 13 multiple-choice questions. The interview mainly consisted of six questions to investigate measures that could improve engineering education. The research methods are summarised in Table 2.

Table 2: Summary of the research methods.

Research method	Sample	Purpose	Data analysis
Questionnaire survey	50 CTGU undergraduates	Identify the most important factors affecting learning efficiency	Microsoft Excel; Frequency statistics
Focus-group interviews	Ten representative opinion leaders from 50 respondents	Examine participants' attitude toward these factors and seek measures to improve the current situation	Word descriptions; Content analysis

RESULTS AND FINDINGS

There are three parts, viz. sample description, quantitative data analysis, and qualitative data analysis.

Sample Demographics

The participants in the study were all college students studying engineering majors at CTGU. Architectural engineering and safety students accounted for 50% of the total and male students for 75%. During the survey, 60 questionnaires were handed out, 54 were returned, and 50 were valid, for an effective rate of 83.3%.

Questionnaire Results

This presents the quantitative data of the students' perception of the importance of learning resources, teaching quality and the learning environment.

Appraisal of learning resources: this section describes how the students perceived the importance of learning resources. It was evaluated from three aspects, viz. textbooks, on-line learning resources and library resources. The results are displayed in Table 3.

Table 3: Students' appraisal of learning resources.

Importance of learning resources \ Choice		Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
Textbook	Frequency	22	18	4	6	0
	Percentage	44.0	36.0	8.0	12.0	0
	Cumulative percent	44.0	80.0	88.0	100.0	100.0

On-line resources	Frequency	8	30	6	6	0
	Percentage	16.0	60.0	12.0	12.0	0
	Cumulative percent	16.0	76.0	88.0	100.0	100.0
Library resources	Frequency	23	19	4	4	0
	Percentage	46.0	38.0	8.0	8.0	0
	Cumulative percent	46.0	84.0	92.0	100.0	100.0

Table 3 shows that 80% (44% strongly agree and 36% slightly agree) of students perceive textbooks as an important factor for learning, and nobody considered it as of very little importance. It needs to be mentioned that six respondents regard textbooks as of little importance, i.e. the *slightly disagree* group.

The data also show that 76% of the students considered on-line resources important for learning, while only 12% of the respondents considered it of little importance. None of them considered it to have very little value.

As for library resources, 84% of the students consider it is beneficial for learning, while only 8% consider it is not important. Based on these statistics, the factors in order of importance are: library resources (84%), textbooks (80%) and on-line resource (76.0%).

The outcome also revealed that library resources and textbooks have played an increasingly more important role in students' learning, for they cover a wide range of knowledge and skills, and are frequently updated. Besides, with the widespread use of the Internet, the on-line resources are also an important channel for delivering knowledge [5].

Appraisal of teaching quality**:** this section explores the role of teaching quality for students' learning, and is evaluated from three aspects, including lecturing materials, feedback and tutor-student contact. The results are shown in Table 4.

Table 4: Students' appraisal of teaching quality.

Importance of teaching quality \ Choice		Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
Learning materials	Frequency	23	20	5	2	0
	Percentage	46.0	40.0	10.0	4.0	0
	Cumulative percent	46.0	86.0	96.0	100.0	100.0
Tutor's feedback	Frequency	18	24	3	5	0
	Percentage	36.0	48.0	6.0	10.0	0
	Cumulative percent	36.0	84.0	90.0	100.0	100.0
Tutor-student contact	Frequency	20	19	4	6	1
	Percentage	40.0	38.0	8.0	12.0	2.0
	Cumulative percent	46.0	78.0	86.0	98.0	100.0

The data indicated the importance of each sub-factor in influencing students' learning. From Table 4, for 86.0% of the students who consider lecturing materials to be important, 84.0% consider the tutor's feedback to be important and 78.0% consider tutor-student contact to be important.

The average percentage of importance is 82.67%, which is higher than the learning resources at 80%.

Appraisal of the learning environment**:** this section analyses the learning environment from two aspects, namely social events and the campus learning atmosphere. The results are shown in Table 5.

Table 5: Students' appraisal of the learning environment.

Importance of the learning environment \ Choice		Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
Social events	Frequency	28	13	0	9	0
	Percentage	56.0	26.0	0.0	18.0	0
	Cumulative percent	56.0	82.0	82.0	100.0	100.0
Campus learning atmosphere	Frequency	20	21	3	6	0
	Percentage	40.0	42.0	6.0	12.0	0
	Cumulative percent	40.0	82.0	88.0	100.0	100.0

The results show that social events and the campus learning atmosphere are seen as having the same importance in the learning environment, with 82% of the students in both cases considering it important.

In conclusion, the quantitative research has indicated that the four most important sub-factors contributing to the student's learning are, in order, lecturing material (86%), tutor's feedback (84%), library resources (84%) and campus learning atmosphere (82%).

Interview Results

Ten representative respondents were selected to participate in focus interviews to explore the underlying reasons of their questionnaire choices and to determine effective measures for improving engineering education. As to the first question in the interview, among the three main factors, eight out of 10 consider that teaching quality is most important for learning efficiency. This is consistent with the quantitative outcome described above, which showed 82.67% of respondents ranked the teaching quality as important, compared with 80%, who consider learning resource as important and 82%, who consider the campus learning atmosphere as important. The third question provides explanations for the results of the first question.

Almost half of the interviewees are rural students from underdeveloped regions and they have a weak foundation in mechanics and mathematics. Therefore, the tutors' lecturing is important for their understanding [6]. One respondent stated that *...the teacher acts as the guide for teaching and understanding and so getting accustomed to the teacher is necessary to improve learning efficiency*.

Among the three factors influencing teaching quality, 10 participants agree that lecturing materials are quite important, while eight respondents added that tutor feedback and contact are also important for this can bring an instant response to solving a problem. Seven students considered that textbooks were important, while nine out of 10 stated that an additional updated information resource, such as the Internet and library, are also important in enriching the information [7]. One respondent emphasised that it is not adequate to just understand the textbook. Eight out of the 10 respondents considered the learning environment to be important for learning and one stated that, *...we should live in a place which is suitable for learning*.

As for measures to improve engineering education, all 10 participants emphasised the necessity of frequently refreshing teaching materials. Seven participants advised that better communication should be established between teachers and students. Lastly, with the rapid development of the Internet, increasingly more of the students (nine out of 10) depended on on-line resources. Thus, it is urgent for university teachers to use the Internet and communications technology in their teaching [8].

CONCLUSIONS AND IMPLICATIONS

The research methods adopted were that of questionnaire and interview for exploring the factors that are important to engineering students' learning efficiency. The research instruments included a self-administered questionnaire and interview. The aim of the quantitative research was to determine the most important factors contributing to learning efficiency, and the aim of the qualitative research was to further investigate the quantitative outcomes through focus-group interviews.

The survey revealed that 80% of the respondents perceive learning resources as important, 82.67% perceive teaching quality as important, and 82% perceive the learning environment as important. Hence, teaching quality is slightly the most important factor. However, a majority of the sample are rural students from underdeveloped regions, who consider

teachers as guides for effective learning. In addition, the most important four sub-factors contributing to the students' learning are: lecturing material (86%); tutor's feedback (84%); library resources (84%); and the learning atmosphere (82%). Based on these findings, it is important for teachers to update teaching material frequently and to establish timely effective communication with students.

The percentage of students who use the Internet to study is strikingly high compared with several years ago. It is necessary for teachers to embrace the Internet and implement Web solutions for their students. A technology-oriented subject requires both the teachers and the students to pay close attention to engineering technology developments and make full use of the traditional library resources, as well as the Internet.

The results of this study have important educational and practical implications. They suggest that classroom teaching, extracurricular resources and teacher-student relations are important for improving the quality of engineering education, accelerating innovative practices in education and benefiting engineering students' learning. This research is of importance to policymakers, educators, researchers and students. Moreover, improving learning efficiency can enhance students' employability.

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