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Learning Motivation of Science Education Students on Biochemical Learning Outcomes: Profile and Correlation

Dea Santika Rahayu[a*], Setia Rahmawan[b], Ayu Lestari[a], Ismun Nisa Nadhifah[a], Paskalia Pradanti[c]

[a] Department of Science Education, Faculty of Teacher Training and Education, Universitas Tidar, Indonesia
[b] Department of Chemistry Education, Faculty of Tarbiyah and Education, UIN Sunan Kalijaga Yogyakarta, Indonesia
[c] Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Tidar, Indonesia

*Corresponding author: Jl. Kapten Suparman No.39, Potrobangsan, Magelang Utara, Kota Magelang, Jawa Tengah 56116, Indonesia. E-mail address: dea.santika@untidar.ac.id

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a b s t r a c t

Learning motivation is an important aspect that can encourage students to carry out learning. Self-Determination Theory assumes that individuals have basic psychological needs to develop and learn which include competence, relatedness, and autonomy. This study aims to characterize student learning experiences in the affective aspect (motivation) related to learning outcomes (Theory and Practicum). The researchers used the descriptive correlation research design to describe students' motivation profiles and provide an overview of the relationship between chemistry learning motivation and learning outcomes in Biochemistry courses (Theory and Practicum). The data was collected using the AMS-Chemistry instrument, which was analyzed through descriptive statistics and Pearson correlation analysis. The AMS-Chemistry consists of a motivation subscale, extrinsic motivation, and intrinsic motivation, which are spread into 28 statements, which was validated and reliable. The research subjects used 40 students from a total population of 118 people. Overall, the motivation profile to learn chemistry in science education students on the amotivation subscale tends to disagree, extrinsic motivation with a tendency to agree, and the subscale of intrinsic motivation with a tendency to strongly agree. Student learning outcomes in Biochemistry (Theory) courses have a significant relationship with extrinsic motivation (external regulation, introjected regulation, identified regulation) and intrinsic motivation (to know, to experience), while in Biochemistry (Practicum) has a significant relationship with motivation extrinsic (identified regulation) and intrinsic motivation (to know, to accomplish, to experience). This finding is a reflection that can be used as a reference in developing further learning.

1. Introduction

The nature of learning Natural Sciences is as a scientific attitude, product, and process (Desstya et al., 2018; Ismiyanti, 2020). Learning is needed to achieve the essence of science learning, which includes cognitive, affective, and psychomotor aspects. The cognitive aspect involves understanding concepts and theories in science, the affective aspect involves feelings and attitudes toward the material being taught, and the psychomotor aspect involves practical and motor skills in applying knowledge and skills. These aspects are interrelated and contribute to a comprehensive understanding of science material. Thus, science learning is expected to produce individuals who can understand themselves and their surroundings and apply this knowledge in everyday life.

The role of the affective aspect in science learning is a field of research that is widely carried out throughout the world. In particular, studying the importance of motivation to learn in the academic world has widely recognized. Various theoretical perspectives and frameworks have been developed as a reference for educational research (Koballa & Glynn, 2013). Motivation to learn is a psychological condition of students that raises, guarantees continuity, and provides direction for learning activities to achieve learning objectives. Motivation encourages individuals and their environment to do something to achieve the desired goals. Motivation can also foster an individual's desire to learn by feeling happy without the burden and excited. Learning motivation is an essential factor in effective learning. In science learning, learning motivation can influence students to develop their interest and knowledge in learning (Ryan & Deci, 2000).

Several studies have proved the importance of learning motivation in effective learning. Several studies have found that students who have high learning motivation tend to have better learning outcomes and have a greater desire to continue learning the material (Deci et al., 1999; Elliot & Covington, 2001; Sevinc et al., 2011). This motivation is the initial factor that students have that will determine the direction of learning. Learning will be easy, fun, and meaningful when students already know the initial goals of learning through their motivation. But in fact, every student has different motivations. This motivation is influenced by the environment in which the student grows and develops.

According to the social cognitive perspective, students form the structure of their motivation by interpreting information from their school environment (among other sources), and there is evidence of the influence of school environment factors on students' motivation to learn science (Ardura et al., 2021 (Ardura et al., 2021). The social cognitive perspective also proposes that students form their perceptions of motivation by interpreting experiences from their school environment, which include students' feelings towards science teachers, school vision and mission, values in the school environment, and student performance in carrying out assignments and learning activities also play a significant role (Vedder-Weiss & Fortus, 2013).

Self-Determination Theory (SDT) assumes that individuals have fundamental psychological needs to be met to develop and learn (Pratt et al., 2022). These needs include competence, relatedness, and autonomy. Therefore, the need for knowledge to understand the motivational structures of students formed in different cultural contexts and practices (Ardura et al., 2021; Pintrich & De Groot, 2003). Competence is an individual's need to feel effective in interacting, expressing their understanding and abilities, and seeking challenges appropriate to their cognitive level. Relatedness is an individual's need for connection, attention, and a sense of belonging to the community. Autonomy is the need for individuals to feel in control of their environment, actions, and behavior. These needs factor into three types of sustainable motivation based on autonomy (Howard et al., 2017).

According to SDT, when teachers are considered controllers during teaching, students tend to be less independent in learning (Soenens et al., 2012). SDT also predicts that when teachers have high autonomy support, students will be more independent in learning (Vansteenkiste et al., 2012).

In a context that supports autonomy, where students are given a choice to do different things in class while the teacher has a role as a facilitator, students' intrinsic motivation will be aroused. Students with intrinsic motivation tend to learn because of curiosity and deep interest and are more active in learning (Zimmerman, 2000). Other studies have also revealed that students' intrinsic motivation is positively related to their academic experience (Liu et al., 2017), and differences in gender motivation can be associated with learning experiences (Nissen & Shemwell, 2016).

This research is an initial investigation regarding student learning experiences in the Biochemistry course (Theory and Practicum). The aim is to characterize students' experiences in the course, including affective (motivated) experiences using the Academic Motivation Scale - Chemistry (AMS-Chemistry) (Liu et al., 2017) which is linked to student learning outcomes in the course. This research can provide information to lecturers or other education practitioners to understand student learning motivation in detail to help improve learning practices and promote effective learning.

2. Method

This study uses a correlation descriptive research design to find the direction and magnitude of the relationship between variables through correlational statistics (Gall et al., 2007). The variables provide an overview of the relationship between motivation to learn chemistry in Science Education students and learning outcomes in Biochemistry courses (Theory and Practicum). Among the various descriptive research designs, this study applies two designs: survey and correlation. Survey designs provide quantitative or numerical descriptions of a population's trends, attitudes, or opinions by studying a population sample. From the sample results, researchers generalize or make claims about the population (Creswell & Creswell, 2017).

The sampling technique is convenience sampling, where the researcher selects a sample that fits the research objectives and is comfortable with the researcher (Gall et al., 2007). The sample is said to be convenient for research because the sample is located near and easily accessible by researchers, for example, students from classes supervised by researchers. The research subjects used 40 students from a total population of 118 people. The population of this study consisted of science education students taking Biochemistry courses (Theory and Practicum) at one of the Education Universities in Magelang.

The instrument used in this study was an adaptation of the Academic-Chemical Motivation Scale (AMS-Chemistry) instrument used for science education students to measure amotivation subscale, three extrinsic motivations, and three intrinsic motivations, divided into 28 statements according to Figure 1. Each subscale has four statements/items with Likert-type answer formats (Carifio & Perla, 2007; Ruel et al., 2018). The response consists of a score of 1 (Strongly Disagree), 2 (Disagree), 3 (Enough), 4 (Agree), and 5 (Strongly Agree). The instrument has three main types of validity evidence relating to content, response processes, and internal structure. Content validity was examined by expert panel discussion to reach consensus. Response process validity evidence show that no problems of poor readability, none of the phrasing required modification. Internal structure validity evidence used CFI value (0.94) met the suggested criterion of greater than 0.90, the SRMR value (0.058) met the suggested criterion of smaller than 0.08, and RMSEA value (0.059) met the suggested criterion of smaller than 0.06. The results showed that this model is very close to the true underlying model of the data. The internal consistencies of the subscales were estimated by Cronbach's alpha coefficients. The results show a satisfactory level of internal consistency at time 1 and time 2. At time 1, the alpha coefficient is between 0.74 and 0.91. At Time 2, the alpha coefficient was between 0.79 and 0.90 for the seven subscales (Liu et al., 2017).

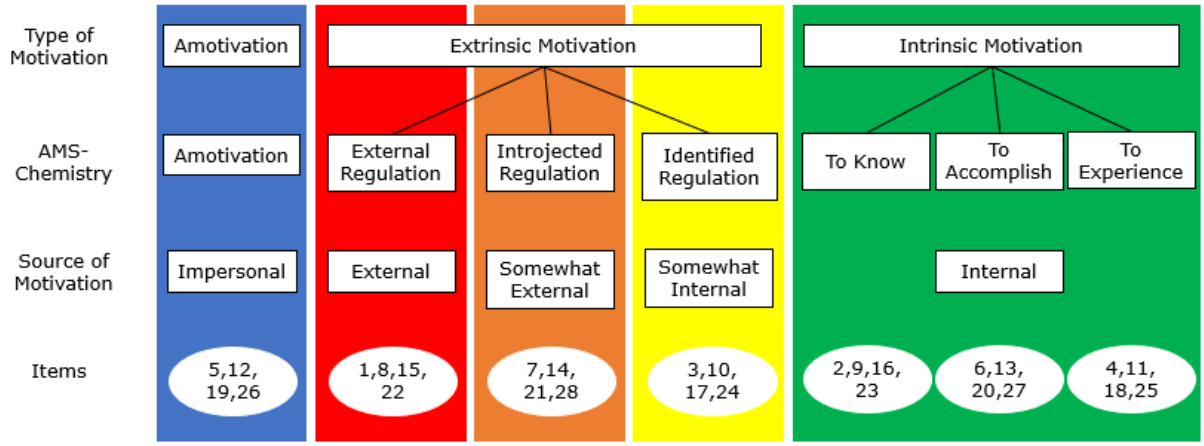


Figure 1. Subscales of AMS-Chemistry adapted (Liu et al., 2017)

A high amotivation subscale score indicates that students have little hope of passing learning. Extrinsic motivation includes external regulation, introjected regulation, and identified regulation. This extrinsic motivation shows external factors that influence a person's motivation, for example, future job/career, self-evident and ability preparation. Intrinsic motivation is classified into subscales: to know, achieve, and experience (Liu et al., 2017). These three types of intrinsic motivation are based on the intrinsic motivation literature (Deci, 1975) which shows that people are intrinsically motivated for different reasons. However, that does not mean that each of these subscales is more decisive than the others.

Data collection was carried out by distributing questionnaires to 40 Science Education students university in Magelang which were done online. Then an analysis was carried out by calculating the percentage of each student's response for each subscale on AMS-Chemistry instrument. A higher mean score on the subscale indicates that the individual agrees more with the response statement. This is evidence that these students have a type of regulation on this motivation for each subscale. The analysis performed included normality tests and correlation tests using SPSS 25. The correlation analysis was carried out between the variables of learning motivation and the learning outcomes of Science Education students in the Biochemistry course (Theory and Practicum). To determine the significant relationship between the two variables, hypothesis testing was carried out. Hypothesis testing is done when all the data has been collected. Hypothesis testing is done to prove the truth of the previous hypothesis. The hypothesis is a temporary assumption or answer to the formulation of the research problem (Sugiyono, 2014). Hypothesis testing is used to determine whether or not there is an influence of the independent variable on the dependent variable. The testing technique in this study was assisted by SPSS 25 by calculating Pearson's r value. The design of hypothesis testing in this study as follows.

H_o : There is no significant correlation between learning motivational subscales and the learning outcomes in the Biochemistry course (Theory and Practicum).

H_a : There is a significant correlation between learning motivational subscales and the learning outcomes in the Biochemistry course (Theory and Practicum)

The hypothesis test used in this research is the Pearson Test using SPSS 25. The basis for making a decision on the Pearson test can be seen from the value of Sig. (2-tailed). When the value of Sig. (2-tailed) smaller or equal to 0.05, there is a statistically significant correlation between the two variables (H_o rejected dan H_a accepted) and if the value is greater than 0.05 then there is no statistically significant correlation between the two variables (H_o accepted dan H_a rejected) (Schober et al., 2018).

3. Result and Discussion

Profile of Motivation to Learn Chemistry for Science Education Students

The first analysis to be carried out is to calculate the distribution of the average percentage of responses from each subscale in AMS-Chemistry. Data on students' motivation in this study included amotivation subscale, extrinsic motivation (external regulation, introjected regulation, identified regulation), and intrinsic motivation (to know, to accomplish, to experience). Four statements represent each subscale. In summary, data on motivation to learn chemistry for science students using the AMS-Chemistry instrument for each subscale is presented in Figure 2.

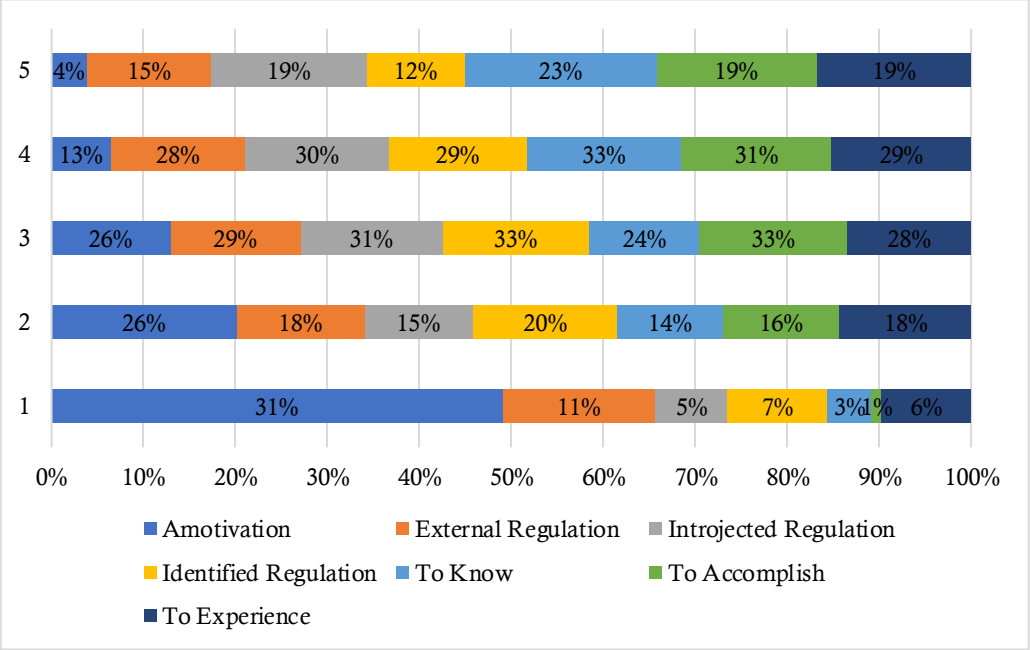


Figure 2. Average Percentage of Responses

A high amotivation score response indicates that students have no hope and enthusiasm to pass the learning. Based on the graph in Figure 2., the amotivation subscale tends for student responses to be higher towards strongly disagree responses. The average percentage of the high amotivation subscale response is in the response of strongly disagree (31%), disagree (26%), and sufficient (26%). This shows that Science Education students have the motivation to learn in Biochemistry course (Theory and Practicum), which is led by the tendency for scores to strongly disagree and disagree high on the motivational scale or not having the motivation to learn. Learning motivation is important for every student because it forms concepts, learning strategies, and learning outcomes (Tuan et al., 2005). Each student has different reasons to foster interest in learning. It can be either extrinsic motivation or intrinsic motivation.

Based on the graph in Figure 2., extrinsic motivation tends for student responses to be higher toward agreeing responses. In this study, extrinsic motivation is divided into three subscales: external regulation, introjected regulation, and identified regulation. The average percentage of responses on the external regulation subscale is high in the responses are enough (29%) and agree (28%). High external regulation scores indicate that students are motivated to take lectures influenced by external factors, namely, to get better careers and jobs in the future. The average percentage of responses to the introjected regulation subscale was high in enough (31%) and agree (30%) responses. An increased introjected regulation score indicates that students are motiv ated to take lectures to prove they are capable and successful in completing lessons. The average percentage of responses on identified regulation subscale is high in enough (33%) and agree (29%)

responses. High identified regulation scores indicate that students believe that they can prepare themselves and improve their career skills by taking lectures. Thus, the subscale that has the highest score on external motivation is identified regulation score, which indicates that students generally have the confidence to prepare skills during the learning process. These skill preparations will help students towards the desired career or job.

Furthermore, intrinsic motivation tends for student responses to be higher towards agreeing to reactions with several additions from sufficient to agree, which is higher than extrinsic motivation. This shows that most students have stronger intrinsic motivation in Biochemistry lectures (Theory and Practicum). In this study, intrinsic motivation is divided into three subscales: to know, to accomplish, and to experience. The average percentage of the subscale responses to know is high response in enough (24%), agree (33%), and strongly agree (23%). In Education, a high to know subscale score indicates that students feel pleasure and satisfaction in understanding something that was previously unknown or unclear. These results were obtained from student involvement in learning activities. Thus learning activity is a way to increase student learning motivation. Learning activities can include the use of worksheets (Husna et al., 2020), use of modules (Ali et al., 2019), and the implementation of practicum in learning (Sari et al., 2016). The average percentage of subscale responses to accomplish is high response in enough (33%) and agree (31%). In this case, a high achievement score indicates that the student enjoys the achievement process in and of itself. The average percentage of the subscale responses to experience were high at enough (28%), agree (29%), and strongly agree (19%) responses—a high score to experience means that confident students carry out activities in lectures to feel their sensations. Overall, students' intrinsic motivation in studying chemistry showed agree and strongly agree responses with high scores. This shows that students have the desire to study chemistry that arises on their own with different goals, namely, to know, to accomplish, and to experience. Nonetheless, there is a subscale on intrinsic motivation with the highest tendency score to agree, namely the to know and accomplish subscale. This shows that the learning experiences carried out by students can help those who need to learn something or are wrong about a concept to know and understand the concept as a whole. Thus, students can obtain maximum learning outcomes and feel satisfied about it.

Relationship between Chemistry Learning Motivation and Biochemistry Learning Outcomes (Theory and Practicum)

Furthermore, a correlation analysis was carried out between these variables to find out the relationship between motivation and learning outcomes in Biochemistry lectures (Theory and Practicum). Student response scores for all measurements are normally distributed, as shown by the Kolmogorov-Smirnov normality test results with a Sig value. 0.200 listed in Table 1. If the Sig. more than 0.05, the data is normally distributed (Field, 2017). Thus, the correlation analysis used is Pearson Correlation.

Table 1. Normality Test

	Kolmogorov-Smirnova		
	Statistics	**Df**	**Sig.**
Amount	.113	40	.200 *

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

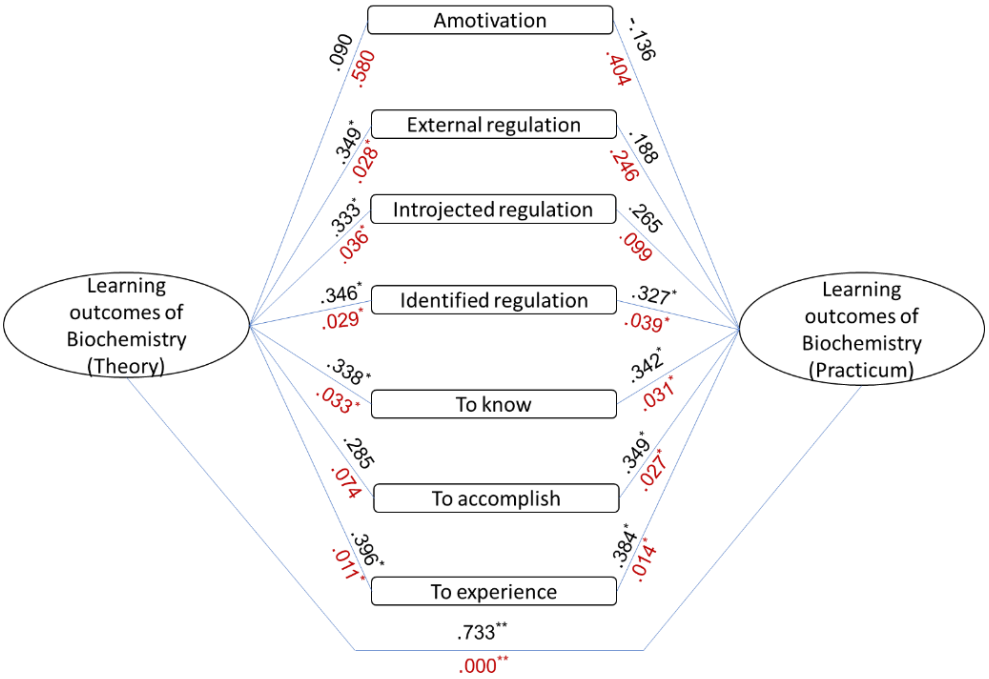
Correlation is a technique for measuring the relationship between two quantitative and continuous variables (Ahlgren et al., 2003). Pearson Correlation Analysis is used to determine if there is a relationship between two variables and measure the relationship's strength and direction. Pearson's correlation coefficient (r) is used to measure the strength of the relationship between two

variables. The strength of the Pearson Correlation coefficient that must be followed is the value of r (Field, 2017). If the value of r is more than zero, then the result tends to be positive. Otherwise, if the value of r is less than zero, the relationship is more negative. To determine the significant relationship between the two variables, hypothesis testing was carried out. The design of hypothesis testing in this study as follows.

Ho : There is no significant correlation between learning motivational subscales and the learning outcomes in the Biochemistry course (Theory and Practicum).

Ha : There is a significant correlation between learning motivational subscales and the learning outcomes in the Biochemistry course (Theory and Practicum)

The relationship can be seen from the value of Sig. (2-tailed). When the value of Sig. (2-tailed) smaller or equal to 0.05, there is a statistically significant correlation between the two variables (Ho rejected dan Ha accepted) and if the value is greater than 0.05 then there is no statistically significant correlation between the two variables (Ho accepted dan Ha rejected) (Schober et al., 2018). The results of the Pearson correlation test based on r value for each variable are listed in Figure 3. below.



**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 3. Result of Pearson Correlation Test (r and sig. values)

The results of the correlation analysis showed that five of the seven motivational subscales on the AMS-Chemistry instrument had significant relationship with learning outcomes in Biochemistry (Theory) based on the sig. obtained on each of these subscales is smaller than 0.05. As for the value of sig. obtained on the external regulation subscale; introjected regulation; identified regulation; you know; to experience, namely 0.028; 0.036; 0.029; 0.033; 0.011. In contrast, for Biochemistry learning outcomes (Practicum), there was a correlation between the four subscales based on the sig. obtained on each of these subscales is smaller than 0.05. As for the value of sig. obtained on the identified regulation subscale; to know; to accomplish; to experience, namely 0.039; 0.031; 0.027; 0.014. As for knowing the strength of the relationship between

variables, the correlation coefficient (r value) data is used, obtained from the statistical test results using SPSS 25. Each r value is interpreted based on Table 2. below.

Table 2. Interpretation of Correlation Coefficient

No	Correlation Coefficient	Interpretation
1	0.00	No correlation
2	0.01-0.09	Very low correlation
3	0.10-0.29	Slight correlation
4	0.30-0.49	Moderate correlation
5	0.50-0.69	High correlation
6	0.70-0.89	Very high correlation
7	>0.90	Perfect correlation

Biochemistry (Theory) learning outcomes have a significant correlation with all extrinsic motivation subscales based on the sig. value that obtained on each of these subscales is smaller than 0.05. Based on the value of r in Figure 3 compared with Table 2., the strength of the relationship for the external regulation, introjected regulation, and Identified regulation subscales, which is interpreted to mean a moderate correlation on all subscales with a value of r at 0.30-0.49. This shows that by doing this biochemistry lecture, students believe they can prepare themselves for a better career. A career is one of a person's goals in learning something. This is in line with findings (Qodriah et al., 2019) that career motivation in a person can encourage progress in achievement. When learning activities are not enjoyable or satisfying, there is little motivation that can guide individuals to engage in learning, called extrinsic motivation (Legault, 2016).

The results of studying Biochemistry (Practicum) correlate significantly with all subscales of intrinsic motivation based on the sig. value that obtained on each of these subscales is smaller than 0.05. Thus, based on the value of r in Figure 3 compared with Table 2., the strength of the relationship for the intrinsic motivation, such as to know, to accomplish, and to experience subscales, which is interpreted to mean a moderate correlation on all subscales with a value of r at 0.30-0.49. This shows that intrinsic motivation has an important role in fostering interest and interest in learning something. Intrinsic motivation refers to individuals' involvement in performing satisfying or pleasurable activities. In the Biochemistry (Practicum) course, lectures are carried out through practicum activities where students perform experiments in groups with the guidance of lecturers. These activities can provide a pleasant learning experience for students, which is characterized by a significant relationship with student learning outcomes. Thus the selection of learning methods (Ernawita & Safitri, 2018; Harum et al., 2020) and the use of learning media (Pradilasari et al., 2020) are important factors for growing students' intrinsic motivation. This is in line with the SDT theory that individuals have fundamental psychological needs to be met to develop and learn, including competence, relatedness, and autonomy (Howard et al., 2017; Pratt et al., 2022; Ryan & Deci, 1985).

In addition, even though other subscales do not have a significant correlation, it is necessary to pay attention to the magnitude of the correlation value and the sign of the correlation value based on the value of r in Figure 3 compared with Table 2. To accomplish (slight correlation and positive in theory), external regulation and introjected regulation (slight correlation and positive in practicum), and amotivation (slight correlation and negative). These subscales further support the claim of SDT Theory that amotivation (lack of motivation) inhibits learning while intrinsic and extrinsic motivation components support learning (Pratt et al., 2022). Thus, these results provide further empirical evidence about the impact of learning influences, especially student motivation and student learning outcomes. Then the results of learning Biochemistry theory and practice have

a very significant correlation (1% significance) with a sig. 0.000 is smaller than 0.001. In addition, the strength of the relationship based on the value of r obtained is 0.733, which can be interpreted as having a very high correlation in the value range of 0.70-0.89. This indicates that the higher the student's theoretical value, the more supportive the student's ability to carry out experimental activities in his group. High learning outcomes can help students understand and apply the concepts taught in practicum activities (Sari et al., 2016).

4. Conclusion

Based on the study results, the motivation profile to learn Chemistry in Science Education students using the AMS-Chemistry instrument on the amotivation subscale tends strongly disagree (31%) and disagree (26%). On intrinsic motivation, the to know subscale tends to agree (33%) and strongly agree (23%), the to accomplish subscale has a high score on enough (33%) and agrees (31%) responses, and then to experience subscale tends to respond agree (29%) and strongly agree (19%). Extrinsic motivation includes the external regulation subscale having a tendency to respond enough (29%) and agree (28%), the introjected regulation subscale having a high score on enough (31%) and agree (30%) responses, and the identified regulation subscale having an enough (33 %) and agree (29%) response tendency. Based on the results of the correlation analysis, it can be concluded that five (external regulation, introjected regulation, identified regulation, to know, and to experience) of the seven motivational subscales on the AMS-Chemistry instrument have a significant relationship with learning outcomes in the subject of Biochemistry (Theory). At the same time, there is a correlation in the learning outcomes of Biochemistry (Practicum) on four subscales (identified regulation, to know, to accomplish, and to experience). Thus extrinsic motivation has a more role in learning Biochemistry (Theory) with moderate correlation, while intrinsic motivation has more role in learning outcomes of Biochemistry (Practicum) with moderate correlation. In addition, there is a significant relationship between the learning outcomes of Theory and Practicum Biochemistry with very high correlation which indicates that one's knowledge will be in line with his ability to carry out practical activities.

References

Ahlgren, P., Jarneving, B., & Rousseau, R. (2003). Requirements for a cocitation similarity measure, with special reference to Pearson's correlation coefficient. *Journal of the American Society for Information Science and Technology*, *54*(6), 550–560. https://doi.org/10.1002/ASI.10242

Ali, A., Nawidi, M. F., Nurusshobah, N., & Sadiah, S. D. (2019). Chemistry learning based on kibas asah module (wetland-based chemistry) integrated ar-sparkol on buffer solution material: Students' cognitive and motivation diagnostic. *Scientiae Educatia: Jurnal Pendidikan Sains*, *8*(1), 103-118. https://doi.org/10.24235/sc.educatia.v8i1.3325

Ardura, D., Zamora, Á., & Pérez-Bitrián, A. (2021). The role of motivation on secondary school students' causal attributions to choose or abandon chemistry. *Chemistry Education Research and Practice*, *22*(1), 43–61. https://doi.org/10.1039/D0RP00168F

Carifio, J., & Perla, R. J. (2007). Ten common misunderstandings, misconceptions, persistent myths and urban legends about likert scales and likert response formats and their antidotes. *Journal of Social Sciences*, *3*(3), 106–116. https://doi.org/10.3844/JSSP.2007.106.116

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. SAGE Publications

Deci, E. L. (1975). Intrinsic motivation. *Intrinsic Motivation*. https://doi.org/10.1007/978-1-4613-4446-9

Deci, E. L., Ryan, R. M., & Koestner, R. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*(6), 627–668.

https://doi.org/10.1037/0033-2909.125.6.627
Desstya, A., Hapsari, U. W. R., & Azizunniza. (2018). Joyfull learning in science (Pelatihan percobaan ipa sederhana di SD Bener I Dan Bener II). *The 8th University Research Colloquium 2018 Universitas Muhammadiyah Purwokerto*, *2*(1), 51–56. http://repository.urecol.org/index.php/proceeding/article/view/328
Elliot, A. J., & Covington, M. V. (2001). Approach and avoidance motivation. *Educational Psychology Review*, *13*(2), 73–92. https://doi.org/10.1023/A:1009009018235
Ernawita, E., & Safitri, R. (2018). Penerapan model pembelajaran kooperatif tipe student teams achievement division terhadap motivasi belajar peserta didik di SMAN 8 Banda Aceh. *Jurnal Pendidikan Sains Indonesia*, *6*(1), 9–16. https://doi.org/10.24815/jpsi.v6i1.10713
Field, A. (2017). *Discovering statistics using IBM SPSS Statistics (Electronic Version)*. 1–1104.
Gall, M., Gall, J., & Borg, W. (2007). *Gall, M., Gall, J., & Borg, R. (2007). Educational research An introduction (8th ed.). New York, NY Pearson Education. - References - Scientific Research Publishing* (8th ed.). Pearson Education.
Harum, C. L., Syukri, M., Yusrizal, Y., & Nurmaliah, C. (2020). Pengaruh model pembelajaran generatif berbasis PhET terhadap keterampilan berpikir kritis dan motivasi belajar siswa pada materi gelombang. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 164–174. https://doi.org/10.24815/jpsi.v8i2.15776
Howard, J. L., Gagné, M., & Bureau, J. S. (2017). Testing a continuum structure of self-determined motivation: A meta-analysis. *Psychological Bulletin*, *143*(12), 1346–1377. https://doi.org/10.1037/BUL0000125
Husna, E. F., Adlim, M., Gani, A., Syukri, M., & Iqbal, M. (2020). Developing STEM-based student worksheet to improve students' creativity and motivation of learning science. *Scientiae Educatia: Jurnal Pendidikan Sains*, *9*(1), 57. https://doi.org/10.24235/sc.educatia.v9i1.6440
Ismiyanti, N. (2020). Perancangan pembelajaran IPA menggunakan software videoscribe. *Vektor: Jurnal Pendidikan IPA*, *1*(2), 50-58.
Koballa, T. R., & Glynn, S. M. (2013). Attitudinal and motivational constructs in science learning. *Handbook of Research on Science Education*, 75–102. https://doi.org/10.4324/9780203824696
Legault, L. (2016). Encyclopedia of personality and individual differences. *Encyclopedia of Personality and Individual Differences*, *November 2016*. https://doi.org/10.1007/978-3-319-28099-8
Liu, Y., Ferrell, B., Barbera, J., & Lewis, J. E. (2017). Development and evaluation of a chemistry-specific version of the academic motivation scale (AMS-Chemistry). *Chemistry Education Research and Practice*, *18*(1), 191–213. https://doi.org/10.1039/C6RP00200E
Nissen, J. M., & Shemwell, J. T. (2016). Gender, experience, and self-efficacy in introductory physics. *Physical Review Physics Education Research*, *12*(2), 020105. https://doi.org/10.1103/PhysRevPhysEducRes.12.020105
Pintrich, P. R., & De Groot, E. V. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology*, *95*(4), 667–686. https://doi.org/10.1037/0022-0663.95.4.667
Pradilasari, L., Gani, A., & Khaldun, I. (2020). Pengembangan media pembelajaran berbasis audio visual pada materi koloid untuk meningkatkan motivasi dan hasil belajar siswa SMA. *Jurnal Pendidikan Sains Indonesia*, *7*(1), 9–15. https://doi.org/10.24815/jpsi.v7i1.13293
Pratt, J. M., Stewart, J. L., Reisner, B. A., Bentley, A. K., Lin, S., Smith, S. R., & Raker, J. R. (2022). Measuring student motivation in foundation-level inorganic chemistry courses: a multi-institution study. *Chemistry Education Research and Practice*, *24*(1), 143–160. https://doi.org/10.1039/d2rp00199c
Qodriah, S., Qodriah, S. L., Hartati, W., & Karim, A. (2019). Self-leadership and career success: Motivation of college lecturers. *Journal of Leadership in Organizations*, *1*(2). https://doi.org/10.22146/jlo.47772
Ruel, E., Wagner, W. E., & Gillespie, B. J. (2018). The practice of survey research: Theory and applications. *The Practice of Survey Research: Theory and Applications*.

https://doi.org/10.4135/9781483391700
Ryan, R. M., & Deci, E. L. (1985). *Self-Determination theory and the facilitation of intrinsic motivation, social development, and well-being self-determination theory*.
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68
Sari, V. A., Adlim, & Mustanir. (2016). Implementasi praktikum berbasis proyek untuk meningkatkan motivasi dan hasil belajar peserta didik pada materi hidrolisis garam kelas XI SMAN I Unggul Darul Imarah. *Jurnal Pendidikan Sains Indonesia*, *4*(2), 84–88.
Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients: Appropriate use and interpretation. *Anesthesia & analgesia*, *126*(5), 1763-1768.
Sevinc, B., Ozmen, H., & Yigit, N. (2011). Investigation of primary students' motivation levels towards science learning. *Science Education International*, *22*(3), 218–232.
Soenens, B., Sierens, E., Vansteenkiste, M., Dochy, F., & Goossens, L. (2012). Psychologically controlling teaching: Examining outcomes, antecedents, and mediators. *Journal of Educational Psychology*, *104*(1), 108–120. https://doi.org/10.1037/A0025742
Sugiyono, D. (2014). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif dan R&D*. Alfabeta: Jakarta.
Tuan, H. L., Chin, C. C., & Shieh, S. H. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education*, *27*(6), 639–654. https://doi.org/10.1080/0950069042000323737
Vansteenkiste, M., Sierens, E., Goossens, L., Soenens, B., Dochy, F., Mouratidis, A., Aelterman, N., Haerens, L., & Beyers, W. (2012). Identifying configurations of perceived teacher autonomy support and structure: Associations with self-regulated learning, motivation and problem behavior. *Learning and Instruction*, *22*(6), 431–439. https://doi.org/10.1016/J.LEARNINSTRUC.2012.04.002
Vedder-Weiss, D., & Fortus, D. (2013). School, teacher, peers, and parents' goals emphases and adolescents' motivation to learn science in and out of school. *Journal of Research in Science Teaching*, *50*(8), 952–988. https://doi.org/10.1002/TEA.21103
Zimmerman, B. J. (2000). Attaining self-regulation. *Handbook of Self-Regulation*, 13–39. https://doi.org/10.1016/B978-012109890-2/50031-7