JPII 12 (1) (2023) 24-31

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

ANECDOTES OF UNIVERSITY STUDENTS IN LEARNING CHEMISTRY: A PHILIPPINE CONTEXT

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DOI: 10.15294/jpii.v12i1.42120

Accepted: January 16th, 2023. Approved: March 30th, 2023. Published: March 31st, 2023

ABSTRACT

Contrasting approaches, principles, and previous learning experiences widely confront chemistry instruction. Therefore a comprehensive and precise understanding of the nature and mechanism of chemistry instruction is essential in attaining mastery of science subjects like chemistry. This study explored the determinants that affect students' chemistry in tertiary education. This study utilized an explanatory sequential mixed-method research design wherein quantitative data is collected and analyzed. Qualitative data was collected and analyzed based on quantitative results. The respondents (n=253) were the students who took their chemistry subjects from 2016-2017, 2017-2018, 2018-2019, and 2019-2020. The study revealed that the type of school significantly affects students' chemistry learning. Based on students' responses, it was revealed that classroom dynamics, a supportive learning environment, the prospect for attractive compensation, poor study habits, non-aligned of academic track, and teachers are the determinants affecting students' academic performance in chemistry.

Keywords: anecdotes; learning chemistry; Philippine; university students

INTRODUCTION

Education is shifting fast; chemistry education is no exemption and must adapt to the change. One common challenge university students may face when learning chemistry is understanding the complex and abstract concepts central to the subject that significantly affects academic performance. Global investigations highlighted various determinants that affect students learning of chemistry (Nnamani et al., 2016; Khaddoor et al., 2017; Keinonen et al., 2017; Gobena, 2018; Ashimwe, 2019; Capuno et al., 2019; Sanchez, 2019; Wei, 2019).

To solve prevailing problems on students learning difficulty in chemistry, specific attention to the different factors considered useful in chemistry instruction is necessary because the expansion of scientific facts and information and the complete range of subjects connected to experimental sciences and practical sciences are continuously increasing (Stuckey et al., 2013). Chemistry is considered a strenuous subject (Omiko, 2013); countless secondary and university students are exposed to the complexities of fundamental ideas in chemistry (George et al., 2021) due to an inadequate and inappropriate understanding of basic concepts (Bharadwaj, 2016). Various researchers cited reasonable efforts to discourse the low performance in sciences and chemistry. Diversity in chemistry preparation, intellectual aspects of several chemistry terms and concepts, instruction approaches utilized during class, shortage in instructional materials, and the subject's complexity and broad contents need to be addressed and be given intervention to refine chemistry learning in universities (Unanma et al., 2013; Burris, 2017; Veale et al., 2018).

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Various determinants have been the subject of numerous research worldwide considering interventions that may refine students' learning in chemistry in tertiary education (Sun et al., 2009; Ijidike et al., 2015; Al-Sheeb et al., 2018). However, there were no contributory factors of students learning in chemistry between and among the studied variables that can forecast the performance of the university students in chemistry, especially in the Philippines. Considering this scenario, teachers and administrators must know the determinants of learning chemistry for possible academic actions.

Based on the previous relevant studies, it is found that students' academic achievement levels are determined by several factors: age, sex, high school grade in chemistry, number of study hours, senior high school strand, assistance in learning, teachers' educational attainment, teacher-student ratio, instructional materials utilized by the teacher, and availability of laboratory facility. However, this study wishes to fill in the knowledge gap presented by Yeliz et al. (2020) by investigating the factors affecting the achievement of university students. The study elaborated that students' success levels are based on sociodemographic characteristics such as gender, the type of university, personal career choice, and fathers' education as essential indicators of students' academic success. The present study is similar to the herein study as it also focuses on determining the factors affecting learning among university students. The present study emphasized enabling and deterrent factors: classroom dynamics, a supportive learning environment, the prospect for attractive compensation, poor study habits, non-aligned of academic track, and teacher factors are the significant features affecting students' academic performance in chemistry. Respondents of the present study are the students who took their first chemistry subjects, while Yeliz and associates focused on Physical education students.

Amitava et al. (2010) explored the factors affecting school students' performance and found that aspects like students' attendance, mothers' education, and trained teachers in the school positively influence students' academic performance. Both studies highlighted students' academic achievement. However, the present study emphasized the university students who took chemistry subjects, while the previous research focused on elementary students. Moreover, factors confirming the different results of the former study with the present findings are evident. The previously cited literature presented other variables not revealed in the present study. Thus, it was highlighted that classroom dynamics, a supportive learning environment, the prospect for attractive compensation, poor study habits, non-aligned of academic track, and teacher factors are the significant features affecting students' academic performance in chemistry are the significantly correlated variables that affect students learning, particularly in chemistry.

The present study showed that various determinants certainly affect students' chemistry learning. This study generated a narrative report as an offshoot to the identified significant determinants of chemistry learning. Discoveries from this study contribute to the burgeoning literature on potential intervening variables in the teaching and learning of chemistry and may be a valuable reference point for baseline information to take actions and measures toward better chemistry knowledge among university students. The study is mainly significant because of its benefactors. Primarily, the students become attentive to such phenomena and can eventually adapt recommendations to improve academic performance, particularly in chemistry. Furthermore, higher education institutions can set new learning approaches to enhance the worth of teaching and learning.

METHODS

This study employed an explanatory sequential mixed-method research design to investigate the determinants of learning chemistry among university students. The study focused on university students who took their chemistry subjects in 2016-2017, 2017-2018, 2018-2019, and 2019-2020. Two hundred fifty-three students enrolled in various university programs participated in this study. These students are enrolled in state universities and colleges, private-sectarian and private non-sectarian types of higher education institutions to adequately represent the different universities in urban, rural – highland and rural–lowland. A snowball sampling technique was employed, where participants were chosen according to availability and convenience. The respondents were selected based on their population characteristics and the study's objective. Table 1 displays the distribution of respondents according to age, sex, school type, and school location.

Table 1. Variables and Percentage of Participants According to Age, Sex, School Type, and School Location

Variable	Frequency	%
Age		
less than 20	224	88.5
20 - 23	24	9.5
24 and up	5	2.0
Sex		
Male	87	34.4
Female	166	65.6
School Type		
State University	120	47.4
Private Sectarian	41	16.2
Private Non-Sectarian	92	36.4
School Location		
Urban	180	71.1
Rural – highland	33	13
Rural - lowland	40	15.8

The study patterned the 6-step framework analysis of Clarke and Braun (2013), including familiarization, generating initial codes, capturing something noteworthy or remarkable idea about the data and/or interview questions, reviewing themes, defining themes, and pinpointing the essence of the write-ups, was done to explore the determinants in learning the chemistry of the students. This paper has undergone instrument validation by three (3) panel members in the committee who evaluated if the instrument meets the standards. Content validity was verified by deliberating the research instrument with the pool of research professionals in the science education department of Cebu Normal University, Philippines. Informed consent was obtained from student respondents from different higher education institutions. The researcher informed the respondents about the study's objective and protocol, wherein interviews were recorded to capture the respondents' verbatim language.

Each respondent was given ample time to answer the questionnaire. The study was duly approved by the Cebu Normal University (CNU) Office of the Research Ethics Committee. The participants in the interview, who were the data sources, also permitted the transcript extract to be used in the study that explored students' life experiences of learning chemistry.

To collect the data, the study employed thematic analysis to categorize the patterns or themes in the data that are significant or remarkable and utilize these themes to discourse the study. The questionnaire was facilitated through various modes like face-to-face interviews through online platforms such as Zoom, Google Meet, and Facebook Messenger to facilitate its administration and data collection. For variables such as age, sex, school type, and school location, chi-square was utilized to find the percent of explanatory variables contributing to the total variance in learning chemistry. Instructions were elaborated to explain the purpose and possible benefits of the study to the participants. Responses were transcribed verbatim. The research explored how students make sense of and use feedback. The present study revolved around the students' life experiences in chemistry: learning experiences on the subject and the enabling and deterrent factors that affect their academic performance in chemistry.

RESULTS AND DISCUSSION

Table 2 shows the results of the data analysis of this research.

Table 2. Data Analysis Results

Variable	Cramer's V-value	p-value
Age	0.084	.740
Sex	0.140	.172
School Type	0.262	.000
School Location	0.095	.603

Based on Table 2, age did not significantly affect students' performance in chemistry in the distribution chi-square analysis based on Cramer's V-value (0.084); p-value (0.740). Also, gender (Cramer's V-value = 0.140; p-value = 0.172) is not a significant factor

affecting students' performance in chemistry. School location with Cramer's V-value = 0.095; p-value = 0.603 is also insignificant. However, it is noticeable that type of school enrolled with Cramer's V-value = 0.262; p-value = 0.000 showed significance and strongly correlated with chemistry learning among university students.

The result of the study evidenced that the significance of quality instruction on succeeding investments in education and labor market products is well organized as a factor affecting chemistry learning in tertiary education. Higher institutions have many choices, including state universities and colleges, private sectarian, and non-sectarian. They offer the best practices for quality education; however, there is an increasing awareness that all schools are unequal (Green, 2020). A quality school education is essential to access higher education and better job market options and outcomes. Several recent empirical works have scrutinized the influence of private schooling on students' learning outcomes (Muralidharan & Sundararaman, 2015; Kumar, 2018; DeAngelis, 2019). DeAngelis (2019) used the Programme for International Student Assessment (PISA) tallies of 63 countries from 2000 to 2012 and found that a more significant portion of private schooling in total schooling leads to better-quality PISA scores worldwide. Also, going through the research on private school selection in the United States, Erickson (2017) finds that parents value academic quality when selecting schools for their children.

Singh (2015) finds that an escalation in the share of private schools denotes a significant and sizable improvement in chemistry learning in rural areas. Parents consider that private schools deliver quality education compared to government and government-aided schools and, therefore, an excellent future for their children. It is broadly regarded that with the increased popularity of private schools, parents value academic quality and other school characteristics (along with their financial capacity) when participating in school choice programs (Choudhury, 2016; Erickson, 2017; Prieto et al., 2019; Anders et al., 2020). Hans (2017) and Tösten et al. (2017) stated that school environment and aggression significantly correlated. The adolescents with a reasonably perceived school environment were less aggressive, and those with a bad one were more aggressive. Personal, familial, and social factors and school environment were significantly related to adolescent aggression. Analysis of the participants' responses pointed out enabling factors that significantly affect students learning in chemistry as classroom dynamics, supportive learning environment, and prospect for attractive compensation.

The classroom dynamic is formulated due to a captivating and fun-filled experience in learning chemistry, as expressed by the respondents. It further explains that students look forward to every chemistry session to interact with each other towards a productive lesson discussion and enrichment, thus creating an active classroom culture. The result suggests that the students are eager to finish the subject by the semester ends as they find the laboratory activities very relevant to their pursued degree. The results displayed that beforehand cultivating students' attitudes, it is indispensable to be aware of the backgrounds of undesirable attitudes (Kubiatko et al., 2017). As expressed by respondents 1, 5, 6,9,11,13,14,15: "Chemistry is interesting; activities are fun, hands-on learning; conducive classroom atmosphere for learning; I felt comfortable learning and collaborating with my groupmates and our instructor. I am learning well through my interaction with my professor and groupmates. I am a transferee at this school, and with this classroom set-up, I feel stress-free in catching up with the lessons, especially during chemistry class".

Students narrated that their learning experience in chemistry during laboratory experiments created a closer bond with fellow students and, at the same time, associated with their teacher. The lecture and laboratory rooms are nurturing spaces that support maximum student learning. A clear manifestation is that students like the learning environment that drives their learning ability by modifying approaches and teaching pedagogies. They want to be a part of a productive learning situation that provides a sense of achievement while being adaptive and interactive with fellow students and teachers. In other words, they want to be active and engaged performers during the learning course. Respondents 1,2,4,5,6,8,10,12,13 stated: "I get additional friends with chemistry; I interact with my groupmates even after the class. I also like this learning environment because it is not obsolete as traditional classrooms but specifically crafted to support thinking. So far, I have engaged, interacted, and learned more about chemistry. Learning chemistry here is appreciated as the materials, supplies, and chemicals are available in every laboratory experiment".

A learning environment is an excellent aspect of student achievement. It deals with a constructive ambiance to feel inspired and motivated. A perfect learning situation encourages collaboration between the teacher and students, ultimately providing support. Constructive classroom surroundings are established to determine academic performance (Mphale & Mhlauli, 2014). It denotes that students enjoyed the varied laboratory activities to build harmonious relationships and friendships with their peers. This situation is a good motivation to continue and finish the

academic endeavor with an excellent remark. Baer (2013) noted a class in which students work collectively frequently. A substantial share of students' time in class is dedicated to cooperative learning undertakings that significantly affect how and how well they learn. Bakasa (2011) pointed out that school factors, including effective teaching, positively impact academic performance when combined with class size. Lawrence and Vimala (2012) displayed no statistically significant correlation between school situation and academic performance concerning the school environment. However, other studies said another way. For instance, Odeh et al. (2015) reiterated that the school surroundings significantly impact academic performance. Furthermore, Duruji et al. (2014) also denoted that the school environment has a statistically significant academic performance relationship.

Students in this generation are practical as far as their plans are concerned. In selecting their upcoming occupation, they prefer a career that fits their strengths and area of interest. In addition, they track a career that will give them the paramount prospect of success. The majority of the participants took up STEM to land a better job. Nonetheless, most participants know that education nowadays is one of the essential considerations employers will consider. Also, skills are acquired through education, which denotes that they need to graduate from college and have performed well with an excellent academic performance to attract the best employment and compensation. Respondents 1,3,5,8,9,11,13,14 noted: "I will earn more as a nurse working in other countries; this course is an in-demand profession. Also, STEM-related career professionals have higher chances of getting jobs in the local, national, and global markets. The ongoing worldwide pandemic demanded more healthcare professionals, which I am inclined. There are good compensation packages that await us and will be ultimately increasing in the future".

The participants' responses indicated a positive motivation toward realizing their chosen careers. They firmly believed that STEM-related professionals have better jobs and excellent compensation opportunities that may uplift better family living conditions. Moreover, salary is one reason students decide on a better course or career. The responses specify that some students pursue careers in STEM due to the enormous eye-catching amount of salaries.

Varma et al. (2022) mentioned that the mandate for STEM alums is remarkably high worldwide, and the world faces engaging more individuals in STEM trades and activities. Indeed, STEM has added significance to constructing the nation's output. In Australia, the dominant assessment is that the labor force and economy necessitate additional STEM skills and knowledge to upkeep the nation's production and success and continue modest on the global boards (Mcgunagle & Ziska, 2020). The STEM-related industries in the United States also strongly emphasized improving students' total engagement in postsecondary involvement in STEM education (Baber, 2020). Deterrent factors affecting university students in learning chemistry include poor study habits, non-aligned of the academic track, and teacher factors.

As per students' narratives, chemistry is a boring minor subject; aside from that library, there are not enough available references to study. The responses showed the students' negative attitude that affects their chemistry learning. Kenni (2020) pinned that if students aim for exemplary academic achievement throughout chemistry class, they must eliminate bad study habits and practice good ones. As expounded by Magulod (2019), good study routines aid students in attending classes very often and doing so on time. It likewise helps them submit their assignment on time, read or prepare very well for tests and exams, take notes, develop the points independently, and ask pertinent inquiries in class to have high remarks at the end of the term or semester. Participants 2,4,5,7,8,9,11,13,14,15 pointed out: "Chemistry is a boring subject, and I do not like to focus on studying because it is not a major. Plus, the library has no adequate file for references. Sometimes, I stay at the boarding house during my chemistry class. Instead, I play computer games and am hooked to social media like Facebook, Instagram, and YouTube. I expect an unsatisfactory grade on this subject at the end of the semester".

Chemistry was taken as a challenging course leading the students to misunderstand. On the other hand, it is essential to identify the problematic parts and misunderstandings students may encounter in chemistry and suggest approaches to address them. Some authors publicized that the low performance in chemistry is ascribed to the undesirable outlook concerning learning and teaching chemistry and unproductive instructional modus operandi and teaching aids (Cheung, 2009a; Khan & Ali, 2012). Thomas (2007) showed that students in the survey do not appreciate chemistry due to the outdated teaching methods and means grounded on chalk and talk usually used by the teachers giving simple problems on the boards. They point out that their teachers only prepare them for public examinations to memo-

rize everything. Furthermore, poor study habits also are likely to interrupt the study (van Rooij et al., 2018), and it will affect students' Cumulative Grade Points Average (CGPA) (Duraku & Hoxha, 2018). According to Alimi et al. (2012), a poor academic performance degree can also affect the country's economy.

As the participants narrated their experiences with their chemistry learning, some expressed the disadvantage of being a senior high school graduate who is not aligned with the degree program they are pursuing.

It shows in the study that participants who graduated from a non-STEM strand encountered difficulty learning chemistry. Students' responses signify numerous concerns regarding their academic track choice during SHS with their chosen college degree of specialization. Pajares et al. (2018) revealed that academic track mismatch exists because some of the senior high school courses accessible in the different districts of Cebu do not match or fit with the field of specialization taken by students during the tertiary level. Thus, this implies that college students, especially non-STEM majors, experience a higher difficulty level (Van Noy & Zeidenberg, 2014). They find it challenging to engage in in-depth learning of content knowledge in chemistry. Students who graduated from STEM academies were more at ease with STEM-related disciplines and more likely to pursue a college degree, and more female students took advanced placement courses (Stotts, 2011).

Participants 1,2,4,6,7,8,10,12 highlighted that the teacher was a causative agent in their chemistry learning. Responses show that the students experienced difficulty adapting to the chemistry teacher's teaching approaches. Teachers' expertise in both the subject area handled and pedagogics contributes to positive educational results. Accordingly, participants narrated:"I am disappointed with how our teacher teaches us because she is too strict and not approachable. Most of all, she is into the traditional teaching method. She does not explain the lesson very well, making topics with computation even more complicated. Our learning tasks are too complex for me, mainly because I am a TVL strand graduate, and I wish we had another teacher. I am planning to shift to another course the next semester".

The responses demonstrate that teachers with particular teaching techniques and different learning approaches may impact students' academic performance. In this sense, teacher expertise matters as it certainly influences student achievement. In a comparative study of teaching and students' learning styles, Sharma and Vyas (2016) explained that when teachers' teaching style is entirely incompatible with most students' learning approaches, the students are more likely to turn out to be distracted and fed up with a low performance on assessment and, in some circumstances, drop out of school or change to other courses. Teachers' manners and characteristics significantly affect students' attitudes concerning chemistry learning. This element was established in five investigations, one with no effect (Adegbola & Depar, 2019) and four with affirmative results (Yunus & Ali, 2012; Chepkorir et al., 2014). It is evident that how teachers perform affects the attitudes of students. It may be ascribed to the circumstance that knowledgeable teachers who are specialists in the subject being taught easily share their knowledge and capability. They permit students to raise questions or give concepts and ideas on the subject and reflect on them instantly (Yunus & Ali, 2012). Through communication, students can converse with their teachers and peers to improve their understanding of chemistry, enhancing their level of thinking. Mangubat and Picardal (2023) emphasized that a supportive learning environment and other motivational factors can help underprepared students succeed academically, even in the most challenging course like chemistry.

CONCLUSION

Various intrinsic and extrinsic factors influence students' academic performance in higher education institutions. The study highlighted that the type of school where a student is enrolled significantly correlates to the student's academic performance, particularly in chemistry. The respondents also narrated deterrent factors. The results of this study will be helpful to the parents; it can provide them with information on their children's academic performance in chemistry and certainly can help their children's learning progression. The study's outcome would inspire educational leaders to refine educational chemistry measures with the identified predictors, which have illustrated significant relationships with students learning, particularly in chemistry, to enhance academic performance. The study's result may guide the school administration to make an effort and address the needs of the students towards excellent chemistry instruction to expand the quality of education in higher institutions.

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