The technological knowledge and the content knowledge on acid-base concepts of senior high school STEM students

Edna B. Nabua¹ Jorgy O. Falcasantos², Maurine Joy Y. Jerez³
¹²³ Department of Science and Mathematics, College of Education, Mindanao State University-Iligan Institute of Technology, Philippines
edna.nabua@g.msuiit.edu.ph

Abstract. The purpose of this study is to assess the levels of Technological Knowledge and Content Knowledge on Acid-Base Concepts and relationship between the Technological Knowledge and Content Knowledge on Acid-Base Concepts among the Senior High School STEM students in Iligan City. The study utilized two (2) Public High Schools in Iligan City schools division that offer STEM Strand. The respondents are the Senior High School STEM students that are taking up a Chemistry subject in the School Year 2018-2019. Questionnaires for Technological Knowledge and Content Knowledge on Acid-Base concepts were used. The collected data were analyzed using mean, frequency distribution, percentage, p-test, t-test, pearson correlation and levene’s test. The level of Technological Knowledge of Grade 11 STEM students in Iligan City National High School is very good. The level of Technological Knowledge of Grade 12 STEM students is also very good. The level of Technological Knowledge of Senior High School STEM students in Iligan City National High School is very good. The level of Content Knowledge on Acid-Base Concepts of Grade 11 students in Iligan City National High School is satisfactory. On the other hand, the result shows that the level of Content Knowledge on Acid-Base Concepts of Grade 12 STEM students on the same school is poor. Moreover, the level of Content Knowledge on Acid-Base Concepts of Senior High School STEM students in Iligan City National High School is poor. The level of Content Knowledge on Acid-Base Concepts of Senior High School STEM students in Iligan City East National High School is poor. The result shows that the difference and relationship of the technological knowledge and the content knowledge of Senior High School STEM students in Iligan City is not significant. Since the level of Technological Knowledge of the students were very good, teachers may make use the available technologies in teaching Acid-Base Concepts. Future researchers may utilize a larger population like different Schools Division in this region to validate this findings.

1. Introduction.
Digital technology has proven a beguiling; some even venture addictive, presence in the lives of our 21st Century (millennial) students while screen technology may offer select cognitive benefits, there is mounting evidence in the cognitive neuroscience literature that digital technology is restructuring the way our students read and think, and not necessarily for the better. Certain cognitive skills are gained while other “deep thinking” capabilities atrophy as a result of alterations in the neural circuitry of millennial brains. This has potentially profound implications for management and practice [1].
The objective of this study is to determine the Technological and Content Knowledge on Acid-Base Concepts of the STEM students in Iligan City. This is also to determine the relationship of the Technological Knowledge and Content Knowledge on Acid-Base Concepts in Iligan City. This study only includes Acid-Base Concepts in relation with the knowledge of technology and knowledge on content. It only intends to know the levels of each competency, the significant difference and the relationship of these two competencies. This study was confined to the Grade 11 and Grade 12 STEM students, who took the Chemistry subject in Public High Schools in Iligan City, School Year (S.Y) 2018 to 2019. The test questionnaire was answered by the students based on their prior knowledge. Only the Iligan City National High School at Mahayahay and Iligan City East National High School at Sta. Filomena that offer STEM academic strand in the Schools Division of Iligan City were included in this study. The unique thing about this study is that it focuses on the Grades 11 and 12 of the K12 Curriculum rather than College students which [2] focused. Second, instead of focusing only the teacher’s knowledge with TPACK, this study focuses on the students’ knowledge on Technology and Content except on Pedagogy. Specifically, this study aims to answer the following problem: (1) What are the levels of Technological Knowledge of the STEM students in Iligan City? (2) What are the levels of Cognitive Knowledge of the STEM students in Iligan City? (3) Is there a significant difference among the STEM students in Iligan City in terms of: a. Technological Knowledge b. Content Knowledge (4) Is there a relationship between the Technological Knowledge and Content Knowledge of the STEM students in Iligan City?

2. Methods.
The study was conducted in all Public High Schools in Iligan City. The respondents of this study were all STEM students who took a Chemistry subject in School Year (S.Y.) 2018-2019 from different public schools Iligan City specifically Iligan City National High School and Iligan City East National High School. The researchers used an adapted questionnaires in conducting the study.

The Technological Knowledge has eight (8) – item questionnaire from [3]. It has an internal consistency of 0.82. The Content Knowledge questionnaire has 20 items for the STEM students about the acid-base concepts. After the enhancement or approval by the experts, it was tried out to some STEM students in other school outside the local of the study for reliability coefficient. It has an internal consistency of 0.75. The researchers sent a preinformed consent to the respondents and distribute the instruments. After analyzing and organizing the data the researchers identified the levels of each competencies, relationship on each competencies and significant difference among the STEM students in different public schools.

3. Results and Discussion.
The level of Technological Knowledge of Grade 11 STEM students in Iligan City National High School is very good while the level of Technological Knowledge of Grade 12 STEM students is very good. Overall, the level of Technological Knowledge of Senior High School STEM students in Iligan City National High School is very good. In addition, the level of Technological Knowledge of Senior High School students in Iligan City East National high School is very good. The difference of the Technological Knowledge between two schools is not significant.

Table 1. Significant Difference of Technological Knowledge between ICNHS and ICENHS

| School   | Mean  | Standard deviation | t-value | p-value | Remark       |
|----------|-------|--------------------|---------|---------|--------------|
| ICNHS    | 2.94  | 0.43               | 1.119   | 0.264   | Not significant |
| ICENHS   | 2.85  | 0.47               |         |         |              |
This is parallel to the study of [4] which stipulated that the heart of the technological society that characterizes the United States lies an unacknowledged paradox. Although the nation increasingly depends on technology and is adopting new technologies at a breathtaking pace, its citizens are not equipped to make well-considered decisions or to think critically about technology. Adults and children alike have a poor understanding of the essential characteristics of technology, how it influences society, and how people can and do affect its development. Many people are not even fully aware of the technologies they use every day. In short, as a society we are not technologically literate. The Content Knowledge (CK) on Acid Base Concepts of Grade 11 STEM students in Iligan City National High School on Acid-base Concepts is satisfactory. On the other hand, the Content Knowledge on Acid-base Concepts of Grade 12 STEM students in the same school is poor. Overall, the level of Content Knowledge on Acid-base Concepts of Senior High School STEM students in Iligan City is poor. The difference of the Content Knowledge between two schools is not significant.

Table 2. Significant Difference of Content Knowledge between ICNHS and ICENHS

| School  | Mean  | Standard deviation | t-value | p-value | Remark         |
|---------|-------|--------------------|---------|---------|----------------|
| ICNHS   | 8.20  | 3.19               | 0.960   | 0.338   | Not significant|
| ICENHS  | 7.61  | 2.67               |         |         |                |

A great deal of research shows that teachers can make a substantial difference in student learning [5]. Recent studies aimed at examining the relationship between diverse teacher characteristics and student achievement benefit from longitudinal designs and value-added models, by systematically controlling for student heterogeneity and for selection bias in the matching of students to teachers and schools [6]. However, there is no consensus on the importance of individual teacher attributes for student learning gains. For instance, some authors find that experience, test scores, and regular licensure, are positively associated with student achievement [7], whereas other studies show no predictive value of teacher credentials on the variance of teacher effects [8].

The relationship between the Technological Knowledge and Content Knowledge on Acid Base Concepts of Grade 11- X and Grade 11- Y students in ICNHS is not significant. Similarly, the relationship between the Technological Knowledge and Content Knowledge on Acid Base Concepts of Grade 12- X and Grade 12- Y students in ICNHS is also not significant based on the resulting p-value. Moreover, the relationship between the Technological Knowledge and Content Knowledge on Acid Base Concepts of the STEM students in ICENHS is also not significant. Overall, the relationship between the Technological Knowledge and Content Knowledge on Acid Base Concepts of the two schools has no significant relationship. This means that their level of Technological Knowledge is not related to their level of Content Knowledge on Acid Base Concepts is not related.

Table 3. Relationship between technological and content knowledge in ICNHS

| Variable                 | r coefficient | p-value | Remark       |
|--------------------------|---------------|---------|--------------|
| Technological Knowledge  | -0.061        | 0.419   | Not significant|
| Content Knowledge        |               |         |              |
| Technological Knowledge  | -0.153        | 0.411   | Not significant|
| Content Knowledge        |               |         |              |

This is parallel to the study of [9] which highlights the effectiveness of learning with technology has been tackled from both sides. There is evidence that the use of technology increases achievement and self-efficacy [10], but some studies indicate that the use of technology in certain areas is not beneficial to students [11]. Still yet, some studies show no link between technology and achievement, but a
positive relationship between technology use and discipline [12]. Technology use in schools has had mixed results. Technology integration must have a purpose in order for it to be beneficial for producing positive results [11], [13], [14], [15]. Voice Thread is a web-based digital storytelling tool that allows users to create digital slideshows with captivating images. The social aspect of Voice Thread allows all users to learn and grow with each other. Using digital tools allows students to use technology while achieving the same objectives of those students using traditional methods of learning.

The Tables 1, 2, 3 and 4 show the significant difference of the technological knowledge and the content knowledge and the relationship between the technological knowledge and the content knowledge of Senior High School STEM students in Iligan City. The result shows that the difference and relationship of the technological knowledge and the content knowledge of Senior High School STEM students in Iligan City is not significant. The level of Technological Knowledge of Grade 11 STEM students in Iligan City National High School is very good. The level of Technological Knowledge of Grade 12 STEM students still very good. Overall, the level of Technological Knowledge of Senior High School STEM students in Iligan City National High School is very good. The level of Content Knowledge on Acid-Base Concepts of Grade 11 students in Iligan City National High School is satisfactory. On the other hand, the result shows that the level of Content Knowledge on Acid-Base Concepts of Grade 12 STEM students one the same school is poor. Generally, the level of Content Knowledge on Acid-Base Concepts of Senior High School STEM students in Iligan City National High School is poor based on the resulting overall mean. The level of Content Knowledge on Acid-Base Concepts of Senior High School STEM students in Iligan City East National High School is poor. In conclusion, the null hypotheses is accepted since there is not enough evidence to reject it. It is recommended that teachers may develop some activities that can boost the students’ interest and curiosity in learning the Acid-Base Concepts. Since the level of Technological Knowledge of the students were very good, teachers may make use of the available technologies in teaching Acid-Base Concepts. Future researchers may utilize a larger population like different Schools Division in this region. They may try to employ this study on both the Public and Private Senior High School STEM students as respondents and compare the levels, significant difference and significant relationship of their Technological Knowledge and Content Knowledge on Acid-Base Concepts of each sector-the public and private. They may include other factors affecting the Technological Knowledge and Content Knowledge on Acid-Base Concepts of SHS STEM Students in Iligan City.

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