Learning Styles and Difficulties of College Students in Chemistry

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Abstract

This study set out to identify the most and least dominant learning styles and difficulties in organic chemistry of the second year college students coming from the 7 campuses of Pangasinan State University namely: Asingan, Bayambang, Binmaley, Infanta, Lingayen, San Carlos, and Sta. Maria who took up organic chemistry subject during the school year 2018-2019. The instruments used were survey-questionnaires. The first questionnaire was adopted from Grasha and Reichmann learning style model Turkish Adaptation by Saritas and Sural (2010) comprised of 6 dimensions which are the learning style. These are independent, dependent, participant, avoidant, collaborative, and competent learning styles. Each dimension is composed of 10 items, in total, 60 items. Each learning styles were determined at three levels of low medium and high. The second questionnaire was made by the researchers consists of thirty-five (35) questions and the respondents would rate themselves as to their perceived level of difficulty of the performance task in organic chemistry. To statistically treat the data, frequency counts, percentages, average weighted mean, spearman rho and point biserial were employed. The most dominant learning styles of the respondents in this study were collaborative and competitive learning styles; and least dominant were independent and participant learning styles. It was understood that difficult performance tasks were from the following topics; bonding and molecular structure; functional groups overview; organic reactions and their mechanisms; stereochemistry; and alkenes, alkynes and aromatic compounds. Moreover, students who have independent, avoidant and collaborative learning styles find all the performance tasks as difficult.

Keywords: Difficulty, Learning Style, Organic Chemistry, Pedagogical Intervention , Performance Task

INTRODUCTION

As a branch of knowledge, science deals with a body of facts and truths that are arranged systematically and gained through observation and experimentation. No curriculum exists in isolation, ie each curriculum is designed to be an input to another output. The interplay of curricula in the trifocal system of education in the Philippines only becomes ideal when alignment is checked at crucial checkpoints including the most recent checkpoint–the implementation of the K to 12 Basic Education Curriculum. One field that changed is Science Education [7]. One branch of science is Chemistry which is said to be the central science, central to a fundamental understanding of other sciences and technologies since many subjects share an essential tie to chemistry. Chemistry is the study of matter and the changes that matter undergoes [2]. One branch of chemistry is Organic Chemistry, which is the study of the compounds of carbon. Perhaps the most remarkable feature of organic chemistry is that it is the chemistry of carbon and only a few other elements—chiefly hydrogen, oxygen, and nitrogen [3].

Chemistry as a subject contains abstract concepts which are seemingly difficult to grasp. The way students learn chemistry could also affect their performance in chemistry. Each student has styles or preference in the way they recognize and process information. They differ in doing performance tasks [4] employing a variety of activities targeting higher- order proficiencies. Requires students to engage in certain activities or create products to demonstrate their academic knowledge and abilities.

Recognizing the students' learning style may very well aid the teachers in becoming more sensitive to students' differences in the classroom, thus promoting enhancement to teaching practices that best suit the student learning styles [8]. Camara [5] studies the correlation between self-efficacy, learning style and aptitude among senior high school students. Some of the reasons identified by [1] for students' difficulties in Organic Chemistry at the University level hinged on: Chemistry teachers` teaching methods; Learning style of the students; Nature of the subject itself; and Students experience of learning. Eticha [9] has also identified the following major areas of Organic Chemistry topics as difficult for students to comprehend: Functional groups (Writing appropriate reaction for different functional groups); Stereochemistry (Visualizing structure of stereoisomers in three-dimensional); Organic reactions (Categorizing the types of organic reactions).

As cited by [10], they stated learning styles and general class preferences of the students with these learning styles as follows: Independent, Dependent, Collaborative, Avoidant, Participant, and Competitive. Independent learners prefer to think for themselves and are confident about their learning abilities. They prefer to work alone, learning content that they think is important. Dependent learners show little intellectual curiosity and learn only what is required. They look to authority figures, teachers, and peers for specific guidelines on structure, support, and what to do. Collaborative learners enjoy working with peers and teachers, and they believe they can learn by sharing ideas and talents. Avoidant learners tend to be uninterested and/or overwhelmed by the learning situation. They are not enthusiastic and do not participate in the learning process. Participant learners are the "good citizens." They are eager to please and will do as much as is required to meet requirements. They enjoy most learning activities and are likely to participate actively in the learning process. Competitive learners compete with their peers for grades and like to be the center of attention receiving recognition for their accomplishments.

Osokoya [8] found out that students with collaborative learning style performed better in chemistry. Awareness of the learning styles is vital for allowing adjustment in the educators' pedagogic approaches or making pedagogical interventions. For example, according to Elban [10] a project-based teaching approach can be used for the students with dependent leaning style where the teacher should be the source of the directive for the dependent learners. For the students with independent learning style, project assignments can be given, yet, teacher will not play the good directive-giving role but will play a role, which sets the student free and alone. When the teacher assigns a project to the students with collaborative learning style, he/she should play neither the directive-giving role nor the setting-free role. Also, Organic Chemistry teachers should understand students' areas of learning difficulties in Organic Chemistry topics and design appropriate instructional strategy and approach for them with relevant interjections wherever applicable [9]. Curriculum evaluation in the perspectives of student- clienteles is a significant and healthy approach to curriculum improvement [6] and thus teachers with students should work hand-in-hand.

OBJECTIVES OF THE STUDY

The researcher came to an understanding based on the realities mentioned above that the success in learning organic chemistry depend on the students' learning style and the difficulties they encounter in performing learning task or performance tasks as a result of the complexity of a performance task. Therefore, there is a need to explore by conducting a study intended to determine the learning styles and difficulties of college students in Organic Chemistry at Pangasinan State University. The problems are as follows;

1. What is the profile of the students who took up organic chemistry in terms of; sex; course; performance in the entrance exam; performance in organic chemistry; and monthly family income.
2. Which learning style/s is/are the most and least dominant among respondents?
3. What is the perceived level of difficulties of the students in the performance tasks in organic chemistry?
4. Is there a significant relationship between the perceived level of difficulties of the students in the performance tasks in organic chemistry across; the different learning styles, and profile variables
5. Is there a significant relationship between the learning style and the profile of the students?
6. What pedagogical intervention can be proposed to address learning styles and difficulties of college students in organic chemistry?

MATERIALS AND METHODS

Respondents of the Study

The subjects of the study are the two hundred four (204) selected second year students coming from the 7 campuses of Pangasinan State University namely: Asingan, Bayambang, Binmaley, Infanta, Lingayen, San Carlos, and Sta. Maria who took up organic chemistry subject during the school year 2018-2019. The courses of these students are Bachelor of Secondary Education Major in Science and Bachelor of Science in Agriculture.

Instrumentation

The instruments which were used as data-gathering tools are survey-questionnaire [14]. The first questionnaire was adopted from Grasha and Reichmann learning style model Turkish Adaptation by Saritas and Sural [1], with modifications for applicability with

the present study like the use of 'organic chemistry class' instead of 'class' and "organic chemistry teachers" instead of "teachers". The model is comprised of 6 dimensions which are the learning style. These are independent, dependent, participant, avoidant, collaborative, and competent learning styles. Each dimension is composed of 10 items, in total, 60 items. When learning styles of the students were determined, each learning styles were determined at three levels of low, medium and high shown in table 1. (Table found in original article).

The second questionnaire was made by the researchers and validated by Chemistry Professors at Pangasinan State University – Bayambang Campus. The questionnaire had thirty-five (35) questions and the respondents would rate themselves as to their perceived level of difficulty of the performance task in organic chemistry. Further, the survey-questionnaire opened with a section asking for their participation with a consent form section, and a reiteration of the confidentiality of their identity.

Data-gathering Procedure

The researchers secured a written permit from the Offices of the Campus Executive Directors of the seven (7) campuses Pangasinan State University. After the approval of the permit, the researchers administered the survey questionnaire. There were two-hundred four questionnaires gathered. The survey-questionnaires were all coded from 001 to 204 by the researchers. After coding, the survey- questionnaires were also encoded by the researchers and submitted for data analysis in SPSS by the Pangasinan State University – Statistic Center Statistician.

Statistical Treatment

The data in the 204 survey-questionnaires were all encoded and analyzed in SPSS. Frequency counts, percentages, average weighted mean, spearman rho and point biserial were employed to statistically treat the data.

RESULTS AND DISCUSSION

Table 2 (found in original article) shows that, majority of the respondents are female (112 or 54.9 %), while in terms of course and major is an equal distribution of students for Bachelor of Science in Agriculture major in General Curriculum and Bachelor of Secondary Education major in Science with 102 or 50% each. With regards to the performance in entrance exam, scores in ranging from 31 – 40 was obtained by majority (47.5% or 97) and on the Performance in Organic Chemistry, the grade of 2.00 is the most obtained grade (67 or 32.8%). And 74.5% or 152 from the respondents belong to families with an income ranging from 8000-below.

Table 3 (found in the original article) shows the number of students for each learning style grade level and the mean. This table shows the most and least dominant learning styles of the students based on the frequency of grading of learning style as low, medium or high by [1]. It reveals that majority of the students under collaborative and competitive learning styles resided in high range of grade according to the frequencies 162 and 120, and means of 3.88 and 3.04 respectively. Accordingly, most students under

independent, avoidant, dependent, participant learning style fell on the medium range with the frequency of 132, 132, 103 and 119 and means of 3.32, 2.89, 3.74, and 3.72 respectively. Independent and participant learning styles have the highest frequencies in low range of grade which is 34 and 31 respectively and lowest frequencies in high range of grade which is 38 and 54 respectively. Overall, this table revealed that the most dominant learning style of the students in this study are collaborative and competitive learning styles while the least dominant are independent and participant learning styles. Similarly, the most dominant learning styles in the study of [11] are collaborative and competitive learning styles and also the study of [10] which revealed that collaborative and competitive learning styles are dominant. Some study like [12] and [13] also found collaborative learning style as dominant but not paired with competitive learning style, instead, for Azarkhordad, dependent and participant learning style are also dominant and for [13], independent learning style is also dominant.

Table 4 (found in original article) presents the performance tasks perceived by the respondents as difficult came from five main topics namely; bonding and molecular structure; functional groups overview; organic reactions and their mechanisms; stereochemistry; and alkenes, alkynes and aromatic compounds. On the other hand, performance tasks perceived by the respondents as Moderately easy came from two main topics; alkanes and cycloalkanes; and functional classes and their nomenclature.

It can be seen in table 5 that 3 learning styles namely: independent, avoidant and collaborative learning styles have significant relationship (at 0.01 level) and have almost slightly high positive correlation with Spearman rho values all found in the range of 0.34 – 0.50 of all the seven performance tasks: bonding and molecular structure; functional groups overview; organic reactions and their mechanisms; alkanes and cycloalkanes (saturated hydrocarbons); Stereochemistry; alkenes, alkynes and aromatic compounds (Unsaturated Hydrocarbons); functional classes and their nomenclature. Hence, students who have independent, avoidant and

collaborative learning styles find all the performance tasks as difficult. Dependent learning style has significant relationship and has low positive correlation to performance tasks; bonding and molecular structure; functional groups overview; and functional classes and theirnomenclature only, therefore dependent learners find performance these performance tasks as difficult. Competitive learning style has low positive correlation to performance tasks; bonding and molecular structure; functional groups overview; and functional classes and their nomenclature, hence, competitive learning style students find these performance tasks as difficult. Competitive learning style has low negative correlation to performance tasks; organic reactions and their mechanisms; alkanes and cycloalkanes; and Stereochemistry making them difficult for those who have low level of attitudes and feelings in competitive learning style.

The participant learning style has significant relationship to all the performance tasks. It has low positive correlation to performance tasks; bonding and molecular structure, organic reactions and their mechanisms, alkanes and cycloalkanes, Stereochemistry and alkenes, alkynes and aromatic compounds making them difficult for students with participant learning style. Meanwhile, participant learning style has slightly high positive correlation to functional groups overview; and functional classes and their nomenclature making those who have high level of attitudes and feelings in participant learning style find these performance tasks as more difficult. a significant relationship and has a very low positive correlation to performance task functional groups overview in a way that females find this task difficult than males. Both courses and majors are significantly related to performance tasks; bonding and molecular structure; functional groups overview; organic reactions and their mechanisms; alkanes and cycloalkanes; alkenes, alkynes and aromatic and their mechanisms; alkanes and cycloalkanes; alkenes, alkynes and aromatic compounds as difficult while BSE students major in science find performance tasks bonding and molecular structure; functional groups overview and functional classes and their nomenclature as difficult. With

regards to entrance exam raw score, this is significantly related to performance tasks: organic reactions and their mechanisms; alkanes and cycloalkanes; and Stereochemistry that have low positive correlation and alkenes, alkynes and aromatic compounds that has very low positive correlation. This means that those who obtained high raw score in entrance exam find those tasks as difficult than those who obtained low raw score. On the other hand, the performance in organic chemistry is significantly related to performance tasks; organic reactions and their mechanisms; alkanes and cycloalkanes; Stereochemistry; alkenes, alkynes and aromatic compounds that have low negative correlation and functional classes and their nomenclature that has very low negative correlation which means that students who have performance that is equivalent to higher decimal grade or poor grade in organic chemistry find those tasks as easy. Also, monthly family income has significant relationship to performance task bonding and molecular structure only which has very low negative correlation, meaning, students who belong to families with higher monthly income find this performance task as difficult.

Table 7 (found in the original article) showed that sex is significantly related and has very low negative correlation to dependent learning style (-.140) and low negative correlation to participant learning style (-.224). Hence, dependent and participant learning styles are the more dominant learning styles for females than males. Course is significantly related to all learning styles, has low negative correlation to learning styles (Independent -.220, Avoidant -.211, Collaborative-.251, Dependent -.302, Competitive -.198,) and very low negative correlation to participant learning style-.164. This means that Bachelor of Secondary Education students are more dominant in varied learning styles than Bachelor of Science in Agriculture Students. Dependent learning style is significant and has a low negative correlation to the entrance exam raw score (-.198) and so Dependent learning style is more dominant for those who obtained lower scores in the entrance exam than those who obtained higher scores. Performance in organic chemistry has no significant relationship to the learning styles.

Monthly family income is significantly related to only one learning style which is the participant learning style and has very low positive correlation (.142).

Table 8 (found in the original article) shows the proposed Pedagogical Interventions addressing Dominant Learning Styles and Difficult Performance Tasks. Students could be engaged to group or competition - based performance task, peer discussion, demonstration and presentation for the difficult performance task for them. Group performance task and peer discussion can be used for the collaborative students and outputs of their tasks will be presented and compared against the outputs of other groups by the competitive students. For competitive students, competition-based performance tasks can be used and at the end of the tasks competitive learners will demonstrate what they did or present their output to the class

DISCUSSION AND CONCLUSION

Majority of the respondents are female, while in terms of course and major is an equal distribution of students for Bachelor of Science in Agriculture major in General Curriculum and Bachelor of Secondary Education major in Science. With regards to the performance in entrance exam, most scores are in the range of 31 to 40 and on the Performance in Organic Chemistry, the grade of 2.00 is the most obtained grade. Majority of the respondents belong to families with an income ranging from 8000-below.

The most dominant learning style of the students in this study are collaborative and competitive learning styles. On the other hand, the least dominant are independent and participant learning styles.

Overall, performance tasks perceived by the respondents as difficult came from five main topics namely; bonding and molecular structure; functional groups overview; organic reactions and their mechanisms; stereochemistry; and alkenes, alkynes and aromatic compounds. On the

other hand, performance tasks perceived by the respondents as moderately easy came from two main topics; alkanes and cycloalkanes; and functional classes and their nomenclature.

Students who have independent, avoidant and collaborative learning styles find all the performance tasks as difficult. Students with dependent and competitive learning styles find performance tasks: bonding and molecular structure; functional groups overview; and functional classes and their nomenclature only as difficult. Performance tasks organic reactions and their mechanisms, alkanes and cycloalkanes (saturated hydrocarbons) and stereochemistry are difficult for those who have low level of attitudes and feelings in competitive learning style. The students with high score in participant learning style find performance tasks bonding and molecular structure, organic reactions and their mechanisms, alkanes and cycloalkanes (saturated hydrocarbons), stereochemistry and alkenes, alkynes and aromatic compounds (Unsaturated Hydrocarbons) as difficult while functional groups overview and functional classes and their nomenclature as more difficult.

Females find performance tasks from the topic functional groups overview as difficult than males. BSA students major in general education find performance tasks organic reactions and their mechanisms, alkanes and cycloalkanes (saturated hydrocarbons) and alkenes, alkynes and aromatic compounds (Unsaturated Hydrocarbons) as difficult while BSE students major in science find performance tasks; bonding and molecular structure, functional groups overview and functional classes and their nomenclature as difficult. Students who obtained high raw score in entrance exam find tasks from main topics; organic reactions and their mechanisms; alkanes and cycloalkanes; Stereochemistry and alkenes, alkynes and aromatic compounds as difficult than those who obtained low raw score. Students who have performance in organic chemistry that is equivalent to higher decimal grade or poor grade in organic chemistry find; organic reactions and their mechanisms; alkanes and cycloalkanes; Stereochemistry

and alkenes, alkynes and aromatic compounds; and functional classes and their nomenclature tasks as easy. Students who belong to families with higher monthly income find performance task; bonding and molecular structure, as difficult.

Dependent and participant learning styles are the more dominant learning styles for females than males. Course, Bachelor of Secondary Education students are more dominant in varied learning styles than Bachelor of Science in Agriculture Students. This means that dependent learning style is more dominant for those who obtained lower scores in the entrance exam than those who obtained higher scores. Performance in organic chemistry has no significant relationship to the learning styles. Monthly family income, students who have participant learning style as their dominant learning styles are from families with higher income.

Students could be engaged to group or competition - based performance task, peer discussion, demonstration and presentation for the difficult performance task for them. Group performance task and peer discussion can be used for the collaborative students and outputs of their tasks will be presented and compared against the outputs of other groups by the competitive students. For competitive students, competition-based performance tasks can be used and at the end of the tasks competitive learners will demonstrate what they did or present their output to the class.

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