Factors influencing engineering students' use of social media in learning

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ABSTRACT: Social media are the combination of various Internet applications that allow users to create and share user-generated content based on Web 2.0 technology. Social media-supported collaborative learning is a suitable form for problem-based learning, commonly utilised in engineering and technology education. For the better use of social media in teaching and learning activities, a conceptual model on factors influencing students' use of social media in learning is proposed in this article. Empirical data of engineering students were obtained from an education reform project related to social media-based learning, and the data were then used to test the proposed model. Results showed the model was capable of explaining the factors impacting on students' acceptance of social media in learning. Based on empirical analyses, some suggestions on the better use of social media in learning are provided.

INTRODUCTION

With the wide spread of Web 2.0 applications, such as social networks, wiki, blogs, video sharing and virtual reality, social media are now changing the way people obtain and share information. The concept of social media has not been clearly defined, but is related to its decentralised nature. People can use it to create and share information, as well as to get feedback [1].

Engineering education not only requires students to master theoretical knowledge, but also analytical and problem-solving abilities. The cultivation of these practical skills needs students to involve themselves in learning activities. Meanwhile, engineering education encourages students to learn by collaboration. Through communication with other students or teachers, students absorb knowledge more quickly and develop skills faster. Nordin's study suggested that there was a direct relationship between the technical communication skills that engineering students acquired from university study and their day-to-day communication in the workplace after graduation [2]. Social media provide an effective approach to collaborative learning in engineering education. Through social media, students can communicate synchronically or asynchronically with other students or teachers, which enhances their learning.

In recent years, there have been many cases where social media were used in engineering education. Massive open on-line courses (MOOCs), based on social media, have launched a revolution in education since 2012. For example, Udacity, one of the best MOOC providers, has now opened over 40 on-line courses about information technology. These MOOCs use video-sharing Web sites to provide learning resources and where students learn collaboratively through social media. Many teachers of technology and engineering-related courses have tried to use social media in their teaching so as to allow learners to interact with each other.

Although there have been successes achieved in the application of social media in engineering education, this new approach has not been very well accepted among students. Dropout rates for MOOCs are very high and some studies indicate that less than 10 per cent of MOOC learners stay with the course to the end. Teachers who introduce social media to their engineering classes also find that students are not always actively engaged. Knowing the factors influencing students' use of social media is crucial for its efficient use in engineering education in the future.

The structure of this article is as follows:

- A review and analysis of the use of social media in engineering and technology education.
- A summary of factors influencing students' acceptance of social media in learning.
- Construction of a hypothesis-based model reflecting the relationships among these factors.

- Verification of the model using questionnaire data obtained from engineering students from an education reform project on using social media in learning.
- Discussion and conclusion.

SOCIAL MEDIA IN ENGINEERING AND TECHNOLOGY EDUCATION

The most obvious difference between social media-based and traditional classroom teaching is about the ways to communicate knowledge. Classroom teaching is centred on the teacher, where knowledge is communicated one way, from the teacher to students. However, social media-based learning allows knowledge to be communicated among participants, not only from the teacher, but also from and among students. It is more student-centred, which is one of the primary features of problem-based learning [3]. The figure below shows the ways of knowledge communication in these two teaching modes:

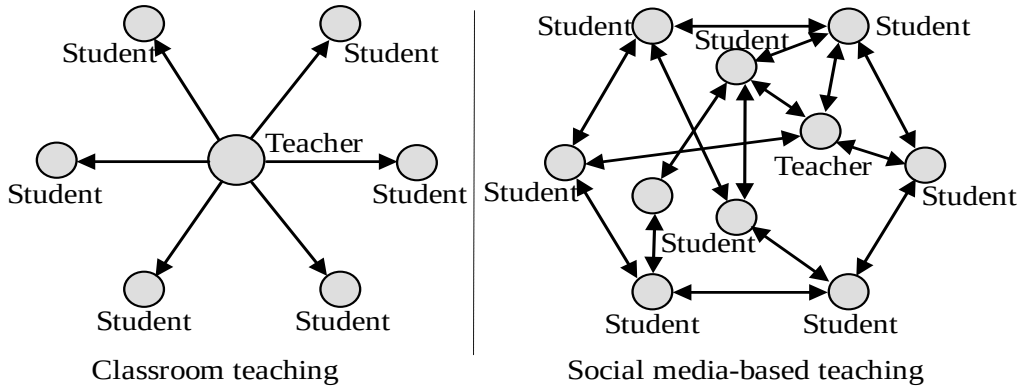

Figure 1: Knowledge communication in classroom teaching and social media-based teaching.

There are many cases involving the use of social media in engineering and technology education. As it is a new teaching method, knowing these pilot cases is beneficial for the more efficient use of social media in teaching and learning. An on-line discussion forum was the social media application first used in engineering education, where students can discuss academic questions by posting and following topics. Wang let technical students discuss academic issues through on-line discussion forums, and found that this type of academic communication could enhance students' critical thinking ability [4].

Wiki is a social media application that enhances the creating of content through collaborative writing, where participants can work in a team to create and edit specific items. Because it allows collaborative learning, it is often used in problem-based learning, which is commonly utilised in engineering and technology education. Chen et al used wikis and blogs in the teaching of a course, *Designing the Human Experience*, so that students could learn collaboratively and fully communicate with fellow students and teachers [5]. Çetin et al used applications, such as Semantic MediaWiki (SMW) and MediaWiki to improve students' communication and to develop their collaborative learning skills in computer engineering education. Results showed that this teaching approach can improve learning results [6].

Social networks, such as Facebook and Twitter, are also used in engineering and technology education to provide learning resources, share experiences and raise a discussion on a certain learning topic [7]. The University of Adelaide used Facebook to mentor students of digital media in their final year so that they could do better career planning [8]. Another pilot study that used Twitter to allow for communication among students of a chemistry major and their course teachers showed 77 per cent of students found it easier to raise questions with teachers in this way [9].

YouTube is used as an open learning resource for engineering students. Virtual reality applications, such as Second Life, were also used in engineering and science teaching to help students improve their practical skills [10].

As this teaching approach is totally different from that traditionally used in the classroom, the acceptance of social media by students has a huge influence on whether it can be well used in teaching and learning. Understanding the factors influencing engineering students' adoption of social media can help teachers design better teaching schemes and achieve better results.

FACTORS INFLUENCING STUDENTS' ACCEPTANCE OF SOCIAL MEDIA

Social media are actually a collection of Internet-based systems that allows users to share information. Theories and previous research about users' acceptance of information systems can help determine, which factors influence students' intentions to use social media in learning.

Davis' Technology Acceptance Model (TAM) is used for explaining the factors influencing users' acceptance of information technology, based on the theory of reasoned action. In this model, perceived usefulness is defined as the degree to which a person believes that using a certain information system would enhance his/her performance of learning or working; perceived ease of use is defined as the degree to which a person believes that using a particular information system would be free of effort [11].

Davis believes that the perceived usefulness and ease of use together influence a user's behaviour intention when accepting an information technology, and that perceived usefulness has an influence also on perceived ease of use. Since the proposal of TAM, abundant empirical studies have proved it to be able to explain factors influencing users' acceptance of information technology [12]. In recent years, this model also has been used to study students' acceptance of educational technology and has provided an explanation for that acceptance [13]. Grosseck pointed out that students' use of Web 2.0-based applications in higher education depends on their perception of it as being useful for learning [14]. Usluel found that students' preparedness to use these Web 2.0 tools is related to their ease of use [15].

PROPOSED HYPOTHESES AND RESEARCH MODEL

Based on the above analysis, the following three hypotheses are proposed:

H1: Perceived usefulness has an influence on engineering students' intention to use social media in learning.
H2: Perceived ease of use has an influence on engineering students' intention to use social media in learning.
H3: Perceived ease of use has an influence on engineering students' perceived usefulness of social media in learning.

Subjective norm means an individual's perception of whether people important to the individual think a behaviour should be performed [16]. Venkatesh and Davis suggested in their extended TAM model that subjective norm has an influence on perceived usefulness and behavioural intention to use [17]. In fact, during teaching, the advice and requirements from teachers often have an effect on students' learning behaviour and attitude. Besides, attitudes from peers and friends will influence a student's learning behaviour. Van found in a study on Chinese students' acceptance of virtual learning environments that subjective norm has an influence on students' perceived usefulness and intention to use [18]. Rejón also found that teachers' advice has an influence on whether students think micro blogs are useful for learning [19].

Thus, from the above analysis, these two hypotheses related to subjective norm were proposed:

H4: Subjective norm has an influence on engineering students' perceived usefulness of social media in learning.
H5: Subjective norm has an influence on engineering students' intention to use social media in learning.

Social media applications, such as social networking sites and micro blogs, mostly belong to hedonic or pleasure-oriented information systems, which make students feel more interested in their learning than they would if in a classroom. Whether social media-based learning can make students feel interested may directly influence their acceptance of it. A study on Chinese students' use of high quality course Web sites (i.e. open educational resource programme led by China's Ministry of Education) found that students' perceived enjoyment of those Web sites influenced their adoptive behaviour [20]. Using social media in learning, students can enjoy the pleasure brought by helping others through sharing knowledge. This kind of intrinsic motivation has been mentioned in several texts [21].

Therefore, based on the above analysis this hypothesis is proposed:

H6: Perceived enjoyment has an influence on engineering students' intention to use social media in learning.

The ultimate purpose of using social media in education is to enable students to acquire knowledge. Knowledge can be divided into explicit knowledge and tacit knowledge [22]. Explicit knowledge is expressed by words or formulas and can be shared and communicated using symbols, while tacit knowledge is usually related to intuition or feelings based on experience. Using social media in learning can not only help students to better grasp explicit knowledge, but also spread tacit knowledge through communication.

The basis of this research is TAM, the core idea of which is that the individual's behavioural intention of using information technology is influenced by perceived usefulness and ease of use. Because the aim of using social media in learning is to obtain knowledge, students' perceived knowledge accessibility will have an influence on their behavioural intention through the perceived usefulness and ease of use of social media in learning.

This leads to the following hypotheses:

H7: Perceived knowledge accessibility has an influence on engineering students' perceived usefulness of social media in learning.
H8: Perceived knowledge accessibility has an influence on engineering students' perceived ease of use of social media in learning.

The above eight hypotheses to be tested involve perceived knowledge accessibility, perceived usefulness, perceived ease of use, subjective norm, perceived enjoyment and intention to use, i.e. six constructs in total. The relationship among these constructs is shown in Figure 2.

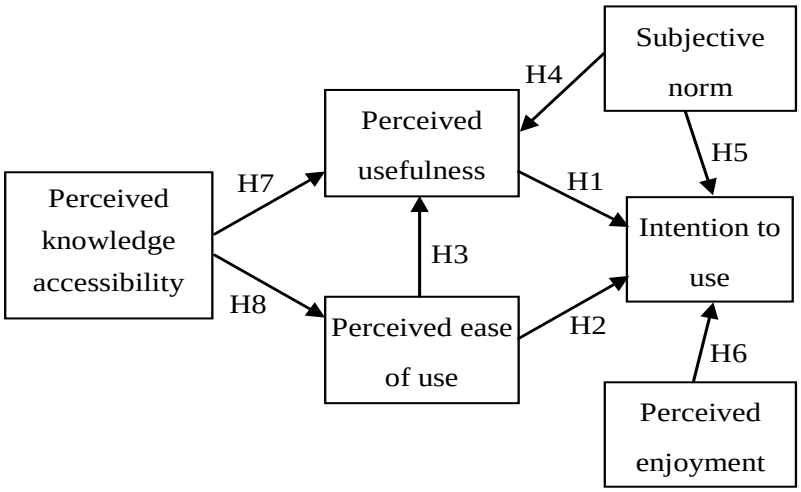

Figure 2: A research model for students' acceptance of social media in learning.

RESEARCH DESIGN AND MODEL VERIFICATION

The research carried out to analyse the factors influencing engineering students' acceptance of social media in learning was through questionnaires, which comprised two parts, i.e. background information and attitudes to social media in learning. The background information part was designed to collect students' personal characteristics and their use of social media in life and in learning. The second part measured the six constructs of the proposed model. The measurement of these constructs was informed by existing studies, but modified to suit this particular research.

The instruments for perceived usefulness, perceived ease of use, subjective norm and intention to use all came from the extended TAM of Venkatesh [17]; the instruments for perceived enjoyment came from a study on users' acceptance of Second Life conducted by Lee [23], and the instruments for perceived knowledge accessibility came partly from related items of a questionnaire used in Selim's study about e-learning system adoption [24]. The measurement of the constructs adopted the 5-point Likert scale. Each item has 5 alternatives, from *strongly disagree* to *strongly agree*, representing the 5 degrees of agreement.

Empirical data were collected from an education reform project about social media use in learning carried out by the Open University of China (Sichuan Branch). In this project, teachers encouraged students to learn by using social media collaboratively. Also, teachers used social media to provide learning resources for students and to communicate with them. After the courses ended, the students who had used social media in learning were invited to take a questionnaire survey. During a period of three semesters, from the Autumn semester of 2013 to the Spring semester of 2014, questionnaires were handed out, of which 242 were returned and 233 were valid. Most (170) were from engineering and technology majors, including engineering management students. The data analysis for the research was based on these questionnaires.

A reliability determination of the data found that the Cronbach's alpha values were all above 0.7 (see Table 1), showing the instruments had high internal consistency. Meanwhile, the mean of each variable was close to 4, which means students hold a generally positive attitude towards social media-based learning.

Table 1: Descriptive statistics and reliability determination of the instruments.

Constructs	Item number	Mean	Variance	Cronbach's α
Perceived knowledge accessibility	4	3.979	0.406	0.771
Perceived usefulness	5	3.828	0.368	0.832
Perceived ease of use	4	3.826	0.432	0.850
Subjective norm	2	3.594	0.678	0.710
Perceived enjoyment	3	3.665	0.531	0.814
Intention to use	2	3.915	0.457	0.785
Overall	20	3.819	0.453	0.929

The validity of this questionnaire was tested by the Kaiser-Meyer-Olkin (KMO) method and Bartlett's spherical check. The overall KMO value of the scale is 0.826 (higher than 0.8), showing a high correlation among variables, so it was suitable for factor analysis. Besides, $\chi 2$ value of Bartlett's spherical check is 2256.111, and the significance < 0.001 ($p < 0.05$), which also means the data were suitable for factor analysis.

The hypotheses in the proposed model were tested using multiple regression analysis. In the research model, variables influencing perceived usefulness are perceived knowledge accessibility, perceived ease of use and subjective norm. The results of multiple regression analysis are shown in Table 2.

Table 2: Results of multiple regression analysis (with *perceived usefulness* as the dependent variable).

Independent variable	Standardised coefficient	*t*	Sig.	Significant
Perceived knowledge accessibility	0.192	2.718	0.007	Yes
Perceived ease of use	0.394	5.900	0.000	Yes
Subjective norm	0.339	5.771	0.000	Yes

The correlation coefficients for the three variables with perceived usefulness are all significant ($p < 0.01$), so H3, H4 and H7 were all verified. Using perceived knowledge accessibility, perceived ease of use and subjective norm as independent variables and perceived usefulness as the dependent variable, the regression equation model had an R^2 of 0.585, showing that the explanatory ability of the three variables for perceived usefulness is 58.5%.

H8 hypothesised that perceived knowledge accessibility had an influence on perceived ease of use. The result of regression analysis is shown in Table 3. The correlation coefficient between variables reached a significant level of $p < 0.01$, thus verifying H8. With an independent variable of perceived knowledge accessibility and dependent variable of perceived ease of use, the R^2 of the regression equation model was 0.431, showing that perceived knowledge accessibility's explanatory ability for perceived ease of use was 43.1%.

Table 3: Results of multiple regression analysis (with *perceived ease of use* as the dependent variable).

Independent variable	Standardised coefficient	*t*	Sig.	Significant
Perceived knowledge accessibility	0.656	11.271	0.000	Yes

Variables that have an influence on intention to use in the research model are perceived usefulness, perceived ease of use, subjective norm and perceived enjoyment. The result of multiple regression analysis is shown in Table 4.

Table 4: Results of multiple regression analysis (with *intention to use* as the dependent variable).

Independent variable	Standardised coefficient	*t*	Sig.	Significant or not
Subjective norm	0.104	1.398	0.164	No
Perceived usefulness	0.266	2.970	0.003	Yes
Perceived ease of use	0.252	3.241	0.001	Yes
Perceived enjoyment	0.200	2.794	0.006	Yes

The correlation coefficient between subjective norm and intention to use is 0.164, failing to reach the significance level of $p < 0.01$. Three other variables, viz. subjective norm, perceived ease of use and perceived enjoyment, were all found to be significant in their influence on intention to use ($p < 0.01$). Thus, H1, H2 and H6 were verified and H5 was not.

Because the subjective norm influence on intention to use is not significant, it was not regarded as an independent variable in the regression model with a dependent variable of intention to use. The R^2 of the regression equation model with independent variables of perceived usefulness, perceived ease of use and perceived enjoyment and a dependent variable of intention to use was 0.448, indicating that the explanatory ability of the three independent variables for intention to use is 44.8%.

Based on the above analysis, the factors influencing engineering students' use of social media in learning are summarised in the path model in Figure 3.

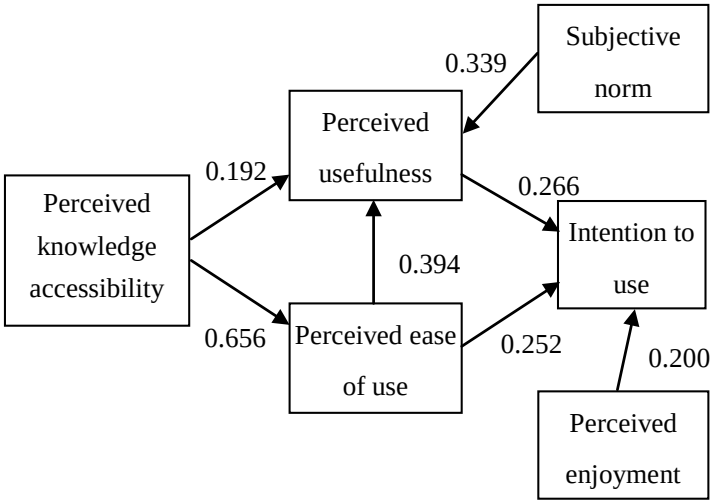

Figure 3: The path model of students' use of social media in learning.

DISCUSSION AND CONCLUSION

Social media provide an alternative for students by which to share educational resources and to communicate in learning. Meanwhile, social media are convenient for engineering students in problem-based and project-based learning. In this process, teachers must play the role of co-ordinators, so as to promote this way of learning; thereby, improving learning. Enabling students to better use social media in learning answers a key question in allowing the construction of a sound, collaborative learning environment. The information technology literacy of engineering students is usually high and using social media in learning is not difficult for them. Teachers' praise of students, who actively share knowledge, can give them pleasure and prompt them to make further contributions.

The research model failed to verify that the subjective norm has effective influence on students' intention to use social media in learning. This is because in the education reform project involved in this research, teachers only encouraged students to use social media in learning and the assessment was not included in the learning process. If a certain assessment is introduced into social media-based learning, students' intention of using social media in learning will be improved.

Empirical analysis showed that perceived usefulness is significantly influenced by engineering students' perceived knowledge accessibility, perceived ease of use and subjective norm in social media-based learning; perceived knowledge accessibility has a significant influence on perceived ease of use; and students' intention to use social media in learning is closely related to their perceived usefulness, perceived ease of use and perceived enjoyment of its use.

As a theory to explain factors influencing an individual's acceptance of a certain information technology, TAM is capable of explaining students' technology adoption for learning. This research has introduced two additional constructs, viz. perceived knowledge accessibility and perceived enjoyment, based on the original TAM. The introduction of more constructs may enhance the explanatory power of the model in an educational context.

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