ASEAN Journal of Science and Engineering Education

Journal homepage: http://ejournal.upi.edu/index.php/AJSEE/

Students' Conceptions of Learning Geotechnics: A Qualitative Approach

Ena Kartina Abdul Rahman[1,], Masitah Shahrill[2], Sri Kartika A. Rahman[2]*

[1] Faculty of Engineering, Universiti Teknologi Brunei, Brunei Darussalam
[2] Sultan Hassanal Bolkiah Institute of Education, Universiti Brunei Darussalam, Brunei Darussalam
Correspondence: E-mail: ena@utb.edu.bn

ABSTRACTS

This study aims to examine students' conceptions of learning Geotechnics by investigating how selected students perceived learning in the teaching and learning to set an enrolled civil engineering program. In addition, students' reasons for approaches used in learning Geotechnics and students' perceptions of the role of the learning environment in studying Geotechnics were also identified. Interviews were conducted with diploma-level students, and two topics, compaction of soils and foundations, were selected to understand the approaches taken by the students in learning Geotechnics. The findings revealed that the interviewed students had more than one conception of learning depending on how the students had experienced the learning environment. Interestingly, these students had an appreciation of higher order conceptions of learning and hence used deeper approaches in acquiring knowledge. However, the students still mostly used surface approaches in learning Geotechnics. The findings also indicate that the learning context influenced students' reasons for approaches used in learning. The students also reported a great preference for laboratory classes as their optimum learning environment.

ARTICLE INFO

Article History:
Submitted/Received 19 Jun 2022
First revised 14 Jul 2022
Accepted 21 Jul 2022
First available online 02 Aug 2022
Publication date 01 Mar 2023

Keyword:
Civil engineering,
Geotechnics,
Learning conceptions,
Qualitative approach.

1. INTRODUCTION

Increasingly, employers prefer to employ graduates with some experience in the field of civil engineering (Atkinson, 2002; Ditcher, 2001). Because of this demand, the framework for civil engineering courses has been changed to include an element of practice in the program. This has required the reorganization and readjustment of the currently overloaded engineering syllabuses in higher education institutions.

This demand has put universities under pressure to decide on the content that needs to be included or excluded in the design framework (Ditcher, 2001). As a result, mistakenly neglecting some important materials may affect students' theoretical knowledge in engineering. Atkinson (2002) writes that due to this reason, there is a knowledge gap between previous generations of civil engineers and present generations of engineers in terms of the depth of theoretical knowledge that these engineers have in core areas in civil engineering. Atkinson further notes that only a few young engineers have truly understood the basic theories that are needed in civil engineering.

The literature, however, points to another issue. Most students in higher education do not entirely understand the concepts of science, technology, engineering, and mathematics and the problem of lack of understanding and misconception appears to be unyielding even under a good instructional method. Hence, it appears that the problem of lack of understanding in theoretical knowledge as described by Atkinson (2002) is probably not due to a lack of fundamental theories being introduced in higher education, but due to students' misconceptions in understanding the theories introduced to them (Montfort *et al*., 2009).

While there were studies that examined how students understand a specific concept introduced to them (Montfort *et al*., 2009), to solve the problem of continuous misunderstanding or misconception of content knowledge, it is vital to initially observe learning through students' perspectives. Hence, to change the framework in teaching and learning, it is important for a lecturer to first identify the students' conceptions of learning and preferences concerning learning environments. This is because students' conceptions of learning and preferences in learning may influence the outcomes of the learning objectives, including the ability of students to understand a concept in their field (Trigwell & Ashwin, 2006).

The main aim of the current study, therefore, is to gain an understanding of students' conceptions of learning in a Geotechnics class. This study was conducted with a group of diploma students from a Civil Engineering program in one of the universities in Brunei Darussalam and draws from other research on conceptions of learning. However, unlike other studies (Tsai, 2004; Lin & Tsai, 2009), it goes on to investigate the reasons behind the approaches taken by the students in learning two selected topics in Geotechnics. In addition, the students' views on the setting or learning environment in which classes are conducted are also investigated.

This study sought to understand students' learning by identifying their perceptions, as well as real problems so that we could begin to share common conceptions of learning Geotechnics, which could form the basis for pedagogy in a higher education setting. The study, therefore, investigated the following research questions: What are students' conceptions of learning based on selected topics in Geotechnics; What are their reasons for approaches used in learning Geotechnics; What are their perceptions of the role of the learning environment in studying Geotechnics?

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

2. LITERATURE REVIEW

The conception of learning is defined as the reasoning process of acquiring knowledge for a specific subject (Hofer & Pintrich, 1997). General learning can be categorized into two: surface and deep learning. In surface learning, students define learning as gaining knowledge from what was told in the class, memorizing, and reproducing it whenever necessary; whereas deep learning involves critical learning by relating, understanding, and interpreting knowledge concerning the real world. In addition to these two approaches, another approach of learning called 'strategic learning' whereby students use motivation in the way they view knowledge. For instance, having an objective to produce good grades motivates students in learning so that they find the right strategies to be successful.

Meanwhile, Tsai (2004) presents students' conceptions of learning in science for high school students in terms of two levels: a low-level view of learning which is considered to be "quantitative", and a high-level view of learning which is also called "qualitative" (p. 1745). The low-level view of learning shares some common features conceptions of learning at this level described as "memorizing", "testing", "calculating" and "increasing knowledge". In this case, learning is focused on the amount of knowledge that is learned by the students, accumulating the knowledge and reproducing what is taught to them. On the other hand, conceptions of "applying", "understanding", and "seeing in a new way" (p. 1745) are considered to be a qualitative view or deep approach to learning. For these three sub-categories of conceptions, students gain knowledge by developing their understanding of the content and relating it to different circumstances. Tsai (2004) also explains that students' conceptions of learning vary depending on students' majors at school. For instance, students with a science major use a deeper approach to learning science as compared to students from non-science majors. This finding is also supported by Eklund-Myrskog (1998) and Marshall *et al*. (1999), which carried out a study with a group of students with different specializations in higher education. However, Tsai's (2004) findings revealed that only half of the students with a science major had a qualitative or deep view of learning science, whereas less than 30% of the students with non-science majors had similar conceptions of learning science.

In a study by Lin and Tsai (2009), they applied the theoretical framework of conceptions of learning science that was adapted from Tsai (2004) to engineering education as both the fields of science and engineering share common features including real-world problem-solving. Lin and Tsai (2009) conducted a survey based on this framework with a group of electrical engineering students, to relate the students' conceptions of learning to their preferences of learning environments. This study found that most electrical engineering students preferred classroom lectures to laboratory classes. The students who preferred classroom lectures saw learning as "testing" and "calculating and practicing" (p. 200), whereas the students who preferred laboratory classes looked at learning more qualitatively. It is also suggested that students' conceptions altered from quantitative to qualitative depending on the changes from classroom lectures to laboratory classes. The study was only applicable to electrical engineering students in Taiwan, and Lin and Tsai (2009) have also suggested that the outcomes of the study may not be similar to students from other engineering courses. In addition, as suggested by the findings by Boulton-Lewis *et al*. (2004) and Tsai (2004), students' conceptions of learning are also influenced by culture. Hence, the present study focused on students' conceptions of learning Geotechnics in the context of Brunei Darussalam. In addition, Suprapto *et al*. (2017) conducted research on university students' conception of learning physics and physics learning self-efficacy in East Java province, Indonesia, where they

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

found that there was no significant difference among the students in laboratory usage and scientific literacy.

Like any other engineering course, the teaching of civil engineering in higher education consists of classroom lectures, laboratory classes, and tutorial classes. This study does not seek to find the relationship between students' conceptions of learning and their preferences for a particular learning environment as studied by Lin and Tsai (2009). However, students' views on the current practice of learning and teaching in civil engineering will also be reviewed as it may influence the students' conceptions of learning in Geotechnics. This is because different approaches from classroom lectures to laboratory classes and then tutorial classes have proven to be significant in students' learning conceptions (Trigwell & Ashwin, 2006).

It is recognized that "higher order" views of learning conceptions, also interpreted as deep or qualitative approaches to learning, resulting in better learning outcomes and are preferable in the teaching and learning situation (Chin & Brown, 2000). However, from previous studies, it has been identified that surface approaches to learning, for instance, the conception of learning as "memorizing and reproducing" has been commonly adopted by students at different educational stages (Marton *et al*., 1993; Eklund-Myrskog, 1998; Marshall *et al*., 1999; Tsai, 2004; Lin & Tsai, 2009). There is a high possibility that surface approaches to learning may also be identified in the current study involving Bruneian civil engineering students. Hence, other than categorizing the students' conceptions of learning in civil engineering and looking into students' views of the current design setting of classes, this study also aims at analyzing the reasons behind the students' conceptions of learning Geotechnics.

3. METHODS

A review of previous research suggests that the study of students' conceptions of learning can be carried out either quantitatively (Lederman *et al*., 2002; Lee *et al*., 2008; Lin & Tsai, 2009) or qualitatively (Eklund-Myrskog, 1998; Marshall *et al*., 1999). It should be noted that the current study only focuses on exploring students' conceptions of learning a significant module in civil engineering, i.e. the Geotechnics module using the qualitative approach. Additional questions explore their perceptions concerning learning environments and relevant reasons concerning their conceptions of learning.

3.1. Topic selection

The study was conducted with a group of students who took the module "Fundamentals of Geotechnics and Pavements" in their second semester of a higher national diploma of construction management and quantity surveying course. This course is part of the discipline of civil engineering and it should be noted that the basic principles of geotechnical theory introduced at this level are equivalent to the first year of basic fundamental theory introduced in the bachelor's degree of civil engineering, and the diploma of civil engineering. Due to this similarity, it has been decided that the common label "Geotechnics" will be used throughout this report on the study.

Geotechnics is an essential subject in undergraduate or diploma-level civil engineering programs. At the initial stage of the Geotechnics module, students are introduced to the basic principles of geotechnical engineering. The content of Geotechnics covers all aspects related to the responses of soils and rocks due to applied stresses. Having a basic fundamental knowledge of Geotechnics allows students to be equipped to solve more advanced geotechnical problems, for instance, the design of foundations, retaining walls, slopes, pavements, tunnels, dams, and bridges.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

For this study, the following two topics from Geotechnics were selected: (a) compaction of soils and (b) foundations. Hence, the investigation of students' conceptions of learning in this study was specifically focused on concerning these two topics in Geotechnics.

The teaching of compaction of soils consisted of two lectures, one laboratory class, and one tutorial class. Here, the students were expected to recognize the relationship between dry density and moisture content and its interpretation during soil compaction; understand the laboratory and field procedures of soil compaction, and appreciate the in-situ measurement of dry density and moisture content of the soil. In addition, the students should be able to estimate the performance of compacted soil in the field.

3.2. Class observations

Initially, all classes on compaction of soils and foundations were audio and video recorded. This included lecture, laboratory, and tutorial classes. The purpose of collecting this data was to examine the approaches taken in delivering these topics to the students. In addition, the students' behavior in all classes was also observed. From class observations, a set of questions was prepared for students' interviews. It should be noted that class observations were only used to obtain an idea of students' experiences in the class, and more detailed qualitative data were obtained by conducting 'one-to-one semi-structured interviews with six students selected from the class.

3.3. Participants for interviews

In selecting the sample, students with different abilities were considered for in-depth study through interviews. The six interviewees, Siti, Sally, Hendry, Johari, Elon, and Nadal (all names are pseudonyms) were selected based on their performance during the first semester of the program. In addition, the quality of the students' reflective papers written in the first few classes during the second semester was also taken into consideration. Furthermore, lecturers in the civil engineering program who had taught the students were consulted in making the selection. It should be noted that the willingness of the students to take part in this study was also considered during the selection process. Therefore, following the ethics of research, the consent of participants was obtained.

There were two female and four male students who participated in the interviews, and five of the students were between the ages of 20 to 21 years old and had completed Year 12 before enrolling in the diploma program. Like many other students in civil engineering, these students came to the program with majors in science and all of them had taken Mathematics and Physics as their main subject areas. It should be noted that students who enroll in the diploma level usually obtain lower grades in the Year 12 examination as compared to students who enroll in the first-degree level. One of the six participants had obtained a national diploma in building services before joining the program. It was expected that this student would have some background in understanding the terms used in the construction field when compared to the other five students. It should also be noted that the number of students who have joined the course with technical backgrounds was typically small.

3.4. Interviews

Interviews were the main source of data collection for this study. These interviews were transcribed, analyzed, compared, categorized, and interpreted. Each student was individually interviewed for approximately 45 to 60 minutes depending on the responses given by the student. A semi-structured interview was used in the process, whereby a prepared question

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

was first asked the student, and later further questions were prompted based on answers given by the student.

Interview questions were related to how the students saw and understood the topics on compaction of soils and foundations; the approaches taken by the students in learning the topics; and the students' experiences with current teaching and learning practices in Geotechnics classes. The following are the questions that were asked to the students during the interview on the topic of compaction of soils:

(i) What does 'compaction of the soil' mean to you?
(ii) What do you like about the topic of soil compaction?
(iii) How do you understand 'compaction' based on the lecture?
(iv) How do you learn compaction from the handouts?
(v) How was your experience working in the laboratory class and what did you expect to learn from this?
(vi) How did you do report writing after the laboratory?
(vii) How did you learn compaction from tutorial class?
(viii) How did you prepare for your exams and tests on the topic of compaction?
(ix) How do you think we should improve the teaching of the topic of compaction of soils?

The students' experiences in learning the topic on foundations were also probed using the same approach. However, it should be noted that these questions were not asked in a similar sequence as questioning depended on the responses given by the students during the interview session. The students were constantly encouraged to give full explanations for their responses through non-directive questions from the interviewer (the first author). Hence, questions like "What do you mean by saying..." "Can you explain that further?", "Why did you say that?", "Is there anything else you want to add?" were asked to the students throughout the interviews. All interviews were audio and video recorded, and later transcribed.

3.5. Data Analysis

Each transcript was first to read over a few times and similar to Eklund-Myrskog (1998) and Tsai (2004), the important quotes were highlighted and any words that were related to students' conceptions of learning, students' reasons for the approaches used in learning, and students' perceptions of the role of the learning environment were marked. An attempt was also made to interpret unclear and indirect meanings that were related to the context of the research. Each transcript was compared to identify the variations and agreements in students' responses and it was recognized that during the process, the student may have said a similar expression but intended a different meaning or a similar meaning could be communicated with a different expression. Tsai (2004) has also described the similarities and differences in expressing the same meaning. Hence, categories for the conceptions of learning, students' reasons for the approaches used in learning, and students' perceptions of the role of the learning environment were identified. It was understood that the process was tedious and time-consuming. A few adjustments were needed until the solid meaning was completely established.

4. RESULTS AND DISCUSSION

The findings presented in this section were obtained mainly from examining the six interview transcripts. The data were analyzed to categorize the students' conceptions of learning based on the two topics in Geotechnics, as outlined in the first research question. The data were also studied to identify the students' reasons for approaches used in learning as described in the second research question. In addition, as expressed in the third research

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

question, the students' perceptions of the role of the current learning environment were also examined. The findings and discussion of this study are presented according to the research questions. It should be noted that the use of ellipsis in presenting students' responses indicates pauses.

4.1. Students' conceptions of learning

This section discusses the first research question on students' conceptions of learning based on the two topics in Geotechnics. The findings reveal that the students have more than one conception of learning. It should be noted that an attempt was also made to compare the findings with the seven conceptions of learning identified by Tsai (2004). It was found that the students' conceptions of learning could be classified into eight categories. The first six of these categories were drawn from the conceptions of learning found in Tsai (2004). However, it should be noted that whenever necessary, some adjustments were also made, depending on the nature of the engineering discipline and concepts introduced in the two topics. In this section, the sequence of these six categories is presented following the hierarchy from surface to deep approaches to learning as described in Tsai (2004). In addition, two new categories were also identified during the analysis: learning as sharing knowledge and learning as experiencing knowledge.

4.1.1. Learning as memorizing

In this first category, learning Geotechnics was viewed as the memorization of an "important word", "keyword" or "main point"; "methods", "diagrams" and "facts". During the interviews on the topic of compaction of soils, the students highlighted the need to memorize as evidenced by the responses below.

> I read first… When I read… I remember the *important word*. First, I tried to remember those *important words* and then try to make them into sentences. Then I checked back the answer… If it is wrong… Then I can find the mistakes. It is kind of an exercise. If I made some mistakes, I can just cancel the answer and replace it with a correct answer. (Siti)

> If I can't memorize anything… like for instance… this one (pointing at the notes). It says about the compaction. I just highlight compaction. *Increase*. *Density*… *Pressing*… *Closer*… Just like that. So that when I remember those *main points*. I can just straight away use my sentence to write. (Sally)

> The definition can be considered straightforward. Whereas for the character… factors… the graphs… For example, like *factors* [of compactions]. There are quite a lot. So… some of them need to be memorized. I can just make mistake if I just simply do it. I will memorize the part that I don't understand. And the rest… the one that I have understood… should be considered okay. (Elon)

For the topic of foundations, the students described how they learned through memorization:

> [I do not like the dewatering topic] because there are too many *methods* that I need to remember… Uhm… For dewatering [for instance] … You use the pump. And then you use pits… something. But then I have to read a lot. I need to remember the *diagram*. The pump… They have their own. What do you call this? Uhm… They have their parts, right? Where you put the suckers, the filter… everything. I have to remember all of those small things. Uhm… Then for the depth, the width [of the excavated area]. I... (long pause). I am

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

not confident. Don't feel confident, when I answered dewatering, especially during the exam. (Siti)

We need to remember the *keyword*. Let's say the question is like this. Just as long as you know the *keyword*, you just need to elaborate on it. (Elon)

The memorization of an "important word" refers to remembering a specific word in content knowledge. The "important word" in Siti's view was a technical term used in civil engineering. This was further emphasized when she described her difficulty in remembering technical terms used in the topic of foundations. Even though she memorized "methods" and "diagrams" of dewatering systems, methods and diagrams that had been introduced in this topic were related to different techniques of the dewatering process. This required some memorization of new technical terms that were used to label the parts found in different equipment. The term "keyword" which was described by Elon also refers to a specific word in content knowledge. However, rather than just a technical term to be memorized, it signaled a concept concerning the topic.

Sally's use of "main point" suggested a third dimension, which involved memorizing a particular word concerning other words. Similarly, the term "factors" which was used by Elon involves looking at a fact concerning other information. For this topic, factors referred to the specifications in soil compaction. A failure to recognize factors affecting the compaction of soils may result in poor planning of construction. Hence, due to a long list of factors that need to be considered during compaction, this student felt that it was very important to memorize all the facts.

4.1.2. Learning as preparing for tests

Learning as preparing for tests is also described as "learning for testing" (Tsai, 2004, p. 1739). The students described their learning of the topics as partly for examination purposes. They also highlighted the importance of knowing how to answer examination questions and recognizing that good result for the module was essential to proceed to the next level. Their responses concerning learning in preparation for examinations indicated a strong affective dimension as suggested by the data below:

From my experience during the first semester… what we need to do now is *to survive* [in] every semester. With the good result of the course. So most important is to *survive* [in] every semester. To *survive* your topic, to *survive* each unit. We need to focus on what's going to be asked during the exam. For future work… we can just refer it back. Refer to our notes. Refer to something. But for the exam… we need to *read the important stuff* that will be coming out for the exam. (Hendry)

It is not about overcoming the difficulty. Well… I already feel *secure* with the first two topics [on foundations] And I can understand the first few parts of dewatering. Towards the end, I feel 'chaos' about the last topic [last part of the topic on dewatering] I just read it. But I just hope that it doesn't come out for the exam. (Elon)

The two terms: "survive" and "secure," suggest anxiety in addition to recognizing the importance of learning for test taking. Even though Hendry recognized the significance of learning as preparation for a future career, he felt that it was important to be able to perform well on every topic and unit to proceed to the next stage of study in higher education. Learning "to survive" was a recurring phrase by Hendry during the interview. It suggested his determination to endure difficulty to find a strategy that could help him to get through each semester.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

Elon used the examination as a yardstick to measure his mastery of content saying that he already felt "secure" about the first two topics. Lack of content mastery resulted in anxiety that he described as "chaos" and the hope that it would not be examined.

Hence, to achieve good grades in the exam, strategies by the following students were, "reading important stuff", "using past papers", "listening in the class" and "giving concentration in the class", recognizing the need for individual effort and the importance of class processes. Hendry's comments were echoed by the other students, as in the data below.

> [I use *past papers* so that] I can understand. If the question is like this… the answers will be like this. So basically, maybe in the future… maybe in the exam, or in the phase test… probably there may be this same kind of question. Not the same… but the way… indirectly. How do you understand it… how you answer the question… from our understanding. (Johari)

> I tried my best to *listen* [in the class]. Usually, I listened carefully. Because I know that if I listen to the lecture… not only in your lecture… but in all lectures... if I don't listen in the lecture, I tend not to do well in my test. (Nadal)

> I need to *concentrate* on anything you have said. Because I believe in this extra information… So that I can answer any question better. (Siti)

Hendry only read and focused on materials that he considered important for examination. It appears that this student has "targeted" certain topics based on what he had seen in previous examination papers. For instance, Hendry clearly explained this to the interviewer saying, "It doesn't come out in the past exam. So, I don't bother to read for that period". Johari also described the use of previous exam papers for revising the topics in Geotechnics. However, he used past papers to develop familiarity with the questions and to acquire a technique for answering questions.

Nadal and Siti were focused on lectures to ensure that they were able to obtain all the relevant content, in preparation for their tests or examinations. Even though both students used different expressions, they communicated a similar meaning and hence possessed a similar purpose for their focus in the class. Nadal listened carefully in the class so that he could do well in the test whereas Siti spoke of her concentration in the class. Thus, she could give better answers to questions. "Concentration" in this case might have involved intense and complete attention that required more than just listening to the lecturer.

4.1.3. Learning as practicing or repeating the process

In Tsai (2004), the conception of learning science as calculating and practicing tutorial problems was identified to categorize students' views in seeing learning as a series of doing calculations and practicing tutorial problems. Even though this conception focused on formulae and numbers, it appears that in the context of civil engineering, tutorial problem-solving was not limited to solving problems that only involved calculations. Tsai (2004) further explained that giving accurate answers were essential in this category. Hence, the students were very likely to practice solving tutorial questions. It can be said that "practicing" involved a repetitive process that allowed the student to confidently solve a problem. However, for civil engineering students, "practicing" or "repeating" was not only limited to tutorial problem-solving. It covered other aspects like answering past year's questions and reading notes repetitively. Because of these reasons, it is essential to label this conception as "learning as practicing or repeating the process" rather than limiting the conception to "learning as calculating and practicing tutorial problems".

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

In this category, data indicated that the students carried out a repetitive process of "reading", "redoing tutorial questions" and "answering past year questions". This is evident in the student interview excerpts below.

> [I had difficulty with a topic] I just understand. And *read again*. Understand, and *read again*, then *read again*. (Sally)

> I just *redo the tutorial* for the test. And for the exam, I'll give more effort… Not that I did less for the test. It's just that we already did the tutorials in the class, right? So, I just redo it again on my own time, without looking into my answers. (Siti)

> Past questions can be considered as my means of arranging the point... If we have *past year questions*…. So, if I want to know the answer, I will refer to the notes. From there… I read the whole thing… so that I can understand. Then answer the question. Repeat it… Not really like sitting down and reading the whole notes. I need questions. (Hendry)

Sally reported reading the topic repeatedly when she had difficulty understanding the topic. However, the reading of the materials was only limited to the handouts given by the lecturer. Siti and Hendry stated that they repetitively carried out problem-solving. However, Siti mentioned the use of tutorial questions whereas Hendry has made use of past questions in learning Geotechnics. Both students had the same purpose of finding the right answer to the given question. The students carried out the repetitive process involving practice to prepare themselves for examinations or tests. Hence, it can be said that learning in this category is considerably related to learning as preparing for an examination or test. However, during the interviews, the students gave two other explanations for conducting the repetitive process. One was trying to "memorize" while the other explanation was they wanted to "understand" content knowledge. Hence, the need for a separate category as it is related to the other three conceptions of learning described. The two explanations offered may be seen below.

> If I don't have any time anymore, I usually just read through the notes for one time. And for the second time… I *memorized* everything again. Then after that… I covered the whole thing and used the title. From there trying to remember the title and after that, I checked whether it is correct or not. (Sally)

> [If I don't understand something] I read and read until I *understand*. (Siti)

4.1.4. Learning as applying

In this category, the students were able to relate the two topics to real-world applications involving geotechnical engineering problems. All of the students recognized that learning the topic of compaction of soils was mainly for applying the concept of compaction to real engineering problems. The students also illustrated the importance of having foundations in civil engineering practice. In addition, the students were able to include case studies during the interviews based on what they had seen around them. This category can be divided into three subcategories based on the data obtained: (a) relating basic knowledge to real problems, (b) relating theoretical knowledge to real problems, and (c) relating in-depth theoretical knowledge to real problems.

In the first subcategory, the students were relating the basic knowledge they had learned in the class to what they had observed outside class. The students did not relate the theoretical aspects of knowledge but just recognized their significance in engineering problems through observations. For instance, Sally said,

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

> I see that… usually we use it everywhere… usually like for the roads. All those buildings and everything… so I think that it is really important. I [am] really happy also that I did learn about compaction… because everywhere we go… everywhere we stand or wherever… is also using compaction.

In the second subcategory, the students related the theoretical aspects of knowledge to real engineering problems through observations. Here, the students were not only observing and relating basic knowledge received in the class to real problems but were starting to develop reasoning in understanding the application of knowledge to real civil engineering situations. The following are examples:

> Compaction is important. That's all. Before you start [to construct a] building [or] any infrastructure… the roads… the building… compaction is important… so that we can increase the strength of the soil, to prevent settlement and future problems. For example, in Belait at the moment, they are constructing highways. They did some compaction… so that the roads will not be deformed after heavy loading. (Hendry)

> Let [us] say a building… we first prepare the foundation… what if there is no preparation for foundation or compaction… we just let the whole thing go, we simply create this building… Eventually, the building will most probably tilt and then collapse. So… it's like the foundation needs to be done before you construct a building… Even roads require foundations. (Elon)

> Foundations… It is built… I mean it is constructed to support the load... support and transfer the load to the underlying ground… So that the building that we are going to construct will not settle… it will not settle… The building will not sink… like the Tower of Pisa. That's why we need to have a stable foundation… to support the building. (Siti)

In the final subcategory, the application of knowledge moved to a deeper understanding of the real problems in engineering concerning the theoretical aspects of understanding the mechanics of soils. For instance, Johari explained that the presence of air in voids might result in soil settlement:

> [If there is still air in the soil] the settlement can occur. Like roads for example… the road can be… settled. And the road can be damaged… easily damaged. Like… wavy... I think because there is *air presence* [in the soil]. [When there is] traffic loading… possibly [due to] the weight of vehicle… Like when there was continuous traffic and loading… maybe the soil is getting compacted [at that time] … in the… within the voids… or the air voids.

4.1.5. Learning as understanding

In this category, all six students acknowledged the importance of understanding the topics of compaction of soils and foundations. However, learning as understanding was expressed differently depending on the nature of the topics. For the topic of compaction of soils, the students recognized that the right approach to learning, for instance, the introduction of the laboratory class helped them to understand the topic better. However, on the topic of foundations, the nature of content knowledge, which consists of procedural texts with diagrams and the step-by-step process of installing systems, allowed the students to easily understand the content of the topic.

It was recognized that from the students' experience in attending laboratory classes, they were able to develop their understanding through three processes: (a) "relating the practical work to the theory", (b) "learning from mistakes through observations" and (c) "thinking critically of the situation". This may be seen in the following:

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

> From what we do from the lab… [after] everything is done… and then when we look at the theory… everything is like making things more understanding… So that's why it is better if we have the *practical* and the *theory* together. (Sally)

> I like to do hands-on… like doing practicals. So, I know what I am doing… and I know… I can see what I am doing… So, I can know what is my *mistake*… what... uhm… how to… how to understand again how it works. For me, I like practicals more than just theory… I like to see it. (Johari)

> In the lab… the result and the theory are sometimes contradicted. Sometimes the result is not something that we aimed for. So that part of things like… *Why does it happen?...* that is something that we need to discuss and understand. Basically, in reality…. If it is [from] theory, everything is fixed. So, the practice can be considered a must in a way… even though we already know the theory… the practice is a must for students to do. (Elon)

Here, Sally felt that it was essential to relate the practical to the theory to enhance her understanding of the content knowledge introduced. She compared theoretical aspects that she has learned in the lecture with practical aspects that she had experienced in the laboratory class "relating the practical work to the theory".

Johari said that doing the practical, observing the lab process, and identifying mistakes allowed him to develop his understanding. However, the student only limited his development in understanding content knowledge to the laboratory environment. He did not state the relationship between laboratory classes and lectures, mentioning, "learning from mistakes through observations".

Elon's view was similar to Sally's view in terms of relating the theory with the practical. However, Elon reflected on the situation more deeply by identifying differences in the results obtained from the practical from the one described in the lecture. This contradiction gave him a way to develop his judgment by questioning his findings further so that the problem could be understood. Hence, in this case, "learning as understanding" was developed from "thinking critically of the situation".

Apart from developing students' understanding through laboratory work, the students also mentioned that the use of note-taking during lectures helped them to understand the topic better as the terms used in lectures or notes could be very advanced. For example, Elon explained:

> It is not that we jot down only in English… probably *in Malay* as well… the way to make us understand. So… dual-language for the notes writing… And then if I [still] don't understand… I'll keep the drawings... It's like… Uhm… Sometimes it was illustrated only by wording… wording tends to be very strong sometimes. So, to understand… sometimes you sketched it to make us understand… So, the drawings are needed… *We just drew what the sentences mean*.

In this example, Elon used two approaches of note-taking that could help him to understand the topic: "writing the notes in the Malay Language" and "sketching the meaning of the sentences" suggesting the use of translation and visualization.

In talking about the topic of foundations, the students saw learning as understanding the content they encountered through descriptive and procedural texts in Geotechnics. Elon said that the topic required understanding to be able to answer questions properly. He explained:

> Sometimes you don't need to memorize the thing… [For instance] For this type of soil… why do we need to use this bracing… Based on the question for example, if the soil is like

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

this… So, the diagram… is just straightforward… I just drew it… It is simple… because it plays around with lateral bracing, sheeting, and anchors. You need to understand.

Even though the students saw the need for understanding foundations, they still memorized relevant content for examination purposes. The students saw studying at the university and the professional practice of engineering as having two different purposes as is evident in Nadal's comment:

[I memorize it] to pass. But if you asked me… why I don't just understand it… I do understand it… for myself… but not the exam. Because I know that when we finish our HND… we then might go to work… So, when it comes to this kind of stuff, first I already know about it… because I have studied about it. Second… I understand why we need that and how are we going to apply that… So that's why I understand it only for myself… not for exams.

4.1.6. Learning as seeing reality in a new way

This category emerged from the data suggesting that the students had seen learning the topic on compaction as resulting in making them look at construction with a new perspective. Even though the students had seen some of the equipment and materials involved during construction, the students had not understood their purpose before studying the topic. It appears that the students' understanding of this topic was initially very limited. Below is the supporting data from student interviews:

Before I learned about compaction… I thought when you built a house… you just need to… Uhm… Okay… For road for example, when they were constructing road… all I see was that… they put tar… and they used big rollers. I didn't know the use of that machinery… I thought they were just trying to level the road. But now I realized that it was actually for compaction… I learned something new. (Siti)

I also like the temporary support system… Because… Uhm… I never… I didn't know that we used that kind of stuff in excavation. Well… we see it in front of us when people were doing some excavation, right? But we didn't know that the purpose of this temporary excavation is very important. Once we studied it… like me… I studied it… then I realized how important it is…. Now I know the support has to be there to support the excavation part. (Nadal)

For temporary support… first I never expect that… I never thought that was known as temporary support… [Don't know] why we need that the temporary support… I never expected that before. At that time, I don't think… About … clay and sand… For clay for instance… sometimes it doesn't need temporary support because sometimes there are strong… but for sand… there need it because there are weak and there can collapse very easily. Uhm… It also prevents the movement of the earth. In an urban area for example, if we want to make a structure, we need to dig it, right? But… First… They need temporary support… to prevent them from failing... that was the thing that I didn't know in the first place… During the lecture, then only I understand. (Johari)

Here, even though the students recognized learning as seeing reality in new ways, it appears that the students had addressed the conception in three different stages: (a) "forming a new perspective on reality", (b) "forming a new perspective and seeing its significance to reality" and (c) "forming a new perspective and recognizing its significance to reality concerning theoretical aspects".

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

For Siti, learning compaction of soils had simply changed her view in seeing the purpose of having a roller in road construction resulting in her "forming a new perspective on reality". Here, Siti was able to explore the same principle of compacting soils to compaction of road pavements. However, during the conversation, she did not highlight the importance of compaction in engineering.

Similarly, Nadal changed his view when he saw the purpose of having a support system. He also understood the significance of installing a support system: "forming a new perspective and recognizing its significance to reality". Hence, it shows that the student's thinking had developed further through examining reasons for having the system during construction.

In another example, Johari developed a new perspective when he saw the reality concerning the theoretical aspects of soil mechanics "forming a new perspective and recognizing its significance to reality concerning theoretical aspects". He was able to relate the differences in soil properties and construction conditions to the requirement of installing a support system. It may appear that Johari's conception of learning was very close to seeing learning as the application to an engineering problem. However, it should be noted that he had initially seen the system before attending Geotechnics class. Hence, in this case, the data shows that his initial view of Geotechnics knowledge had deepened as he developed new perspectives.

4.1.7. Learning as sharing information

"Learning as sharing information" was one of the two new categories identified during data analysis. When the students were asked about their approaches to learning compaction and their approaches to overcoming an unsolved problem, all of them instantly said that they would choose to discuss it with their friends. They would either directly ask other students in the class or form a small group discussion. The students did not only limit their discussion to their friends but involved family members as well. The following excerpts show how they learned through sharing.

> We do some group *discussions*… It is informal. But… by doing that… we have a different opinion. Since everyone has probably a different opinion… and we refer back to the theory, if one of us gives the correct opinion… then we used that as the conclusion to the discussion. It is a discussion but it is informal. (Siti)

> If I don't still understand, I will *ask* some of them. So that… I can understand how to get that. (Sally Lim)

> If that person has a problem… we will *help* that person and…discuss it. (Johari)

> If anything, we didn't know… we just *meet* and discuss. [For instance] 'What is the aim of this report?' Then… one of us will explain to us. If that person didn't know his part… then it is our turn to *advise* the person on what should be put inside the report. (Elon)

> Sometimes I *shared* with my friends... and my father. And I asked him [my father] what is [the foundation]. If this one is what foundation… Something like that… Others also have like [Other topics as well like] … the pavements… I also got [the chance] to ask questions. (Sally Lim)

This conception was created due to the frequent use of terms such as "discussion", "ask", "help", "meet", "advise" and "share", which suggested that sharing of information and knowledge was essential in the students' learning process. In this category, this process may

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

involve either sharing information with a group of students, with one student, or with a family member.

4.1.8. Learning as experiencing

All of the students mentioned that their experience in conducting laboratory compaction tests had helped them to understand the topic further indicating the significance of their experiences. The students explained that the unavailability of certain laboratory equipment had created some difficulties in terms of helping them to understand properly. The role of experience in their learning may be seen below:

> I like doing the practical on compaction... But other methods that were not available in the lab [but mentioned in the lecture] … it is quite difficult [to understand] .... because there is no hands-on… no practical… so we don't know how it works… so it was difficult for us to imagine… a bit difficult for us to *imagine*. (Hendry)

> In the lab, we can see it… we can *see* what we were doing… we can see how it was kept. How can the soil become very tough in the mold after being compacted… you have to knock it when you want to remove the soil... I like doing the practice because I can see it. That way for me… I can explain it in my way. (Johari)

The students further emphasized the importance of experiencing content knowledge during the interviews on students' conceptions of learning concerning foundations. The students felt that experiences through practical work or site visits were essential in their learning so that the topic could be understood better. The students also suggested that the topic on foundations should be improved to allow them to be exposed to real engineering projects. The following are their comments:

> [It would be better if this topic could be improved] by doing the practical and *showing* us how they do it. Just going to the site… show us mainly how they do the foundation. And after that once we have seen everything… and then we applied [it] to the theory…it will be easier. We won't have any difficulty writing the words. (Sally Lim)

> In class… we tend to feel confined. At least if we have a site visit… Uhm… We can *observe* how they do excavation and how they install everything. So…. in real life… looking at the real project is another level for us to understand. (Hendry)

This conception of learning is evident in students' use of terms like "imagine", "see", "show" or "observe" to address the idea of using visualization, to help them to understand content knowledge. In this situation, the students may develop a deeper approach to thinking through their observations and experiences of working in the lab or going to the site. For instance, Johari questioned the condition of the compacted soil when he saw it during the practical. Hendry also pointed out that the involvement of students in real projects moved them to another level of understanding. Hence, this conception can be considered as an instance of a qualitative view of deep learning.

4.2. Reasons for approaches used in learning Geotechnics

This section discusses the second research question on the students' reasons for approaches used in learning. Tsai (2004) suggests that the first three conceptions described in the previous section: "learning as memorizing", "learning as preparing for tests" and "learning as practicing or repeating the process" (p. 1744) were related to a quantitative view or surface approaches of learning. The other three conceptions: "learning as applying",

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

"learning as understanding" and "learning as seeing reality in a new way", were considered qualitatively deep approaches to learning as described by Tsai (2004). In addition, the new two conceptions, "learning as sharing information" and "learning as experiencing", were also categorized as deep approaches to learning due to the nature of the process addressed by the students during the interviews. Both conceptions of learning had developed the students' thinking and understanding. This also motivated the students to think of learning qualitatively.

Students especially in higher education are constantly encouraged to use qualitative or deep approaches to learning (Ditcher, 2001). However, it appears from the findings, that even though it was observed during the interviews that the students appreciated deep or qualitative approaches to learning, it was also noted that the students used surface approaches, for instance, memorization in learning Geotechnics. As such, it was felt that this study should probe the reasons for students' use of surface approaches to learning concerning these two topics.

The limitation of the second research question is that the concern was only with regards to reasons for students' surface approaches to learning and there was no attempt during the interviews to examine the students' reasons for looking at learning qualitatively. Hence, this section only discusses the students' reasons for looking into learning quantitatively. The four main reasons for the use of surface approaches to learning (or looking at learning quantitatively) were identified: "assessment", "amount of content material", "time restriction" and "language barrier". These reasons are described in the following subsections.

4.2.1. Assessment, content, and time considerations

Three reasons for the use of surface approaches in learning emerged from the student interviews: "assessments", "amount of content materials" and "time". These are discussed together in the same subsection because each reason appears to have a relation to the other. It was earlier described that in most cases, the students memorized an "important word", "keyword", "main point", or "methods", "diagram" and "facts" rather than the whole content as presented in the notes. However, further interviews revealed that the students were pressured to practice rote memorization for examination purposes, as may be seen in the student quotes below:

> Actually, understanding is better [than memorizing]. But the problem is [that] I don't know [how] to use my own words to say [it] properly. [laughing]. Yeah… so that's why *memorizing* also [So that's why I also memorized] … I need both... memorizing and understanding... So… both of them when I used [when I used both of them] and I applied to my sentence… It won't be broken and everything. (Sally)

> [I memorize it] to pass. But if you asked me… why I don't just understand it… I do understand it… for myself… but not the exam. Because I know that when we finish our HND… we then might go to work… So, when it comes to this kind of stuff, first I already know about it… because I have studied about it. Second… I understand why we need that and how are we going to apply that… So that's why I understand it only for myself… not for the exam. (Nadal)

Concerning the examination, the students also explained that the lack of time in preparing for examinations encouraged them to carry out surface approaches to learning. The following examples show that the student is either targeting content most likely to come out for the exam, or is memorizing the content of the topic.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

> It doesn't come out in the past exam… so I don't bother to read for that period. Maybe for the future… yes. For [the] exam… No... Because… I mean… *I need to arrange my time*. If it never comes out during the exam for the past years… hopefully, it doesn't come out again this year… Rather than spending time reading something [that] did not come out for the past few years… I rather read something that was only come out. (Hendry)

> *If I don't have any time anymore*… I usually just read through the notes for one time, and for the second time… *I memorized everything again*. Then after that, I covered the whole thing and used the title… from there trying [I tried] to remember [what is] under the title… And after that, I checked whether it is correct or not… But if I still have time, I usually… read and write down all the points. (Siti)

In addition, when the students were asked about the approach taken in preparing for the exam, one of the students explained that the number of materials that had to be covered was considerably high. Hence, this encouraged him to memorize all the facts in the content taught. In addition, the inability of the student to understand some of the content forced him to memorize as described in the following excerpt from an interview:

> The definition can be considered straightforward. Whereas for the character… factors… the graphs… For example, like factors [of compactions]. *There are quite a lot*. So… some of them need to be memorized. I can just make mistake if I just simply do it. *I will memorize the part that I don't understand*. And the rest… the one that I have understood… that should be considered okay. (Elon)

Similar to Ditcher (2001) and Tsai (2004), a key finding of this study is that the students' surface approach of learning was greatly influenced by external factors, or as described in Ditcher (2001), the context of learning. Examples of external factors are assessment, either examinations or tests, and course content. These two factors were identified during the interviews. As in the case of Ditcher's (2001) study, the engineering students were often overloaded with a heavy workload, extensive curriculum content and long contact hours. As a result, the amount of time given to the students to learn qualitatively appears to be limited. This would encourage students to use surface approaches of learning. It shows that even though the engineering students have an appreciation of the use of deep approaches of learning Geotechnics, these approaches were neglected as a result of factors in the learning context.

4.2.2. Language barrier

Another reason for using surface approaches like memorizing was that the students were less confident in writing in English. For instance, Sally explained,

> Actually, understanding is better [than memorizing]. But the problem is [that] I don't know [how] to use my own words to say [it] properly. [laughing]. Yeah… so that's why memorizing also [So that's why I also memorized] … I need both... memorizing and understanding... So… both of them when I used [when I used both of them] and *I applied to my sentence… It won't be broken and everything*.

Another example that was observed from the interview was that even though one of the students knew the technical terms used in Geotechnics, the student appeared to have difficulties in constructing sentences. Initially, the interviewer thought that the difficulty for the student to remember the "keywords" was similar to other students who found it difficult to remember the new technical terms that were introduced in Geotechnics. However, further

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

questions revealed that this student appeared to have difficulty in constructing grammatical written sentences. The following is the conversation between the interviewer and the student regarding this matter:

> Interviewer: I still don't understand this keyword. What do you mean?
>
> Johari: Uhm… In one long sentence… Trying to find out to make just a few… It is very hard for me to explain this [laughing].
>
> Interviewer: Try to give an example from here [pointing at the notes] Because you mentioned 'keywords' during the exam preparation and now you mentioned again about these keywords.
>
> Johari: Okay. ... Example like this… Normally it was chosen when… the surface soil. I only remember the words like strong and stiff… Excessive settlement… But I forgot the first thing in the line [surface soil]. Once I forget the first word, I forget the rest of it.

4.3. Students' perceptions of the role of the learning environment

This section discusses the third research question on the students' perceptions of the role of the learning environment in studying Geotechnics. In typical civil engineering classes, teaching and learning consist of classroom lectures, tutorial classes, and laboratory classes. This section first addresses the students' perceptions of classroom lectures, followed by their perceptions of tutorial classes, and finally, laboratory sessions. It should be noted that a finding of the study is that the students preferred laboratory classes over classroom lectures and tutorial classes.

4.3.1. Classroom lectures

The classroom lecture was a traditional lecture presentation. There were only 20 students in the group, which made it convenient for the students to ask questions to the lecturer during class. However, during the study, it was found that the students showed less interest in lectures when compared to other classes. Nadal said that he listened because he knew that it was important for assessment purposes,

> Usually… I don't like lectures… To be honest… I tried my best to listen. Usually, I listened carefully… because I know that, if I listen to the lecture… not only in your lecture… but in all lectures… If I don't listen to the lecture… I tend not to do well on my test.

Other students, such as Sally reported that she also listened during lectures. However, she felt that lectures alone were not enough to develop a mastery of content knowledge. She explained that she gained a better understanding after attending the practical class:

> Uhm… Usually, listen to what you have said… Sometimes highlight those important parts… And then after that… Usually always like that… always check… I mean as in like… If we have any doubts, we can also ask questions… if there is anything. But sometimes I do get carried away… sometimes... During the lecture, the first time we had this lecture… I had a difficulty in understanding… But then after that when we had the practical and I looked back… it is more understanding.

Another student revealed that he had problems giving full concentration in the class, which made it difficult for him to understand. However, he had a different opinion of his experience attending practical classes:

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

> I am not 'there' during the class [laughing]… Every time is like that. Every lecture… To be honest… I am very weak during lectures. But in doing practical… I am not saying that I am very good [at it] … but I like to do practical better. (Johari)

There was no clear evidence in the study, which suggests that the role of classroom lectures was less significant in teaching and learning. However, the students preferred laboratory classes to lectures as they helped to enhance their understanding of learning Geotechnics.

4.3.2. Tutorial classes

From the study, all students explained that tutorial classes allowed them to communicate among themselves. For instance, the following students reported their experiences with tutorials:

> The tutorial helps a lot… So… by doing the tutorial… I can understand it straight away… Sometimes if I am not sure about my answer, then I… First, I *asked* my friend… But then if they don't know the answer… then I go to the lecturer. (Siti)

> In the tutorial…there were questions, right? Like I said… So, from that questions, I can talk to my friends about it. I *asked* the three people that sit close to me… if you asked me how I understand compaction from the tutorial, I asked people around me for answers. (Hendry)

> We were doing the thing together… so if we didn't understand, we *asked* our friends...tutorial was the time to chill. If I didn't know… I asked my friends directly… and the lecturer. (Elon)

Even though the students developed their understanding of the course content through discussion, as described by Hendry, it appears that the main role of tutorial classes was restricted only to trying to find accurate answers to given problems. Even though tutorial classes offered the opportunity for the student to discuss and develop critical thinking, the findings show that all three students were only interested in obtaining the answers from their friends. Hence, it appears that the role of tutorial classes, in this case, has a close connection with the conception of learning as practicing or repeating the process, which directed the students to use surface approaches to learning.

4.3.3. Laboratory classes

It was very obvious during the interviews that all of the students emphasized the laboratory classes as helping them to enhance their understanding of both topics. Laboratory sessions encouraged the students to use deep approaches to learning. The students tended to closely relate most of their explanations during the interviews to their experiences in the laboratory class. In addition, the lack of hands-on experience in the topic of foundations appears to have been a drawback from the students' perspective, as evidenced in the following comments:

> I think mainly because there is a practice in this topic [compaction of soils]. So that helps me to understand more. If we compare to [a topic on] shear strength and also other topics that do not have practical… makes it a bit difficult to understand… This one, even the practice is fun. (Hendry)

> What makes me very interested is practical. As I can see… for example in the lab we can see it… we can *see* what we were doing… we can see how it was kept. How can the soil

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

become very tough in the mold after being compacted… you have to knock it when you want to remove the soil...? I like doing the practice because I can see it. That way for me… I can explain it in my way. (Johari)

Based on classes… I favor the practical… because the practice is fun... In other classes, like theory, there were graphs. That gave me a bit of a headache. (Elon)

I like doing the practicals… Because in the practical… I tend to understand more. Since what I see is what I get. If [we] just doing the lecture… I don't think I would understand what you [were] trying to do. We need more practical… Because… I am not saying this for myself… Because most of us… this is what I feel... most of us were from Form Six. We haven't… We never… Uhm… Not never… We haven't touched this kind of stuff since we were in Form Six. (Nadal)

In class… we tend to feel confined. At least if we have a site visit… Uhm… We can *observe* how they do excavation and how they install everything. (Hendry)

4.4. Discussion

The approach used in questioning the students during the interviews was different from Tsai (2004). Here, the students were not asked about their conceptions of learning Geotechnics directly. The students' conceptions of learning emerged as they related their experiences attending classes in Geotechnics. In most cases, these students were encouraged to explain their responses during the interviews; as a result, the students gave more than one conception of learning the two topics in Geotechnics. In addition, the reasons behind the students' surface approach to learning and students' perceptions of the role of the current learning environment were also probed.

Lin and Tsai (2009) described the students' approaches toward learning, explaining that conceptions of learning may change depending on the class environment. For instance, a laboratory class or lecture class may shape the students' perceptions of learning as qualitative or quantitative. Similarly, in this study, the data indicated that each student had more than one conception of learning the two topics in Geotechnics. This is because the nature of the topics in the Geotechnics module which involved classroom lectures, laboratory classes, and tutorial classes allowed the students to experience different learning environments influencing them to observe learning differently.

It may be concluded from this study that students' conceptions of learning can be grouped into eight categories, which are "learning as memorizing", "learning as preparing for tests", "learning as practicing or repeating the process", and "learning as applying", "learning as understanding", "learning as seeing reality in a new way", "learning as sharing information" and "learning as experiencing".

The first three conceptions of learning, "memorizing", "preparing for tests" and "practicing and repeating the process", were related to quantitative views or surface approaches to learning (Tsai, 2004). In previous studies, Tsai (2004) have identified that seeing "learning as increasing in knowledge" was also one of the conceptions of learning that also relates to surface approaches to learning. However, there was no clear evidence in this study showing that the students have only seen learning as "increasing in knowledge". The conception of learning as "memorizing" strongly implies the need to memorize the technical terms used in Geotechnics. It appears that the students had difficulties remembering the unfamiliar technical terms used in the module. However, the students were sometimes practicing the rote memorization technique because of external factors like examinations. Furthermore, time restrictions discouraged the students from attempting to understand the content of the

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

topic properly. It was recognized that external factors like the examination were considered one of the learning contexts described in Ditcher (2001). In agreement with Tsai (2004), the students have also seen learning as a motivation to produce good grades at the university that is intrinsic in the conception of learning as "preparing for tests". The students saw examinations as the most important factor in every stage of university education. From the interviews, some of the students clearly described that learning at the university and learning after leaving the university as having two different meanings. Even though the students appreciated the importance of understanding the topics and their application to real engineering problems, the students felt that having good grades was very important for their future careers. Hence, the students tried many approaches, including memorizing and repetitively doing the questions from past year's examination papers or tutorials to achieve the objective of having good grades.

One of the conceptions of learning that was almost similar to "calculating" which has been identified by Tsai (2004) was seeing learning as "practicing and repeating the process". Tsai (2004) described this concept as repetitively doing the calculation from tutorial problems. However, in this study, this concept was called "practicing or repeating the process" as the students did not only emphasize specifically calculating mathematical problems from tutorials. Data showed that the students practiced tutorial and past year questions many times to get familiar with the questions. At the same time, the students read content knowledge materials repetitively to understand the concepts in Geotechnics. In agreement with Tsai (2004), this conception cannot be placed under the conception of "memorizing" because this study, shows that the students do this process to either "memorize" or to "understand" the content in Geotechnics.

Three other familiar conceptions of learning were identified through this study, i.e. "applying", "understanding" and "seeing reality in a new way". Tsai (2004) described these conceptions as related to deep approaches or qualitative views of learning. These conceptions have revealed the need to understand and develop knowledge to clarify and relate it to different experiences (Tsai, 2004). It was very clear during the interviews that the students perceived their learning as applications to real engineering problems. All of the students were able to relate the concepts in these two topics to real case studies, either from what they had seen, experienced, or read from other resources besides the notes given by the lecturer. In addition, the students also highlighted the importance of understanding the topic to apply it to real engineering problems. Even though some of the students had seen the systems or equipment used in construction before attending Geotechnics classes, these students changed their understanding of what they had seen around them to develop another different or deeper perspective after attending the classes. The students were able to relate the theoretical aspects of engineering to the field after covering the topics of compaction of soils and foundations. In this case, it can be said these students have experienced learning as "seeing reality in a new way".

A significant finding from this study was that the students have shown an appreciation of learning qualitatively involving deep approaches. This should be strongly encouraged amongst students, especially in higher education where learning needs to be seen as understanding concepts so that they can be applied to engineering practice. However, interestingly enough during the interviews, the students shifted their conceptions of learning from higher-order conceptions to lower-order conceptions when matters relating to learning context such as assessment were introduced. This finding was very similar to what has been discussed by Ditcher (2001), where the students were likely to use the surface approach to learning, due to the demands of assessment methods.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

Two new conceptions of learning were identified in this study: "learning as sharing information" and "learning as experiencing". It was observed that the students were very comfortable working collaboratively together with their coursemates in the class. The students highlighted that discussion and communication with friends had helped the students to deepen their understanding of certain concepts in the module. The students also described their experiences of working in the laboratory class that had contributed to their understanding of the topic of compaction. The students were able to identify the real problem, which was not identified during the lectures. Hence, sharing information developed students' thinking skills and encouraged a deeper development in thinking and learning. If these two conceptions of learning are to be used properly, they may lead to effective qualitative approaches to learning, for instance, the use of problem-based learning in the civil engineering laboratory as suggested by Boxall and Tait (2008). This may encourage the students to use deeper approaches to learning as discussed in Ditcher (2001).

The students' conception of "learning as experiencing" was also addressed in the students' preference concerning learning environments. Data show that the students preferred laboratory classes to classroom lectures. This study has somehow contradicted Lin and Tsai's (2009) findings that students in Taiwan preferred classroom lectures to laboratory classes. It is, however, in agreement with Shiavi and Brodersen (2005). The students also explained that they were able to understand the topic better through their experiences of working in the laboratory class. Hence, given that the conception of learning as "understanding" was previously categorized under the qualitative approach to learning, it is suggested that the students with laboratory preferences are more likely to use a deeper approach to learning. The findings of this study thus support the findings by Lin and Tsai (2009).

Even though these students have shown some appreciation of the use of qualitative or deeper approaches to learning, it still appears that external factors like assessment have motivated the students to use quantitative or surface approaches to learning. Hence, to encourage the students to use qualitative approaches to learning, it would be very appropriate to look into the assessment process that is currently used in civil engineering programs. In addition, it was also found that the limitation of time during the semester had encouraged the students to use surface approaches to learning. This was because of the large amount of material that had to be covered for this module. In addition, civil engineering students have always been overloaded with the overall content of the engineering syllabus. Hence, it would be difficult for some students to manage their time properly. In agreement with Ditcher (2001), this study clearly shows that these two learning contexts, i.e. assessment and course content, have greatly influenced the students' conceptions of learning.

One of the concerns that has been recognized during the study was that the students did not appear to have much confidence in writing in English. Even though English has been used from primary to tertiary level as a language of instruction in Brunei Darussalam, it still appears that from this study, some of the students were concerned about communicating in writing effectively. As a result, the students felt that it was essential for them to memorize the content of the topics so that they would be able to answer the questions using the appropriate language in the examination. Again, it shows that this problem has a strong relationship with the context of learning itself.

5. CONCLUSION

In this study, what constantly emerged during the interviews was the students had shown some readiness to adopt qualitative approaches to learning. These approaches are considered useful as 21st-century skills for learning. However, some of the current learning

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

contexts, as discussed earlier, have hindered the students from moving forward. The limitation of this work was that the study only focused on two topics in the Geotechnics module. There are other topics in this module that include mathematical aspects of Geotechnics, for instance, extensive calculations and derivations of soil phase relationships. In this case, the students' conceptions of learning might have been different as a result of the content of the topics. In addition, to fully grasp the whole idea of students' conceptions of learning in civil engineering courses, future work to look into students' conceptions of learning in other modules in the civil engineering program, for instance, in the subjects of Structures or Hydraulics is necessary. Hence, the variations and the similarities of students' conceptions of learning in different modules need to be further examined. Furthermore, the study only managed to identify the students' reasons for using surface approaches in learning Geotechnics. The student's reasons for using deeper approaches to learning were not identified. Hence, it would be beneficial to look into this reasoning further so that it can be used to improve teaching and learning in civil engineering programs in higher education.

6. ACKNOWLEDGMENT

The authors are grateful to the participants of this study and the institution where the data was collected.

7. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

8. REFERENCES

Atkinson, J. (2002). What is the matter with geotechnical engineering. *Proceedings of the Institution of Civil Engineers, Geotechnical Engineering*, *155*(3), 155-158.

Boulton-Lewis, G. M., Marton, F., Lewis, D. C., and Wilss, L. A. (2004). A longitudinal study of learning for a group of indigenous Australian university students: Dissonant conceptions and strategies. *Higher Education,* 47, 91-112.

Boxall, J., and Tait, S. (2008). Inquiry-based learning in civil engineering laboratory classes. *Proceedings of the Institution of Civil Engineers, Civil Engineering*, *161*(4), 138-143.

Chin, C., and Brown, D.E. (2000). Learning in science: A comparison of deep and surface approaches. *Journal of Research in Science Teaching, 37*, 109-138.

Ditcher, A. K. (2001). Effective teaching and learning in higher education, with particular reference to the undergraduate education of professional engineers. *International Journal of Engineering Education*, *17*(1), 24-29.

Eklund-Myrskog, G. (1998). Students' conceptions of learning in different educational contexts. *Higher Education, 35*, 299-316.

Hofer, B. K., and Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research, 67* (1), 88-140.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815

Lederman, N. G., Abd-El-Khalick, F., Bell, R. L., and Schwartz, R. (2002). Views of nature of science questionnaires: Toward valid and meaningful assessment of learners' conceptions of nature of science. *Journal of Research in Science Teaching*, *39*(6), 497-521.

Lee, M. H., Johanson, R. E., and Tsai, C.C. (2008). Exploring Taiwanese high school students' conceptions and approaches to learning science through a structural equation modelling analysis. *Science Education*, *92*(2), 191-220.

Lin, C. C., and Tsai, C. C. (2009). The relationship between students' conceptions of learning engineering and their preferences for classroom and laboratory learning environments. *Journal of Engineering Education*, *98*, 193-204.

Marshall, D., Summer, M., and Woolnough, B. (1999). Students' conceptions of learning in an engineering context. *Higher Education, 38*, 291-309.

Marton, F., Dall'Alba, G., and Beaty, E. (1993). Conceptions of learning. *International Journal of Educational Research, 19*, 277–299.

Montfort, D., Brown, S., and Pollock, D. (2009). An investigation of students' conceptual understanding in related sophomore to graduate-level engineering and mechanics Courses. *Journal of Engineering Education*, *98*(2), 111-129.

Shiavi, R., and Brodersen, A. (2005) Study of instructional modes for introductory computing. *Journal of Engineering Education, 94*(4), 355-362.

Suprapto, N., Chang, T., and Ku, C. (2017). Conception of learning physics and self-efficacy among Indonesian university students. *Journal of Baltic Science Education, 16*(1), 7-19.

Trigwell, K., and Ashwin, P. W. H. (2006). *An exploratory study of situated conceptions of learning and learning environments. Higher Education*, *51*(2), 243-258.

Tsai, C. C. (2004) Conceptions of learning science among high school students in Taiwan: A phenomenographic analysis. *International Journal of Science Education, 26*(14), 1733-1750.

DOI: http://dx.doi.org/10.17509/xxxx.xxxx
p- ISSN 2775-6793 e- ISSN 2775-6815