Content Analysis of Problem-Based Learning on Engineering Students' Unemployment Awareness

(Analisis Kandungan Pembelajaran Berasaskan Masalah Mengenai Kesedaran Pelajar Kejuruteraan Terhadap Pengangguran)

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ABSTRACT

Qualitative content analysis can be applied to analysing textual words written in different types of reflection assignments. Thus, the aim of this research is to investigate the adoption of problem-based learning (PBL) learning to understanding the knowledge and level of awareness of chemical engineering students regarding graduate unemployment in Malaysia. Participants are 88 second-year students enrolled on the Differential Equation course at the National University of Malaysia. With technological breakthroughs in computerised text analysis that enable researchers to collect and analyse large amounts of textual data, content analysis employing an inductive approach is used to analyse students' PBL reflective writing which expresses whether all the main factors of graduate unemployment can be identified. The result reveals that almost 80% of participants were unable to meet the requirement of the first stage of PBL, which is to identify the critical learning issue i.e., unemployment factors. This group of students only managed to identify person-related factors associated to unemployment: working experience and soft skills. Only 15 participants, however, have successfully identified all six factors influencing graduate employability. Practical learning, entrepreneurial skills, internal audit and basic qualifications of graduates, along with soft skills and working experience are the main components of the higher education curriculum that have a significant impact on the unemployment problem of graduates in Malaysia if they are revised. The findings have important implications for how the institution can properly plan and take appropriate actions to raise unemployment awareness among students at an early stage of their study.

Keywords: Problem-based learning; content analysis; student's awareness; differential equations; graduate unemployment

ABSTRAK

Analisis kandungan kualitatif boleh digunakan untuk menganalisis perkataan dalam teks yang ditulis daripada tugasan refleksi yang pelbagai. Maka, kajian ini adalah bertujuan untuk menyelidik boleh guna pembelajaran berasaskan masalah (PBL) dalam memahami pengetahuan dan tahap kesedaran pelajar kejuruteraan kimia berhubung masalah pengangguran graduan di Malaysia. Kajian ini melibatkan 88 orang pelajar tahun dua yang mengikuti kursus Persamaan Kebezaaan di Universiti Kebangsaan Malaysia. Dengan adanya teknologi dalam analisis teks secara berkomputer yang membolehkan penyelidik mengumpul dan menganalisis data teks dalam jumlah yang besar, maka analisis kandungan secara pendekatan induktif digunakan untuk menganalisis penulisan refleksi PBL pelajar yang menjelaskan sama ada faktor utama pengangguran graduan dapat dikenal pasti semuanya. Keputusan analisis kandungan menunjukkan hampir 80% peserta kajian tidak dapat memenuhi keperluan peringkat pertama PBL, iaitu mengenal pasti isu pembelajaran kritikal iaitu kenal pasti faktor pengangguran. Kumpulan pelajar ini hanya berjaya mengenal pasti faktor yang berkait rapat dengan peribadi: pengalaman bekerja dan kemahiran insaniah. Seramai 15 orang peserta pula telah berjaya mengenal pasti kesemua enam faktor yang mempengaruhi kebolehpasaran graduan. Pembelajaran praktikal, kemahiran keusahawanan, audit dalaman dan kelayakan asas graduan, serta kemahiran insaniah dan pengalaman bekerja merupakan komponen utama dalam kurikulum pengajian tinggi yang boleh meredakan masalah pengangguran graduan di Malaysia jika ianya disemak semula.

Dapatan kajian ini mempunyai implikasi yang penting tentang bagaimana sebuah institusi pengajian boleh merancang dan melaksanakan tindakan sewajarnya untuk meningkatkan kesedaran mengenai faktor pengangguran dalam kalangan pelajar di peringkat awal pengajian.

Kata kunci: Pembelajaran berasaskan masalah; analisis kandungan; kesedaran pelajar; persamaan kebezaan; graduan menganggur

INTRODUCTION

Graduates wish for satisfactory earnings based on the return on their investment in education, but they are sometimes unemployed after graduation. The fact that one in four local graduates will have to wait longer to realise their investment's return (Husin et al. 2021). Individuals suffer from unemployment because it results in financial deficits due to college debts and educational expenses. The unemployment rate will rise unnecessarily if graduates lack the skills necessary to meet the requirements of industries. It was pointed out some time ago by Razak et. al (2014) in (Hossain et al. 2018) that a large proportion of fresh graduates are in the fields of engineering, manufacturing, and construction. A lack of awareness and inadequate knowledge among undergraduate students regarding the employability skills of fresh graduates is proving to be a barrier to achieving a higher employability rate in the midst of unemployment tensions. Awareness of factors influencing graduate unemployment (and employability) leads to increased self-preparation to become a viable member of tomorrow's workforce (Yusof et al. 2013).

A previous study by Amanuddin et al. (2013) revealed that the level of awareness among undergraduate students in Malaysia regarding unemployment factors was generally low, posing difficulties in identifying students who may not be fully prepared for the job market. As students attempt to fit facts into their knowledge framework, their erroneous understandings impede their ability to acquire new knowledge. If not identified early, their misperceptions will compound and affect how they perceive the problem.

For this, we require learning environments and approaches that provide avenues for increasing students' awareness of the problem of graduate unemployment. The work (Makramalla 2022) suggests that problem-based learning (PBL) will enable students to rapidly assess their conceptual understanding of such complex real-world problems by applying their knowledge of the concepts from a specific field of study. According to (Şenyiğit 2021), PBL can effectively alter misconceptions in order to foster a deeper conceptual comprehension. Identifying and correcting misconceptions can serve as a foundation for students' advancement of knowledge and concepts. In addition, PBL contributes to the development of collaborative skills and group cohesion, thereby enhancing knowledge acquisition and communication skills.

PBL is a student-centred teaching method that aims to improve students' ability to analyse, synthesize, and evaluate a problem situation. The problem is either defined as well-structured or ill-structured. A study by (Jonassen & Kwon 2001) in (Şenyiğit 2021) states that well-structured problems have elements related to the problem that are presented, have a low real-life transferability, are not overly complex, and require a small number of principles and rules to solve. For ill-structured problems, on the other hand, it involves the application of metacognitive skills as well as knowledge from a variety of fields, in addition to what is already known about the subject represented in the problem situation (Chin & Chia 2006). In addition, ill-structured problems (often interdisciplinary) are common in practice, and they usually require the integration of information from multiple disciplines as well as more than one solution option.

PBL, which looks at the current state of the world as a problem statement, develops high-level thinking skills as well as 21st-century skills such as creative thinking, information literacy and machine learning (Capraro & Slough 2013; Mohamd Yusof et al. 2021). These skills are essential to producing students who are progressive and innovative, and better prepared when entering the world of work. As a result of PBL, students gain the ability to solve complex problems, generate new ideas, and predict how a situation will turn out (Strobel & Van Barneveld 2009).

PBL is an active learning model that emphasises student participation and responsibility in all phases of PBL implementation. Students work in small groups to independently develop a solution to the problem. Interestingly, a group or collaborative work joys students within the working group with an engaging and unique classroom experience. Moreover, collaborative learning generally provides students with benefits such as activation of prior knowledge, recall of information, and theory building, all of which have a dynamic effect on the learning process (Dolmans et al. 1994). However, instructors must be wary of the risk of students losing motivation during collaborative learning, which can lead to shallow preliminary discussions. In the context of this study, this scene could provide opportunities to determine students' knowledge and awareness of Malaysian unemployment issues.

Şenyiğit (2021) shows a methodology of content analysis to reveal how students of PBL perceive problem situations that challenge them to activate their prior knowledge and recall information when confronted with different perspectives that may result in renewal and change of cognitive structures. The study of analysing participants› reflective writing through content analysis can be traced back to the early 1990s with researchers such as (Dolmans et al. 1994) and continues on into more recent studies conducted by (Osakwe et al. 2022) in which the authors explored computerised content analysis for extracting participants' own words and identifying their prior knowledge in PBL.

In education, however, there is a growing need for more sophisticated ways of analysing content.

Content analysis (CA) aims to simplify qualitative and textual data so that it can be more easily and suitably explained. Interviews, focus groups, and open-ended survey questions with textual data can all be evaluated using CA. According to Weber (1990) in (Chambers & Chiang 2012), CA is a useful instrument for identifying and describing the focus of personal, group, institutional, and social awareness. The use of CA in qualitative research has recently sparked a lot of attention in higher education, particularly for analysing students' written feedback on group learning experiences (Strobel & Van Barneveld 2009). This is because CA can be an excellent way to figure out a student's tone when describing the content of their reflections (Ahmady et al. 2020).

Therefore, this research is aimed at exploring the adoption of a qualitative content analysis method in analyzing PBL in relation to determining the awareness of chemical engineering students, studying in the Faculty of Engineering and Built Environment regarding factors of graduate unemployment in Malaysia. This work would help instructors better understand students' prior knowledge and investigate how they perceive problem situations that challenge them to recall information, link theories and build social engagement, as well as main drivers to gain confidence and proficiency in problem-solving.

METHODOLOGY

CODING SCHEME

Inductive theory places great emphasis on content analysis (Potter & Levine-Donnerstein 1999). Researchers with a brief set of data from the abstract process put forward the summary finding in a specific study context. It can be done by categorising the finding into concepts, categories and themes which later be used to describe the studied phenomena. For inductive content analysis in this study, guidelines provided in (Bengtsson 2016) were applied. Bengtsson (2016) views decontextualization as the first stage in content analysis. Decontextualization is the process of separating longer passages of text into shorter phrases that still contain the necessary information for the researcher to answer research questions. The created phrases will be coded according to the study's context. Therefore, it is recommended that researchers fully comprehend the text to be processed to avoid word dropping and increase the volume of codes. Moreover, a detailed description of each code is required to prevent cognitive shifts that could compromise the process's reliability (Erlingsson & Brysiewicz 2017). When codes are built inductively, they are more prone to change as the number of texts processed grows. However, in content analysis, reducing the risk of losing process reliability can be accomplished by using computer programmes to generate phrases and code. Also, researchers should check

text passages that aren't used as phrases to make sure they don't have any useful information.

The next stage is known as code categorizing, and it allows the created codes to be managed together based on specific motivations established early in the study. There should be criteria for published categories to ensure that no code falls into multiple categories. However, the created categories must be interconnected to reach answers to research questions. In such cases, the existing categories can be grouped together under a wider, more comprehensive category. Figure 1 shows inductive content analysis from selection to presentation.

FIGURE 1. Inductive content analysis from selection to presentation

PROBLEM-BASED SCENARIO

PBL was implemented in the Differential Equation course (with course code KQ2123) by the Department of Engineering Education, Faculty of Engineering and Built Environment, UKM Bangi for the second-year chemical engineering students. The course was taught by the author. The problem situation was designed to determine the level of awareness among chemical engineering students regarding unemployment factors in the Malaysian job market. The selection of general issues applicable to all engineering students enrolled in KQ2123 is intended to ensure that all students implement PBL in the predefined sequence. This is because it is thought that a title or theme of PBL that sounds like a study programme might make students want to skip the early stages of PBL, such as self-learning.

Regarding the implementation of PBL for KQ2123, students were asked to figure out which parts of the higher education curriculum needed to be changed to mitigate the problem of graduate unemployment in Malaysia. It is necessary to demonstrate how changes to specific parts of the curriculum affect the rate or the total number of unemployed graduates in Malaysia using differential equation modelling.

DATA COLLECTION

At the beginning of PBL, each student conducted self-study before presenting their findings or suggestions to their

group members. Typically, group discussions concluded with each group filling out a FILA (*Facts-Ideas-Learning issues-Actions*) form. The PBL administrator (lecturer and tutor) reviewed this form to ensure that the proposed solution did not go beyond the scope of the KQ2123 course. At the same time, each student completed an individual PBL reflection form to reflect on each stage of PBL that they had completed. Before completing all levels of PBL, the content of the reflection forms were analysed to determine how well students understand how PBL is used and what the title or theme is. In PBL for KQ2023, students were required to complete (online) individual reflection form. The reflection form contains five sections, each of which corresponds to a level of PBL; the first section identifies learning issues, followed by self-directed learning, group discussion, and the presentation of proposed solutions. The final stage, the fifth PBM, included a PBL administrator's evaluation of the proposed solution as well as student feedback.

The focus of this study was on the first stage of PBL. At that stage, students need to identify learning issues relevant to the problem statement of PBL. Learning issues should be recorded in the first part of the PBL form (hereinafter to be referred to as the LI section). Performing a content analysis for the LI section can provide an (initial) clue to the PBL administrator as to whether students have successfully identified critical learning issues or simply general learning issues. Content analysis will find out if the content of the LI section has nothing to do with PBL's problem situation i.e., graduate unemployment in Malaysia.

Students' reflections on PBL activities were collected using the Wileyplus platform, which was originally subscribed for the purpose of e-learning the difference equation course. This data collection method increases the value of Wileyplus subscriptions and supports the university's green sustainable campaign. Due to data accessibility concerns, the online LI section's contents were copied into a Microsoft Excel file. This data transfer procedure is also part of the preparatory steps prior to utilising the MAXQDA3 software for qualitative data analysis (MAXQDA 2019). Figure 2 depicts a screenshot of a Microsoft Excel file that contains students' reflections and brief information.

	A	B	C	D	E	F	G
1	Document Group	Document Name	Gender	Student ID	Set	Group	Reflection
2	Reflection	M1	M	A167520	1	13	1)What changes can be done to improve the current higher education system so that the unemployment rate will decrease? 2)What are the qualities needed in a fresh graduates needed in a fresh graduates for them to be employ?
3	Reflection	F1	F	A167538	1	20	1. How to overcome unemployment problem?, 2. What is contributing factors of inefficient Higher Education System?, 3. Are graduates aware of unemployment problem?
4	Reflection	F2	F	A167590	1	10	How does the skill mismatch affect employment rates?
5	Reflection	M1	M	A167599	1	15	1) To find the unemployment rate among graduates in Malaysia, 2) To figure out the relationship between unemployment rate and gross domestic product (GDP),3) To apply Okun's first-difference method to test the relative sensitivity between GDP and unemployment rate

FIGURE 2. Students' reflections and brief information

In this study, 88 second-year chemical engineering students were involved with the PBL activity. With 15 students failing to complete the PBL individual reflection form, the study sample size was reduced to 73. Fortunately, the sample size was large enough to ensure that at least two respondents (students) will provide a response that differs from the majority. This sample size is still relevant to the study's problem statement (Krippendorff 2018).

RESULTS AND DISCUSSION

Word Cloud, which has the capability of calculating the frequency of repeated words in sentences, has been used as a word processing tool to generate content analysis code from the LI section. A code term can be understood as a label for a group of sentences containing specific information within the context of content analysis. For this study, the code focuses on the aspects of the higher education curriculum that are associated with the issue of graduate unemployment in Malaysia Figure 3 displays the Word Cloud generated from the respondents' answers (after excluding essential words such as connecting words, pronouns, and so on). The words that make up the Word Cloud in Figure 3 are the 25 most frequently occurring words out of the 369 words detected.

FIGURE 3. 25 most frequently occurring words out of the 369 words detected

Following the generation of Word cloud, a word combination search was carried out to eliminate more words that did not match the set code definition. Using the *MaxDicx-> Word* combination command found on the MAXQDA screen menu, a list of word combinations as in Figure 4 is published. A manual content verification check was conducted on each sentence containing the word combination and it was agreed that all of them were eligible to be used as code in content analysis for PBL.

Code System	F22	F23	F24	F29	F30	F35	F44	F49	M21	M22	M23	M25	M26	M31	M33	SUM
Working experience		■			■						■		■		■	5
Entrepreneurship skill			■									■				2
Internal audit							■							■		2
Basic qualification	■					■			■							3
Practical learning			■	■				■		■						4
Soft skills		■	■								■	■	■			5
∑ SUM	1	2	3	1	1	1	1	1	1	1	2	2	2	1	1	21

FIGURE 4. Using the *MaxDicx-> Word* combination command found on the MAXQDA screen menu

Only 15 (approximately 21 per cent) of the total study sample of 73 respondents argued that at least one of the six codes was the most popular, a sentiment echoed five times by two separate groups of respondents. The following are examples of learning issue statements that contain the code:

Soft skills and work experience are the two most frequent codes, occurring five times among two distinct respondent groups. The following are some examples of learning issue statements that contain the code:

1. How soft skill will affect the rate of unemployment? Does soft skill need to be emphasized in higher education system?
2. What type of soft skills needed in working field?
3. What are the soft skills needed? To what extent does soft skills is required by industries or employers?

Meanwhile, the main issues to be studied in the second stage of PBL; self-learning, were chosen by three and four respondents, respectively, as basic qualifications and practical learning. The following are some examples of learning issue statements that include the above two codes:

1. What is the basic qualification for certain job especially in engineering field?
2. How industrial internship allows good working experience?

Two respondents chose internal audit code and entrepreneurship skills as their primary learning issues. Hence, this study assumes that chemical engineering students can only propose one component of the higher education curriculum that needs to be overhauled to address the problem of graduate unemployment with the release of six content codes as described above.Figure 4 (see the last line) shows not only how many and where the content analysis codes are, but also that some groups of respondents suggested more than one code. Meanwhile, Figure 5 shows the codes chosen by the same respondent at the same time. Internal audit code and essential qualification were two principles that two different respondents chose separately. The question is, does choosing more than one code give an advantage to the student and the group they represent? Suppose this question is based on the results of previous studies by (Dolmans et al. 1994). In that case, there is a possibility that they will gain an advantage, proposed solution.
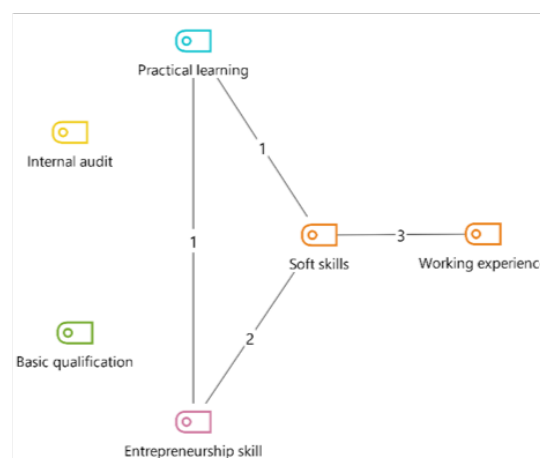

FIGURE 5. Codes chosen by the same respondent at the same time

This is because, in theory, the student will study the characteristics of each learning issue that has been identified, as well as related issues. While it is acknowledged that this situation will require a significant amount of self-study time, it is advantageous for the third stage of PBL, group discussion. For example, in the second stage, learning outcomes based on learning issues provide a broad perspective to the students' group members in dealing with the problems studied.

At the same time, about 79% of all respondents didn't come up with any major learning issues. Instead, they came up with general learning issues like the ones below:

1. Why the unemployment rate is so high in Malaysia?
2. How far the unemployment rate can affect the economic growth in a country?

How can changes in the education system that can improve the quality of our education to fit the world?This high percentage reflects a large group of respondents' inabilities to identify key learning issues regarding the relationship between higher education curriculum and the problem of unemployed graduates.

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The question is whether the students in this group are unaware of the learning issues that must be stated in order to solve a PBL problem. Or do these students have limited thinking skills and abilities when it comes to determining the link between the quality of higher education curriculum and graduate unemployment rates? If the question is based on the findings of a study by Yuen Lie Lim (2011), it has a foundation. The author found that students' 'thinking habits and level of thinking influence how a student undergoes PBL. Students who practise reflective thinking have become accustomed to identifying the main learning issues of a PBL topic. The student will feel more comfortable working with others in the group to finish PBL assignments if they are good at reflective thinking.

CONCLUSION

Although the problem of (non-voluntary) unemployment among university fresh graduates is an issue at the national level, it may rarely be discussed by junior engineering students. As such, it is difficult for institutions to determine the extent of students' awareness to interact with unemployment issues in their effort to take appropriate actions to assist students in getting employment (Shamsuddin et al. 2013). In this paper, the role of PBL activity on students' awareness regarding factors of graduate unemployment in Malaysia was investigated using inductive content analysis. Based on the content analysis of the IT section, which is part of the PBL individual reflection form, this study found that overall, chemical engineering students have successfully listed dozens of fundamental issues of unemployment but are seen to be less successful in tracing the relationship of the higher education system curriculum with unemployment graduate. This is likely due to students' perceptions that they have plenty of time before entering the job market. But it is the responsibility of the students to be concerned about the factors that influence graduate marketability and employability.

Although this study demonstrated the effectiveness of content analysis in identifying knowledge gaps among engineering students on unemployment factors, more evidence from various content analysis methods is needed. A similar study can be performed with different sets of engineering students using either machine learning, support vector machine or mixed methods as in content analysis. This may also improve the reliability and trustworthiness of content analysis results.

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None

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