



Analysis of Students' Learning Difficulties in Physical Chemistry: Perspective on Various Sub-Variable

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Abstract

This study aims to identify student learning difficulties in physical chemistry lectures. The subjects are 61 students in the chemistry education study program from two different classes. The research method used is mixed. Data were obtained by using instruments in the form of structured and unstructured questionnaires. Based on the results of the data analysis, several student learning difficulties were identified. Based on unstructured questionnaires, students' learning difficulties in physical chemistry material based on internal factors are caused because students find it difficult to do calculation problems, formulate derivation, and use many formulas. Based on external factors, namely the learning method used. Students prefer learning that is carried out face-to-face in a class by doing a lot of practice questions connected with applying formulas to questions and in everyday life. 55.7% of students in the medium category in learning disorder, 72% of students in the high category in learning disability, 65.5% of students in the medium category in learning dysfunction, 57% of students in the medium category in slowly learner, and 54% of students in the medium category in lower achiever. According to many students, physical chemistry is difficult. In addition, some of the causes of physical chemistry being considered difficult are confusion in analyzing questions, and learning conducted online during the Covid-19 pandemic is considered less effective. Students expect the learning method used to provide many examples and practice questions.

Keywords: Learning difficulty, physical chemistry

Introduction

Two factors cause students to have difficulty learning: internal and external. Biological, health, psychological, intelligence, interests, and talents are internal factors. At the same time, external factors include the environment, home atmosphere, community environment, and the characteristics of the subject matter. The talents and interests of students have a strong influence in terms of internal factors because if the learning materials studied follow their talents, students will enjoy learning. Likewise, with interest in learning, if the learning materials follow students' interests, they will learn as well as possible (Arfani, 2016).

Teachers, subject characteristics, and learning methods used are external factors to the difficulty of student learning outcomes in class. The competence of a teacher has an important role in shaping student achievement. In chemistry subjects, it is especially difficult to find out the causes of learning difficulties experienced by students because these difficulties can be caused by classroom instructions, lack of parental care, and lack of teacher motivation and training (Sagita & Syamsurizal, 2021). Especially in chemistry learning, learning difficulties need to be

studied to identify misconceptions in the material (Tümay, 2016).

For Education to have an effective e-learning system, it is important to adjust learning materials according to a certain difficulty level so that the media can facilitate the learning (Gon & Rawekar, 2017). Interactive multimedia based on auditory, intellectual, and repetition can improve student learning outcomes (Pratama et al., 2017; Wolfson et al., 2014). Three parameters are considered as evaluators of learning difficulties in certain subjects, namely: (a) readability of the text, (b) words that are not commonly used in the text, and (c) the level of information embedded in the text. This approach considers the psycholinguistic features of a given text (Wahyudi & Suradi, 2022).

Physical chemistry is the study of macroscopic, microscopic, atomic, sub-atomic, and particle phenomena in chemical systems and processes based on the principles and concepts of Physics (Kiray, 2016). Based on these characteristics, this knowledge needs to be studied with an appropriate approach to minimize learning difficulties experienced by students, especially from external factors. For example, the problem-based learning model can improve students' scientific

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process skills and academic achievement (Gürses et al., 2007; Sanjiwani et al., 2019). Another learning that can be done is incorporating active learning principles outside lectures. These methods can improve learning and motivation (Partanen, 2020).

Most of the students' learning difficulties in physical chemistry are caused by abstract concepts in physical chemistry, too much weight, teacher-centered learning methods, and low student motivation. These problems come from two different points of view between lecturers and students. Lecturers generally focus on factors related to crowded classes, academic backgrounds, resources, and even students' economic conditions. Meanwhile, students are more critical of the learning content, available resources, lecturers, and teaching methods. Lecturers generally focus on factors related to the course, such as overcrowded classes, lack of resources and staff, and student's academic background and socioeconomic conditions. (Dimitrova & Wellman, 2015; Hahn & Polik, 2004; Sözbilir, 2004)

The researcher analyzed students' learning difficulties in physical chemistry by reviewing various aspects that cause these difficulties. These aspects are in the form of causes of difficulties experienced by students from the internal and external aspects of these students. The researcher examines these aspects from the perspective of students in seeing their inner abilities and from the learning methods carried out by lecturers. This reveals the difference with previous research where learning difficulties experienced by students were reviewed on one side only. For example, on the side of student learning motivation, learning methods, or only student conditions.

Five types of learning difficulties are the focus of this research, namely learning disorder, learning

disability, learning dysfunction, slowly learner, and lower achiever which is an adaptation of research conducted by Hambali (2016). The five types of difficulties represent internal and external factors that cause learning difficulties in students. Based on the description that has been presented, this study aims to identify student learning difficulties in physical chemistry lectures. The problem in this study are 1) the Types of learning difficulties experienced by students in physical chemistry subjects; 2) The causes of learning difficulties experienced by most students in physical chemistry courses

Method

The research method is a mixed method that focuses on data collection and analysis. The object of the research is 61 students of the Department of Chemistry who have passed the Physical Chemistry 1 course. These students are from two classes in the Chemistry Education study program. The instrument was used as a learning difficulty questionnaire adapted from the instrument developed by Hambali (2016).

The questionnaires used were mixed. This questionnaire contains questions that students must answer with four alternative answers on a Likert scale, namely 1,2,3, and 4. The assessment of the answers to statements in this study are:

- 1) Score 1 for the answer strongly agree
- 2) Score 2 for the answer agree
- 3) Score 3 for the answer disagree
- 4) Score 4 for strongly disagree

This study analyzes five learning difficulties: learning disorder, learning disability, learning dysfunction, slow learner, and lower achiever.

Table 1. Indicator of each variable of learning difficulties

No.	Sub-Variable	Indicators
1	Learning disorder	a. Exhaustion
		b. Lack of confidence
		c. The relationship between friends is not good
2	Learning disability	a. Low Learning Concentration
		b. Bad attitude and behavior
		c. Lack of Study Time
3	Learning dysfunction	a. Impaired Vision
		b. Hearing Loss
		c. Low Intelligence Level
		d. Low Memory
4	Slowly Learner	a. Pemberian Tugas tidak sesuai yang diajarkan a. Low Teacher Competence
		b. Less Effective Teaching Method
		c. Less appropriate learning instruments
		d. Inadequate school facilities
		e. The assignment does not match what was taught
5	Lower achiever	a. Low Interest
		b. Low Motivation
		c. Lack of Learning Readiness

The indicators of each variable of learning difficulties can be seen in **Table 1**. The data obtained were analyzed using the following formula:

$$\text{Value} = \frac{\sum \text{Score obtained}}{\sum \text{Max Score}} \times 100$$

The categories for each type of learning difficulty are shown in **Table 2**.

Table 2. Category of learning difficulty level

No	Learning difficulties scale	Category
1	85 – 100	Very High
2	70 – 84	High
3	55 – 69	Medium
4	40 – 54	Low
5	0 – 39	Very Low

Results and Discussion

Analysis of student learning difficulties in physical chemistry was carried out to determine the characteristics of the difficulty students experienced. Based on open-ended questions given to students, 97% of them answered that physical chemistry is a difficult subject. Through an open questionnaire, students are asked questions about a brief description of the physical chemistry course. Some answers that researchers can summarize into major themes, namely:

"Because physical chemistry was new, I faced many difficulties. The difficulty is like using a formula that I don't know and how to derive the formula."

"The application of the material and formulas that have been learned into the problems"

"During the study of Physical Chemistry, I did not understand the material. Maybe because it's a new course or I don't understand. Moreover, the lectures are online, so I don't understand the material presented."

"There are many derivatives of the formula so that they don't understand the concept and are confused about which one to use later".

"For me, the difficulty I experienced was that it was a bit difficult to remember the formulas in physical chemistry because there were so many formulas used".

Based on some of the student statements above, it can be seen that most of the causes of physical chemistry being considered difficult by students are because many formulas are used. This shows that students have difficulty learning the concept of calculation if their mathematical ability is low because there is a significant relationship between mathematical ability and calculation (Merdekawati, 2013).

Several statements by these students indicate that the cause of learning difficulties experienced is an internal factor. To find out the existence of external factors that cause difficulties in learning outcomes, the researchers gave open questions to students regarding the learning methods expected by students. The learning method is one of the external factors that come from the teacher or lecturer. Based on these questions, some students gave the following answers.

"Online learning through platform applications is less effective, so students are made lazy, while offline students are required to enter class on time."

"Perhaps you can give a lot of examples of questions."

"Both online and offline may be explained with examples of its application so that students can easily imagine what is being explained. Then maybe it can be explained in a basic way first. Because students will find it difficult if they don't understand the basic material."

"Online, I do not understand what the lecturer is explaining because the network is not supportive, while offline, I understand more what the lecturer is saying because I immediately listen and respond to what the lecturer explains".

Based on some student statements, the researcher can outline the solution to the learning method, which should be carried out face-to-face in a class by providing many practice questions that are discussed together. In addition, students also hope that material delivery is carried out slowly by first conveying fundamental concepts and combined with approaches related to the application of the material in questions and everyday life.

This is reinforced by Rai et al. (2017) that teachers or lecturers must use an innovative learning system to increase student learning motivation. Through increasing student learning motivation, learning difficulties caused by internal factors can be overcome by external sources.

Apart from the qualitative results obtained from open-ended questions, students were also given a closed questionnaire with several choices chosen by students according to their experiences. Opportunity to convey the difficulties experienced in studying physical chemistry courses. The researcher analyzed five sub-variables of learning difficulties in this section: learning disorder, learning disability, learning dysfunction, slow Learner, and lower achiever. These sub-variables are part of the factors that cause learning difficulties internally and externally.

Each sub-variable of learning difficulties is presented as a category diagram. The diagram shows the percentage of students who have difficulty in certain categories. The purpose of presenting this data is to determine the level of difficulty experienced by students in each sub-variable.

Figure 1 shows the categories of student learning difficulties in the sub-Variable of learning disorder. This section deals with students' abilities in physical aspects, social relationships, and self-confidence. Based on the data in the figure, it can be seen that in this learning difficulty, sub-variable, 56% of students are in the medium category. Followed by the high category as much as 26%. Not the number of students in the very low category for this learning difficulty. This shows that students tend to have learning difficulties due to physical conditions (fatigue while studying) and a lack of self-confidence in undergoing physical chemistry lectures.

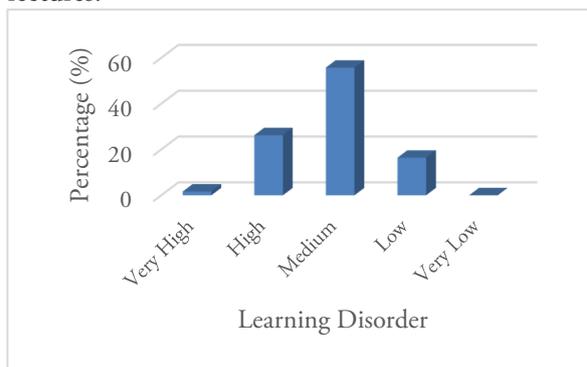


Figure 1. Category of student learning disorder

The findings on this sub-variable explain that the learning difficulties experienced by students vary in level. The percentage of students in the medium category is the highest. This shows that physical aspects, social relations, and self-confidence do not have a big effect on learning difficulties in physical chemistry. Even so, these factors have little influence on the learning difficulties experienced by students. This can be seen from the second highest percentage in the high category, followed by the low and very high categories. This is in line with research conducted by *Dimitrova & Wellman (2015)* that most of the factors that affect student learning difficulties are material characteristics, learning methods, student learning motivation, facilities and infrastructure, and student cognitive abilities.

The second sub-variable of learning difficulties is learning disability. In this section, the learning difficulties experienced by students are viewed from the attitude and concentration of students in learning physical chemistry. The figure shows as many as 54% of students are in the high category, which means that more than half of the students answered that they had high learning difficulties according to the indicators in this sub-variable. The next category is followed by the medium, very high, low, and not in the very low category. This shows that students' learning difficulties in physical chemistry are quite influenced by concentration and student attitudes in the learning process. Students tend to pay close attention when the lecturer explains this material, but they find it difficult to concentrate well. one of the things related to attitude is a discipline where students who are disciplined in learning have a

positive influence on their learning achievement (*Senjaya et al., 2020*). This is due to the characteristics of physical chemistry they are studying for the first time.

The third sub-variable of learning difficulties is learning dysfunction. This section is related to the cognitive abilities of students. This shows that one of the internal factors possessed by students is the cause of difficulties in studying physical chemistry.

Based on **Figure 3**, we can see that 66% of



Figure 2. Category of student learning disability

students are in the medium category in this sub-variable. This shows that most students have average abilities in the cognitive aspect, meaning that when students study physical chemistry, they can try to understand based on the explanations given by the lecturer. It's just that according to the students' questions, they have difficulty. One of them is due to the learning method that is considered less effective for them. This is explained in the slow learner sub-variable.

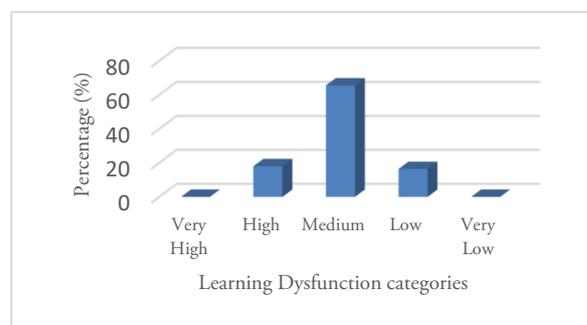


Figure 3. Category of student learning dysfunction

Next up is the slow Learner. This sub-variable relates to external factors that cause learning difficulties. In this section, students are asked questions about their views on the learning methods used by lecturers. This sub-variable data is shown in **Figure 4**. The figure shows as many as 57% of students are in the medium category, followed by the high category as much as 25%. This shows that students view the learning methods used by lecturers as one of the main external factors that cause them to experience learning difficulties in physical chemistry subjects. This is closely related to the learning methods carried out online during the Covid-19 pandemic. Students admit that they have difficulty understanding physical chemistry due to virtual learning. This can also lead to low student

learning motivation. This learning motivation is included in the next sub-variable.

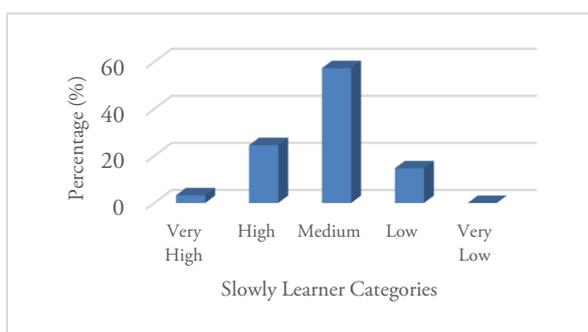


Figure 4. Category of slowly learner

The last sub-variable is a lower achiever. This learning difficulty is related to students' learning motivation. Learning motivation is related to students' enthusiasm for learning while receiving the material and preparing for the exam (Lin et al., 2017; Zhou et al., 2016). As many as 56% of students with learning difficulties related to motivation are in the medium category.

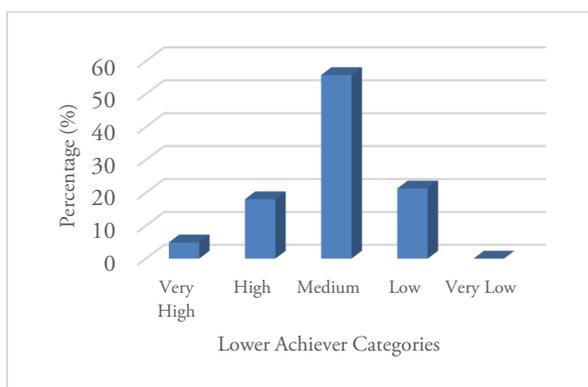


Figure 5. Category of lower achiever

The category with the highest number of students is low. This shows that students' learning motivation tends to be low due to external factors such as learning methods and several internal factors that have been described previously.

Conclusion

Students are of the view that physical chemistry is difficult to understand. Two things cause physical chemistry to be seen as a difficult material by students, namely the characteristics of the material with many chemical formulas and calculations and learning methods that are considered less efficient. Students want physical chemistry to be taught with the face-to-face method in the classroom (not online) and include many lecturers giving practice questions related to the material presented. The percentage of the highest category in each sub-variable of learning difficulties experienced by students is 55.7% of students in the medium category in learning disorder, 72% of students in the high category in learning disability, 65.5% of students in the medium category in learning dysfunction, 57% of students in the

medium category in slowly learner, and 54% of students in the medium category in lower achiever.

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References

- Arfani, L. (2016). Mengurai hakikat pendidikan, belajar dan pembelajaran. *Jurnal PPKn & Hukum*, 11(2), 81-97.
- Dimitrova, D., & Wellman, B. (2015). Special issue part II: Networked research. *American Behavioral Scientist*, 59(5), 527-530.
- Gon, S., & Rawekar, A. (2017). Effectivity of e-learning through whatsapp as a teaching learning tool. *MVP Journal of Medical Sciences*, 4(1), 19-25.
- Gürses, A., Açıkyıldız, M., Doğar, Ç., & Sözbilir, M. (2007). An investigation into the effectiveness of problem-based learning in a physical chemistry laboratory course. *Research in Science & Technological Education*, 25(1), 99-113.
- Hahn, K. E., & Polik, W. F. (2004). Factors influencing success in physical chemistry. *Journal of Chemical Education*, 81(4), 567-572.
- Hambali, M. (2016). *Kesulitan belajar siswa kelas x pada mata pelajaran mekanika teknik dan elemen mesin di SMK Negeri 2 Wonosari*. Unpublished master's thesis. Sleman, Yogyakarta: Universitas Negeri Yogyakarta.
- Kiray, S. A. (2016). The pre-service science teachers' mental models for concept of atoms and learning difficulties. *International Journal of Education in Mathematics, Science and Technology*, 4(2), 147-162.
- Lin, M., Chen, H., & Liu, K. (2017). A study of the effects of digital learning on learning motivation and learning outcome. *EURASIA Journal of Mathematics, Science and Technology Education*, 13(7), 3553-3564.
- Merdekawati, K. (2013). Pengaruh kemampuan matematik terhadap prestasi belajar kimia. *Jurnal Inovasi dan Kewirausahaan*, 2(1), 26-31.
- Partanen, L. (2020). How student-centred teaching in quantum chemistry affects students' experiences of learning and motivation a self-determination theory perspective. *Chemistry Education Research and Practice*, 21(1), 79-94.
- Pratama, I. W. A., Mahadewi, L. P. P., & Suartama, I. K. (2017). Pengembangan multimedia

- interaktif berbasis model vak pada mata pelajaran IPA siswa kelas V di SDN 2 Banjar Bali. *Jurnal Edutech Undiksha*, 05(1), 132-141.
- Rai, I. G. A., Suryatini, K. Y., & Budiayasa, I. W. (2017). Upaya meningkatkan motivasi dan hasil belajar melalui penerapan beberapa metode pembelajaran inovatif. *Jurnal Edukasi Matematika dan Sains*, 6(2), 180-193.
- Sagita, S., & Syamsurizal. (2021). Pengembangan multimedia interaktif berbasis pendekatan kontekstual untuk meningkatkan kemampuan berpikir kritis siswa pada materi laju reaksi. *Journal of Chemical Education*, 10(3), 268-273.
- Sanjiwani, N. L. I., Muderawan, I. W., & Sudiana, I. K. (2019). Analysis of student chemistry learning difficulties on buffer solution at SMA Negeri 2 Banjar Buleleng Bali. *Journal of Physics: Conference Series*, 1503, 1-6.
- Senjaya, P., Kotamena, F., Ong, F., Andika, C. B., Purwanto, A., & Pramono, R. (2020). School environmental influences, student discipline and learning motivation toward increasing senior high students achievement. *International Journal of Advanced Science and Technology*, 29(5), 4572-4586.
- Sözbilir, M. (2004). What makes physical chemistry difficult? perceptions of Turkish chemistry undergraduates and lecturers. *Journal of Chemical Education*, 81(4), 573-578.
- Tümay, H. (2016). Emergence, learning difficulties, and misconceptions in chemistry undergraduate students' conceptualizations of acid strength. *Science & Education*, 25(1-2), 21-46.
- Wahyudi, A., & Suradi, A. (2022). Usaha pendidik dalam membimbing siswa pada materi teks eksplanasi. *Jurnal Pendidikan Bahasa dan Sastra Indonesia*, 1(1), 33-43.
- Wolfson, A. J., Rowland, S. L., Lawrie, G. A., & Wright, A. H. (2014). Student conceptions about energy transformations: Progression from general chemistry to biochemistry. *Chemistry Education Research and Practice*, 15(2), 168-183.
- Zhou, S., Wang, Y., & Zhang, C. (2016). Pre-service science teachers' PCK: Inconsistency of pre-service teachers' predictions and student learning difficulties in newton's third law. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(3), 373-385.