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# University students' self-efficacy, attitudes, and intentions toward chemistry: Myanmar context

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**ABSTRACT**
This research examined the self-efficacy beliefs, attitudes towards Chemistry, and intentions to take future Chemistry courses in a sample of 112 students from selected universities in Myanmar. The main purpose of the study was to determine the university students' self-efficacy, attitudes, and intentions toward Chemistry in Myanmar context. Findings indicate that self-efficacy (Mean=2.05) and attitude are both significant, making a larger unique contribution. According to the findings, Self-efficacy of undergraduate students was slightly significant indicating confidence of the participants. Our findings suggest that in general, although the population at Myanmar universities slightly feel confident in their ability to perform in Chemistry, have strong attitude towards Chemistry, and moderate intentions toward enrolling in future Chemistry courses. In the current context, the students believe that they are capable of successfully performing tasks affiliated with Chemistry content. Students with a high self-efficacy toward Chemistry will be more likely to take on the challenge of Chemistry and persist through the courses. Finally, implications for educators and administrators are discussed.



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## 1. INTRODUCTION

At the university level, a Chemistry course often consists of students who are completing the course as an elective course for some further study of science, technology, or engineering. They have previous experiences in science or math, they are roughly similar in their Chemistry background, they are beginning their university and they are early enough in their academic pursuits where they can change majors easily with little consequence. Therefore, the purpose of this research is to examine how university students' perceived skills (self-efficacy) in Chemistry and liking of Chemistry (attitudes) affects their willingness to enroll in future Chemistry courses (intentions).

Ebbing & Gammon (2010) define Chemistry as "the science of the composition and structure of materials and of the changes that materials undergo" (p. 2). Chemistry is a complex science that helps not only explain the world around us, but also helps to explain processes in many other fields such as biology, physics, environmental science, and medical sciences. There are many different types of Chemistry; Inorganic Chemistry, Organic Chemistry, Biochemistry, Physical Chemistry, Analytical Chemistry, Chemical Engineering, etc. The Chemistry course is a complex and challenging course that is essential for training professionals; therefore, the present study will address the following research objectives:

1. To explore students' self-efficacy beliefs toward Chemistry by using Self-Efficacy for Chemistry (SEC) scale
2. To investigate students' attitude toward Chemistry by using Attitude Toward Chemistry Lessons Scale (ATCLS)
3. To find out intentions toward Chemistry through Student's Chemistry Intentions (SCI) Scale.

Self-efficacy refers to a person's belief about his or her capabilities on a specific task (Bandura, 1997). Research has shown that students with a higher self-efficacy typically choose more challenging tasks and persist longer on challenging tasks than students with lower self-efficacy (Bandura, 1997; Bandura & Schunk, 1981). Likewise, students with a high self-efficacy will show more effort when pursuing a challenging task and will generally perform higher on that given task than students with low self-efficacy (Bandura, 1997). Laboratory experiences at university level tend to vary in terms of quantity and quality and we wanted an operational definition that would be applicable to both levels of study regardless of the varying laboratory experiences. Therefore, self-efficacy is an important motivational variable that has been shown to influence cognitive and behavioral choices. Another way self-efficacy can increase is if a person performs above his/her peers on a task.

To test the self-efficacy of Chemistry, the scale must inquire about student's beliefs to perform specific tasks encountered in Chemistry curriculum only. Therefore, the Self-Efficacy for Chemistry (SEC) scale was developed and tested in a pilot study with students at the undergraduate level based on the recommendations of Bandura (2006). The SEC scale consists of 14 items that specifically focus on concepts taught in a Chemistry course and does not include items that assess beliefs about laboratory skills. The SEC scale was shown to have good internal consistency. Chemistry is challenging and takes persistence at the secondary level, and even more so at the university level. Ajzen (1991) defines intentions as indications of people's willingness to try and/or amount of effort they will exert to perform the behavior. Therefore, Chemistry self-efficacy would be a predictor of intentions toward Chemistry.

It is agreed that one of the purposes of introductory science courses, whether at the secondary or university level, should be to ignite positive student attitudes toward that specific science subject (Cheung, 2009a). The stronger the person's attitude, the greater their perceived control, the stronger the intention, and the more likely the person is to carry out the behavior (Ajzen, 1991). In science, a person's thoughts, feelings, and behaviors towards the discipline are important to consider because attitudes have been shown to influence academic performance (Bennett, Rollnick, Green, & White, 2001), self-efficacy (Bandura, 2006; Dalgety et al., 2003), as well as intentions (Ajzen, 1991; Cheung, 2009a; Kurbanoğlu & Akin, 2010). Many researchers agree that research on attitudes must be broken down into subjects such as Chemistry, physics, and biology instead of a general science attitude measure (Cheung, 2009a). The Attitude Toward Chemistry Lessons Scale (ATCLS; Cheung, 2009b) was developed to measure a person's attitude (i.e., predisposition to respond to something in a favorable or unfavorable manner) toward Chemistry lessons (i.e., theory plus laboratory). The ATCLS is a 12-item scale where the total score represents overall attitude toward Chemistry with four subscales (3 items each) representing the following dimensions: 1) liking of Chemistry lessons, 2) liking of Chemistry laboratory work, 3) evaluative beliefs for school Chemistry (i.e., usefulness of Chemistry), and 4) behavioral tendencies to learn Chemistry (Cheung, 2009b).

Students with low self-efficacy and unfavorable attitudes towards Chemistry can negatively affect the efforts of institutions to recruit, retain, and graduate majors. Therefore, educators at university level should seek to improve students' self-efficacy and attitudes toward Chemistry. Sadly, less than 40 percent of students intending to major in a discipline upon entering university complete a degree. However, jobs requiring degrees are projected to increase four times as fast as the overall job growth (Business-Higher Education Forum, 2010). Therefore, for institutions to recruit and retain majors by increasing students' self-efficacy and attitudes toward Chemistry. Since experiences occur at both the undergraduate and postgraduate level, educators must find ways to increase self-efficacy and attitudes at both levels.

## 2. RESEARCH OBJECTIVE

The objectives of this research are as follows**;**

(1) To explore students' self-efficacy beliefs toward Chemistry by using Self-Efficacy for Chemistry (SEC) scale.

(2) To investigate students' attitude toward Chemistry by using Attitude Toward Chemistry Lessons Scale (ATCLS).

(3) To find out intentions toward Chemistry through Student's Chemistry Intentions (SCI) Scale.

## 3. METHOD

### 3.1 Sample

The sample of 19 (male) and 90 (female) students from selected universities in Myanmar.

### 3.2 Instruments

Self-efficacy for Chemistry was measured with the Self-Efficacy for Chemistry (SEC) scale created specifically for this study and piloted in a separate study. The SEC scale contains 14 items which together measure students' perceived abilities to be successful in performing specific Chemistry content related tasks. Participants are asked to rate their level of confidence in their capabilities to complete the tasks using a 3-point Likert scale with anchors at 1 (Not at all confident) and 3 (Very confident). The total mean score from the SEC scale represents an overall self-efficacy towards Chemistry. Attitude towards Chemistry was measured using the

12-item Attitude Toward Chemistry Lessons Scale (ATCLS; Cheung, 2009b) where participants were asked to rate their level of agreement for each item using a 3-point Likert scale with anchors at 1 (Disagree) and 3 (Agree). The total mean score from the ATCLS represents an overall attitude towards Chemistry. Intentions to take future Chemistry courses were examined using the newly created Students' Chemistry Intentions (SCI) scale. The SCI scale contains 6 items which asks students to pinpoint when/if they plan to take a Chemistry course in the future. Three of the items are positively worded (e.g., "I intend to enroll in a postgraduate Chemistry course in the future") and three items are negatively worded (e.g., "I do not intend to enroll a Chemistry course unless I have to"). Participants are asked to rate how true each statement is to them using a 3-point Likert scale with anchors at 1 (Definitely not true for me) and 3 (Completely true for me). Basic demographics of the participants such as gender and major were collected. To answer research questions, calculation was conducted using the SPSS 20.0 program.

**3.3 Data collection**

The present research was carried out using 109 students enrolled at Chemistry departments in selected universities. Participants were (19) male and (90) female. For the present study, self-efficacy for Chemistry, attitude towards Chemistry, and intentions toward Chemistry were explored. To explore Self-efficacy for Chemistry, participants were asked to rate their level of confidence in their capabilities to complete the tasks on a 3-point Likert scale with anchors at 1 (Not at all confident) and 3 (Very confident). The Attitude Toward Chemistry Lessons Scale (ATCLS; Cheung, 2009b) was used as the parameter of attitude in this study showcasing good internal consistency in the studies. This scale comprises 12 items which collectively measures students' intentions to take future Chemistry courses and again is evaluated using a 3-point Likert scale with anchors at 1 (Disagree) and 3 (Agree). A scale to measure students' intentions to take future Chemistry courses was also necessary, therefore the Student Chemistry Intentions (SCI) scale was applied. This scale contains 6 items which collectively measures students' intentions to take future Chemistry courses and again is evaluated using a 3-point Likert scale with anchors at 1 (Not at all true for me) and 3 (Completely true for me).

**3.4 Data analysis**

The SEC scale contains 14 items which together measure students' perceived abilities to be successful in performing specific Chemistry content related tasks. The total mean score from the ATCLS represents an overall attitude towards Chemistry. The SCI scale contains 6 items which asks students to pinpoint when/if they plan to take a Chemistry course in the future. Basic demographics of the participants such as gender and major were collected. To answer research questions, calculation was conducted using the SPSS 20.0 program.

## 4. RESULT AND DISCUSSION

### 4.1 Self-Efficacy for Chemistry (SEC) Scale

Table 1: Students' responses toward self-efficacy for Chemistry (SEC) scale (n=112)

| SN | Items | Responses | | | Calculation | | Interpretation |
|---|---|---|---|---|---|---|---|
| | | Not at all Confident | Confident | Very Confident | Mean | SD | |
| 1 | How confident are you in your ability to learn theories of the coordinate bond in metal complexes? | 15.00% | 59.00% | 26.00% | 2.11 | 0.63 | Confident |
| 2 | How confident are you in your ability to study basic concepts of molecular spectroscopy? | 17.00% | 62.00% | 21.00% | 2.04 | 0.62 | Confident |
| 3 | How confident are you in your ability to learn theoretical concepts of organic chemistry? | 6.00% | 71.00% | 23.00% | 2.17 | 0.51 | Confident |
| 4 | How confident are you in your ability to write a balanced chemical equation for a given reaction? | 19.00% | 59.00% | 22.00% | 2.03 | 0.64 | Confident |
| 5 | How confident are you in your ability to apply a precipitation titration? | 19.00% | 66.00% | 15.00% | 1.96 | 0.58 | Confident |
| 6 | How confident are you in your ability to prevent air pollution and water pollution? | 5.00% | 72.00% | 23.00% | 2.18 | 0.50 | Confident |
| 7 | How confident are you in your | 18.00% | 63.00% | 19.00% | 2.01 | 0.61 | Confident |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ability to classify electronic absorption spectra of complexes? | | | | | | |
| 8 | How confident are you in your ability to calculate statistical thermodynamics? | 21.00% | 58.00% | 21,00% | 2.00 | 0.65 | Confident |
| 9 | How confident are you in your ability to learn electrophilic aromatic sub situation? | 25.00% | 61.00% | 14.00% | 1.89 | 0.61 | Confident |
| 10 | How confident are you in your ability to categorize a fundamental of electrode processes? | 22.00% | 64.00% | 14.00% | 1.92 | 0.59 | Confident |
| 11 | How confident are you in your ability to study Inorganic Chemistry? | 9.00% | 70.00% | 21.00% | 2.12 | 0.53 | Confident |
| 12 | How confident are you in your ability to apply the Physical Chemistry? | 15.00% | 63.00% | 22.00% | 2.07 | 0.60 | Confident |
| 13 | How confident are you in your ability to learn Organic Chemistry? | 12.00% | 68.00% | 20.00% | 2.08 | 0.56 | Confident |
| 14 | How confident are you in your ability to explain Analytical Chemistry? | 16.00% | 59.00% | 25.00% | 2.09 | 0.63 | Confident |
| Average | | 15.64% | 63.93% | 20.43% | 2.05 | 0.60 | Confident |

Note:
1.00-1.66=Not at all Confident
1.67-2.33=Confident
2.34-3.00=Very Confident

According to the data, self-efficacy of undergraduate students was slightly confident (Mean=2.05) indicating confidence of the participants. In the current context, students believe that they are capable of successfully performing tasks affiliated with chemistry content.

**4.2 Attitude Toward Chemistry Lessons Scale (ATCLS)**

The Attitude Toward Chemistry Lessons Scale (ATCLS; Cheung, 2009b) was used as the parameter of this study showcasing good internal consistency in the studies.

Table 2 Students' responses toward Chemistry Lessons Scale (ATCLS) (Cheung, 2009b) (n=112)

| SN | Items | Responses | | | Calculation | | Interpretation |
|---|---|---|---|---|---|---|---|
| | | Disagree | Neutral | Agree | Mean | SD | |
| 1 | I like Chemistry more than any other school subjects. | 25.00% | 7.00% | 68.00% | 2.43 | 0.86 | Positive |
| 2 | Chemistry lessons are interesting. | 25.00% | 5.00% | 70.00% | 2.45 | 0.86 | Positive |
| 3 | Chemistry is useful for solving everyday problems. | 15.00% | 4.00% | 81.00% | 2.66 | 0.72 | Positive |
| 4 | Chemistry is one of my favorite subjects. | 27.00% | 7.00% | 66.00% | 2.39 | 0.88 | Positive |
| 5 | I am willing to spend more time on reading Chemistry books. | 21.00% | 7.00% | 72.00% | 2.51 | 0.82 | Positive |
| 6 | I like to do Chemistry experiments. | 28.00% | 9.00% | 63.00% | 2.35 | 0.89 | Positive |
| 7 | When I am working in the Chemistry lab, I feel I am doing something important. | 21.00% | 6.00% | 73.00% | 2.52 | 0.82 | Positive |
| 8 | People must understand Chemistry because it affects their lives. | 21.00% | 10.00% | 69.00% | 2.48 | 0.82 | Positive |
| 9 | I like trying to solve new problems in Chemistry. | 30.00% | 5.00% | 65.00% | 2.35 | 0.91 | Positive |
| 10 | Doing Chemistry experiments is fun. | 23.00% | 10.00% | 67.00% | 2.44 | 0.84 | Positive |
| 11 | Chemistry is one of the most important subjects for people to study. | 20.00% | 5.00% | 75.00% | 2.55 | 0.80 | Positive |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | If I had a chance, I would do a project in Chemistry. | 19.00% | 10.00% | 71.00% | 2.52 | 0.79 | Positive |
| Average | | 22.90% | 7.10% | 70.00% | 2.47 | 0.84 | Positive |

Note:
1.00-1.66=Negative
1.67-2.33=Not Decided
2.34-3.00=Positive

Average mean value of attitude was very strong (Mean=2.47) indicating that students' attitudes are uniquely positive.

### 4.3 Students' Chemistry Intentions (SCI) Scale

Table 3 Responses of participants toward Students' Chemistry Intentions (SCI) Scale (n=112)

| SN | Items | Responses | | | Calculation | | Interpretation |
|---|---|---|---|---|---|---|---|
| | | Definitely not true for me | Neutral | Completely true for me | Mean | SD | |
| 1 | I intend to attend a workshop on Chemistry learning in the future. | 21.00% | 4.00% | 75.00% | 2.54 | 0.82 | Having sole intention |
| 2 | I do not intend to enroll in a master's degree program of Chemistry specialization in the future. | 70.00% | 6.00% | 24.00% | 1.54 | 0.85 | Having no intention |
| 3 | I intend to enroll in a research project on Chemistry teaching and learning before the end of my university years. | 18.00% | 5.00% | 77.00% | 2.59 | 0.78 | Having sole intention |
| 4 | I intend to NEVER enroll in a Chemistry course in the future. | 81.00% | 5.00% | 14.00% | 1.33 | 0.71 | Having no intention |
| 5 | I do not intend to enroll a Ph.D. program in Chemistry if I have to. | 74.00% | 7.00% | 19.00% | 1.45 | 0.79 | Having no intention |
| 6 | I intend to attend a research conference on Chemistry teaching within the next year. | 24.00% | 7.00% | 69.00% | 2.45 | 0.85 | Having sole intention |
| Average | | 48.00% | 5.70% | 46.30% | 1.98 | 0.97 | Having a moderate intention |

Note:
1.00-1.66=Having no intention
1.67-2.33=Having a moderate intention
2.34-3.00=Having sole intention

With a sample of 112, we have met students' intentions toward Chemistry. Mean is too high in items, 3 (Mean=2.59), 1 (Mean=2.54) and 6 (Mean=2.45). These items in Table 3 display the descriptive statistics (i.e., means and standard deviations) for the intentions for future Chemistry classes.

Table 4 Descriptive statistics for three variables

| SN | Items | Responses | | | Calculation | | Interpretation |
|---|---|---|---|---|---|---|---|
| | | Disagree | Neutral | Agree | Mean | SD | |
| 1 | Students' self-efficacy for Chemistry (SEC) scale | 15.64% | 63.93% | 20.43% | 2.05 | 0.60 | Somewhat positive impact |
| 2 | Students' attitude toward Chemistry lessons scale (ATCLS) | 22.90% | 7.10% | 70.00% | 2.47 | 0.84 | Positive impact |
| 3 | Students' Chemistry Intentions (SCI) Scale | 48.00% | 5.70% | 46.30% | 1.98 | 0.97 | Somewhat positive impact |
| Average | | 28.9% | 25.6% | 45.6% | 2.17 | 0.85 | Somewhat positive impact |

Note:
1.00-1.66=Negative impact upon the Chemistry learning environment
1.67-2.33=Somewhat positive impact upon the Chemistry learning environment
2.34-3.00=Positive impact upon the Chemistry learning environment

In this research, although both attitude (Mean=2.47) and self-efficacy (Mean=2.05) make significant contributions, attitude was found to make the largest contribution. Both attitude and self-efficacy also indicate a contribution to the intentions. Thus, the ability of self-efficacy for Chemistry and attitude for Chemistry might support intentions toward Chemistry. Students who approach a Chemistry lesson with fear have likely slight confidence in their science skills. Chemistry teachers can help their students encourage positive Chemistry attitudes in order to increase retention.

In this study, we sought to examine the effect of self-efficacy and attitudes towards general Chemistry on university students' intentions to take future Chemistry courses. Our findings suggest that in general, although the population at university slightly feel confident in their ability to perform in Chemistry (Mean=2.06, SD=0.60), strong attitude towards Chemistry (Mean=2.47, SD=0.84), and moderate intentions toward enrolling in future Chemistry courses (M=1.98, SD=0.97). In the present study, self-efficacy, and attitude were found to support the intentions. Of the two, attitude made the largest significant contribution. Together these results suggest that self-efficacy and attitude are important motivational variables that should be considered when trying to determine students' intentions to engage and persist in Chemistry related fields.

Chemistry self-efficacy and attitude, gives students meaningful tasks connected to the content at which they can succeed is very important. Meaningful tasks refer to learning tasks that are designed to be relevant for the students and provide opportunities for students to connect new content with information they already know (i.e., stored in long-term memory). Learning through meaningful tasks has been shown to be more effective than learning information in isolated pieces (Lin, 2007; Mayer, 2002; Nuangchalerm & Prachagool, 2010). When students learn through meaningful tasks, they accomplish greater depth of understanding, therefore adding to their mastery experiences and increasing their self-efficacy (Uzuntiryaki & Aydin, 2009). Meaningful tasks come in a variety of forms: student-performed inquiry-based experiments, real-life applications, inquiry-based instruction, and cooperative learning (Sahatsathatsana et.al., 2021).

In addition, these experiments or labs should be connected to the real-world community to mimic students' natural experiences (as closely as possible) to help make the content more meaningful to the students (Bransford et.al., 2000). Due to the microscopic scale of Chemistry and its reliance on teaching abstract concepts, students often struggle with the everyday applications of Chemistry for community engagement. To alleviate this problem, educators should incorporate real-life applications into their Chemistry instruction (Cheung, 2009a; Kurbanoğlu & Akin, 2010). The defining component of a real-world or authentic task is that the students practice thinking like that required in the real world. Real-life applications require students to use higher order thinking processes; "authentic activities foster the kinds of thinking and problem-solving skills that are important in out-of-school settings…". These higher order thinking skills are necessary for success in a major and allowing students to see that the content is used outside of school fosters stronger attitudes toward Chemistry because of an increase in the perceived value of the discipline (Anderman & Wolters, 2006).

## 5. LIMITATION

Within this research study, we must acknowledge a limitation and provide our suggestions for future research. The information gathered from the SEC scale could allow Chemistry educators to then design instructional interventions to help increase student success, interest, and performance, which could help to increase self-efficacy, attitudes, and students' intentions to pursue careers. Our intention during the scale's development was for the SEC scale to be used at both the secondary and university levels; therefore, future research would first need to validate this scale at the secondary level. In addition, future research should be conducted within these classrooms to test the effectiveness of these interventions on important motivational variables such as self-efficacy and attitudes, as well as university and career-readiness variables and career intentions.

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