Analysis of Student's Learning Style in Online Learning

Galuh Catur Wisnu Prabowo[(✉)], Annisa Meristin, and Hardini Anggun

Chemical Education, University of Lampung, Lampung, Indonesia
{galuh.catur,annisa.meristin}@fkip.unila.ac.id,
hardinianggun175@gmail.com

Abstract. Research on learning styles during the Covid-19 pandemic and several related studies are very important because of the greater learning loss in students. Student learning style is one of the factors that are hypothesized to affect the mastery of student concepts, especially during online learning. The purpose of this study specifically is to identifying, categorizing, mapping, and evaluating the learning style of chemistry education students, at FKIP University of Lampung during online learning. Using One Shot Case Study design, this study was analyzed using descriptive qualitative methods, a questionnaire sheet based on Kolb's Learning Style Inventory version 4.0 (KLSI 4.0) was used. The mapping results showed that students of 2021 who were a hundred percent studying online, had a learning style in the assimilating category of 9 percent; accommodating 33 percent; diverging 41 percent, and converging 17 percent. The most dominant learning space of Kolb's Learning Style Inventory v4.0 in this class is deciding, imagining, and initiating, respectively. The results of this mapping are expected to be an input for lecturers to design more effective and targeted learning based on the learning style of their learners.

Keywords: Experiential Learning · Learning Style Inventory · Online Learning

1 Introduction

Student's proficiency in concept of the material which being taught in learning process is an important focus that needs to be considered to attain the learning objectives. Based on [1–3], data from research that has been carried out show that the ability to master the concept of chemistry among high school students and its equivalent is still low when compared to other subjects. Not only among students, several studies that have been carried out have also shown that the ability to master chemical concepts among students is quite low[4–6], one of which includes the students of University of Lampung [2]. Not understanding the basic concepts in chemistry, is one of the causes of the difficulty of students mastering the concepts of other chemical materials because chemistry is interrelated with one another.

Stoichiometry is one of the basic concepts that students must understand before studying other chemical materials in a learning process. However, based on previous

research, the ability to master students' concepts in stoichiometric material is very low because it is influenced by several things, including multiple representations, learning methods and models applied in the classroom, the influence of classmates, and the learning resources used. [4, 7, 8]. In the learning process, chemistry starts from a simple level to a more complex level [9, 10], for example to learn the concepts of thermochemistry, chemical kinetics, solution chemistry, and colligative properties, it is necessary to first master the stoichiometry concept [10–12]. As one of the basic concepts, educators must make efforts to improve students' understanding of stoichiometric concepts.

Analyzing students' learning styles is one of the approaches that can be taken by educators to improve students' ability to understand stoichiometric concepts [13, 14]. Understanding a student's concept is influenced by the learning style of the pupils. Furthermore, it can be analyzed with the LSI (Learning Style Inventory) instrument developed by Kolb [15–21]. The application of LSI has been widely used in the assessment of student learning styles to classify students based on their respective characters and levels of learning abilities [22–24].Research on LSI mapping on learning style assessment has been applied by several researchers, but the relation to mastery of chemical concepts, especially stoichiometric concepts has never been done. Therefore, based on these descriptions, this research was conducted to figure out about the relation between LSI (Learning Style Inventory) mapping and student's concepts proficiency in stoichiometric chemistry.

2 Method

A. *Design*

This research was conducted using a pre-experimental method with a One-Shot Case Study design, where the research was carried out in two classes with the object of research namely 3rd semester chemistry education students of Lampung University. This study uses Kolb's LSI [18], the latest version of the Learning Styles Inventory (LSI) as a measuring tool which is dividing learners into four different learning styles: divergence, assimilation, adaptation, and convergence. Stoichiometry was taken as the topic in this research. As the pre-experimental study, the following study will be about case method model regarding learning style of the pupils. The learning of chemical student was fully online using case method approach.

B. *Data Collection*

This study used 32 questions regarding to the Kolb's Learning Style Inventory v.4.0 (KLSI v.4.0). The questionnaire used [25] Each original learning style has 8 questions. Students given numbers 4, 3, 2, and 1 (Likert Scale) according to the suitability of students; students chose and did not repeat filling. The steps were: first, select the most suitable and unsuitable description for the students, chose 4 as the most suitable description, and select 1 as the most unsuitable description. The score was measured by the method was based on the average point of A, the "Concrete Experience" score. The average value of B is the value of "Reflective Observation", and the average value of C

is the value of "Abstract Conceptualization", and the average value of D is the average value of "Active Experiment". Students were classified based on the "Abstract Conceptualization" score minus the "Concrete Experience" score and the "thinking-feeling" learning style dimension score. Another learning style dimension score of "doing and seeing" was to use the "Active Experiment" score minus the "Reflective Observation" score. Then score on these two dimensions as the horizontal axis and the vertical axis, and the average points of subjects in the two learning style dimensions, "think-feel" and "do-to-see", to draw a distributed diagram of learning styles and classify learners as four different learning style learners. In the analysis, the data will be classified into nine learning styles according to the KLSI 4.0, namely initiating, experiencing, imagining, acting, balancing, reflecting, deciding, thinking, analyzing.

To ensure the questionnaire given is valid and reliable, the validity and reliability was conducted using SPSS v26 with *Alpha Cronbach's calculation.* After that, the questionnaire was distributed to the students by google form. Qualitative analysis uses descriptive statistical analysis where the results of the research will be reported in the form of a description. This analysis aims to describe, explain and analyze the styles of student in learning chemistry at the University of Lampung.

3   Result and Discussion

A.   *Result*

Can be seen on Table 1, the questionnaire has been checked for its validity and reliability using SPSS 26. All 32 items are valid and reliable. The Pearson correlation coefficient is $0.566 > 0.349$ (score of r_{table} for $N = 32$ with 5% of significance level). The average score for alpha Cronbach is $0.812 > 0.349$ (score of r_{table} for $N = 32$ with 5% of significance level). So that, the instrument can be used for research.

The data can be described as experiential learning namely Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AC). Then, the data was calculated into four categories of learning style namely diverging, assimilating, converging, and accommodating [15]. The result can be seen on Fig. 1 where the Accommodator is dominant with 41 percent, in the second place is 33

Table 1. Validity and reliability of LSI Instrument

Case Processing Summary

		N	%
Cases	Valid	70	100.0
	Excluded[a]	0	.0
	Total	70	100.0

a. Listwise deletion based on all
Variables in the procedure

Reliability Statistics

Cronbach's Alpha	N of Items
.812	32
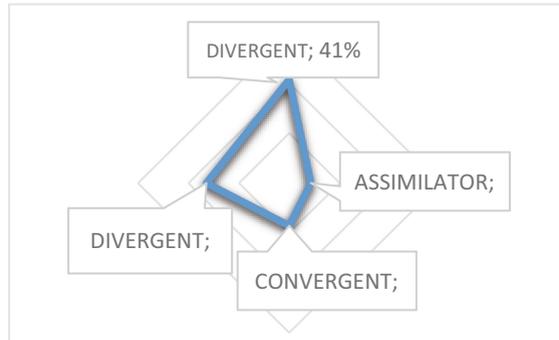
Fig. 1. LSI Mapping of Chemical Education Student, University of Lampung.

Table. 2. Learning Style Distribution

Learning Styles	Pupil/s
Initiating	21
Experiencing	7
Imagining	11
Acting	4
Balancing	1
reflecting	3
Deciding	7
Thinking	2
Analysing	3
Analysing and Deciding	2
Deciding and Initiating	2
Imagining and Analysing	1
Imagining and Initiating	6

percent of Divergent, followed by 17 percent of Convergent, and the last is Assimilator 9 percent only.

The next analysis came to the Kolb's LSI version 4.0 [18] which has nine learning style categories which are initiating, experiencing, imagining, acting, balancing, reflecting, deciding, thinking, analyzing. The result can be seen on the Table 2.

B. *Discussion*

In learning, both teachers and students have their own way. Teachers have their own style of teaching, from physical appearance to understanding in determining models, methods, and strategies in teaching. Likewise with students who certainly have their

own learning style. After absorbing information, each individual will be easy to learn and communicate with his own style, so that learning style becomes the key in developing performance. Students will also get maximum learning outcomes if they use their own learning style rather than trying other people's learning styles.

There are some learning style models such as Visual, Auditory, Reading & writing, Kinesthetics (VARK) by Fleming and Mills, Index Learning Style (ILS) by Felder and Silverman, and Learning Style Inventory (LSI) by Kolb. Kolb's Learning Style Inventory is a tool for measuring learning styles that describes how individuals learn and how individuals treat ideas and situations in everyday life. The first Kolb's Learning Style Inventory adapts The John Dewey's theory which emphasizes the correlation between experience and learning activities. Other theories are Kurt Lewin's which underpin the importance of one's activeness in learning and John Piaget's which is mentioned the individual interaction between the person and the environment will create intelligence as a result. The Kolb's Learning style itself has been revised several times, and the latest is Learning Style Inventory version 4 in 2014. David Kolb's Learning Inventory growth accordance with the development of experiential learning since some prominent 20th century scholars like John Dewey, Lev Vygotsky, and Jean Piaget others. There are nine categories of learning style which is the refinement result of previous version of Kolb's. as shown on Fig. 2.

Getting deeply to each style will be connected to the observation of this study which is discussed from chemistry learning perspective. Stoichiometry is the topic that relate to the fundamental laws in chemistry subject and its calculation. It is really interesting to observe the experiential learning by the student to this topic. So that, KLSI v4.0 were used to map and project the student's learning style based on their experiences in online learning.

The **Initiating** style – this style is the ability to initiate to the respect of experiences and conditions involving concrete experience (CE) and active experimentation (AE). Most student dominates this learning style, where is 21/70 students has this ability. This style is part of accommodator style that is dominant in this research sample. The value shown in Fig. 3 tells us that the accomodator style quiet the same with the whole
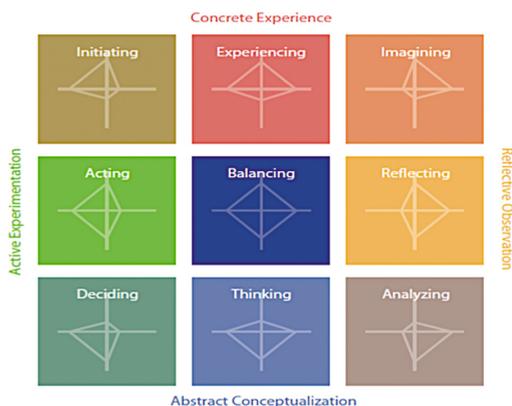

Fig. 2. Learning Style in Kolb's LSI v.4.0.

class performance. In stoichiometry topic, students were involved directly in applying fundamental of chemistry law into the calculation. More rehearsal on this activity will gain more active and concrete experiences. There was no experiment in this online learning, so actually concrete experiences is only gained from the rehearsal to the respect of problems given and their participation in the discussion forum.

The pupils seek the new challenging experiences. They common depend on their intuition instead of analytical on their logic, mix and match in solving problems, lacks patience and wants to act immediately. They tend to ignore every theory that contradict with the fact r their knowledge. The case method learning where the students was given a case and must be solved in group will gain student's experience, that is why in this class the initiating style was dominant.

The second most students have is imagining ability with 11 students. The imagining style is characterized by excel predict skills by the observation and apply it as experiences by combining reflective observation and concrete experience. Imagining style is included to divergent quadrant style as fit as the second most category of the student's learning style mapping in this study, see Fig. 1.

Mastering the ability to see concrete situation from different perspectives and sequently connecting it into a whole piece is the characteristic of divergent. His approach to every situation is to "observe" and not "act". The divergent pupils tend in learning tasks that has generating ideas, and brainstorming as prerequisite. The highest score is from this style, see. Figure 3. Can be said that case method is suitable for this learning style which require deep experience in gaining information and can reflect the observation to conclude or solve the case given.

Other two most styles uncovered are experiencing and deciding with each of it is 7 students. The **Experiencing** style – by balancing the reflective observation and active experimentation this, the concrete experience will be gained, which is combination between diverging and accomodating. Meanwhile, the **Deciding** style apply the theories and models in finding the problem solutions and courses of action by combining the active experimentation and abstract conceptualization. This style tends to converging style. These styles performed better result amongst the others, which have higher minimum scores, see Fig. 3. This type of student does not really need concrete experience to make the decision, However for experiencing students, they can make good reflection from their observation or experience to make a good decision.

The rest categories namely acting, thinking, analyzing, and reflecting have spead out into several students, only one student is included into balancing style which has adapted by compromizing the good and the bad to make good adaptation ability. It balances all the abilities that exist in the four quadrants.

The most interesting from this study is the funding of four extra categories that has same score for each aspect/style, namely analysing and deciding; deciding and initiating; imagining and analysing; and imagining and initiating. Can be said that analysing and deciding is formed by converging and assimilating, deciding and initiating is formed by accommodating and converging, imagining and analysing is formed by diverging and assimilating, and the last imagining and initiating is formed by diverging and accommo-dating. This finding as approve of Kolb's theory that stated it is impossible for student
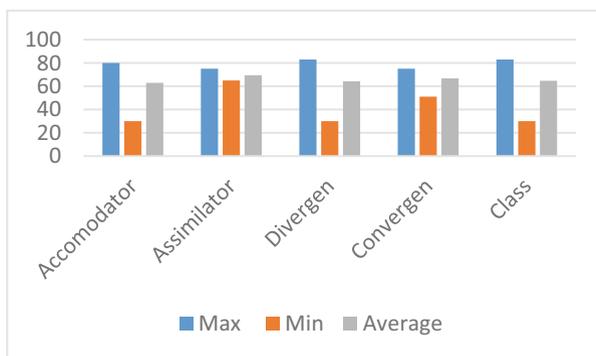
Fig. 3. Student's achievement according their learning style

has only one quadrant of learning style as the domination. Usually happened is a combination of the two poles and forms a tendency or learning orientation and it is an advance in nine quadrats of learning style.

From this study, chemical education students are predenominately concentrated in initiating, imagining, and deciding region of learning space. This learning space offer the typology of learning style based on the context which require thinking, experiencing, and acting. As the pre-experimental study, this finding give insight for the next step in determining the treatment/strategy in order to get the maximum result of master of concept in chemistry learning, especially ini stocichiomety topic.

4 Conclusion

Learning style for an individual is very special for only one or two type of learning space. This flexibility shown the development of student to be more holistic and advance in learning activity. The second-year chemical education students in Lampung University tend to have experiencing, acting and deciding modes in learning style with the following distribution 41 percent of accommodator, 33 percent diverging, 17 percent converging, and 9 percent assimilating.

References

1. Kamila, A., Fadiawati, N., Tania, L.," Efektivitas Buku Siswa Larutan Penyangga Berbasis Representasi Kimia dalam Meningkatkan Pemahaman Konsep". (Effectivity of Chemical Representations-based Student's Book of Buffer Solution to Improve Student's Concept Mastery). Jurnal Pendidikan dan Pembelajaran Kimia, Vol. 7, No.2 Edisi Agustus 2018, 211-222 (2017).
2. R. Betta Rudibyani, G. Catur Wisnu Prabowo, D. "Pembelajaran Berbasis Masalah Untuk Meningkatkan Literasi Kimia Dan Penguasaan Konsep Mahasiswa FKIP Universitas Lampung". (Problem based Learning to Improve Chemical Literacy and Concept Mastery of the students of Lampung University. Jurnal Pendidikan dan Pembelajaran Kimia 9 (1), 54-62.

3. R. B. Rudibyani, "The Effect of Problem-Solving Model To Improve Communicating Skills And Mastery Concept In Chemistry".3rd Annual International Seminar on Transformative Education and Educational Leadership. 2018.

4. A. Suhardi And L. Yunita Susanti, "Pengaruh Penggunaan Mind Map Terhadap Pemahaman Konsep Stoikiometri". (The effect of Mind Map to The Concept Mastery of Stoichiometry). Journal of Natural Science and Integration. Vol. 3, No.1, April 2020, 106–114 2020.

5. M. Danial, "Kesadaran Metakognisi, Keterampilan Metakognisi Dan Penguasaan Konsep Kimia Dasar."(Metacognitive Awareness, Metacognitive Skills And Mastery of Basic Chemical Concepts). Jurnal Ilmu Pendidikan, 17, 3, October 2010, 225-229.

6. N. Delima & Y. Budianingsih, "Gaya Belajar dan Mathematics Self-Concept Terhadap Minat Akademik Mahasiswa," Teorema: Teori Dan Riset Matematika, Vol. 5, No. 1, Pp. 1–8, 2020, [Online]. Available: https://www.Jurnal.Unigal.Ac.Id/Index.Php/Teorema/Article/View/3296

7. Nilawati, A., & Y. Utomo, "Keefektifan Pembelajaran Interkoneksi Multipel Representasi Dalam Mengurangi Kesalahan Konsep Siswa Pada Materi Stoikiometri". (Effectivity of Interconnection of Multiple Representation Learning to Minimize Misconception in Stoichiometry Topic). Jurnal Pendidikan, Vol. 1, 11, November, Thn 2016, 2076-2082

8. D. R. Lailia & D. Suyono, "Verifikasi Status Miskonsepsi Siswa Pada Konsep Stoikiometri Menggunakan Metode CRI (Certainty Of Response Index) Dan Metode Three-Tier Diagnostic Test The Verivication of Student Misconception Status on The Stoichiometry Concept Using Cri (Certainty of Response Index) And Three-Tier Diagnostic Test Method,". Unesa Journal Of Chemical Education. Vol. 3,. 3, 176-180 September 2014

9. E. Susilaningsih, A. Drastisianti, Lastri, E. Kusumo, And D. Alighiri, "The Analysis of Concept Mastery Using Redox Teaching Materials with Multiple Representation and Contextual Teaching Learning Approach," Jurnal Pendidikan Ipa Indonesia, Vol. 8, No. 4, Pp. 475–481, Dec. 2019, Doi: https://doi.org/10.15294/Jpii.V8i4.18072.

10. S. Ibnu, "Analisis Dampak Kesulitan Siswa Pada Materi Stoikiometri Terhadap Hasil Belajar Termokimia". (Analysis of the Impact of Students' Difficulties on Stoichiometry on Thermochemistry Learning Outcomes). Vol. 3, No. 1, 2018.

11. N. Hanif, W. Sopandi, And A. Kusrijadi, "Analisis Hasil Belajar Level Makroskopik, Submikroskopik, Dan Simbolik Berdasarkan Gaya Kognitif Siswa SMA Pada Materi Pokok Sifat Koligatif Larutan". (Analysis of Macroscopic, Submicroscopic, and Symbolic Learning Outcomes Based on Cognitive Style of High School Students on Main Material Colligative Properties of Solutions). Jurnal Pengajaran MIPA, Vol 18, 1, April 2013. 116-123

12. C. F. Handayani, W. Sunarto, D. Sri, And S. Sumarti, "Penerapan Model Pembelajaran Guided Discovery Melalui Kegiatan Praktikum Pada Materi Stoikiometri Larutan". (Applying Guided Discovery Learning Model through Practical Activity in Stoichiometry Solution Topic). Jurnal Inovasi Pendidikan Kimia, Vol. 11, 1, 2017, 1840–1848.

13. C. Carol, "Learning Styles in Higher Education. A Case Study in History Training," Procedia - Social & Behavioral Sciences, Vol. 180, Pp. 256–261, May 2015, Doi: https://doi.org/10.1016/J.Sbspro.2015.02.113.

14. C. Manolis, D. J. Burns, R. Assudani, And R. Chinta, "Assessing Experiential Learning Styles: A Methodological Reconstruction & Validation of The Kolb Learning Style Inventory," Learning And Individual Differences, Vol. 23, No. 1, Pp. 44–52, 2013, Doi: https://doi.org/10.1016/J.Lindif.2012.10.009.

15. D. C. Kayes, "Internal Validity & Reliability of Kolb's Learning Style Inventory Version 3 (1999)," Journal Of Business And Psychology, Vol. 20, No. 2, 2005, Doi: https://doi.org/10.1007/Sl0869-005-8262-4.

16. D. A. Kolb, "Experiential Learning: Experience as The Source of Learning And Development, David A. Kolb, Prentice-Hall International," Journal of Organizational Behavior, Vol. 8, 1984.

17. D. J. Gooden, R. C. Preziosi, And F. B. Barnes, "An Examination of Kolb's Learning Style Inventory," American Journal of Business Education (Ajbe), Vol. 2, No. 3, 2009, Doi: https://doi.org/10.19030/Ajbe.V2i3.4049.

18. A. Y. Kolb & D. A. Kolb, "The Kolb Learning Style Inventory - Version 4.0," Experience Based Learning Systems, Inc., 2013.

19. A. Kolb And D. Kolb, "The Kolb Learning Style Inventory–Version 3.1 2005 Technical Specifications,"Boston, Ma: Hay Resource Direct, 2005, Doi: https://doi.org/10.1016/S0260-6917(95)80103-0.

20. D. A. Kolb, "Experiential Learning: Experience As The Source Of Learning And Development, David A. Kolb, Prentice-Hall International, Hemel Hempstead, Herts., 1984. No. Of Pages: Xiii + 256," Journal Of Organizational Behavior, Vol. 8, No. 4, 1984.

21. D. A. Kolb And A. Y. Kolb, "The Kolb Learning Style Inventory 4.0: Guide to Theory, Psychometrics, Research & Applications How You Learn Is How You Live View Project Learning Sustainability View Project," 2013. [Online]. Available: https://Www.Researchgate.Net/Publication/303446688

22. A. J. Fuad, "Gaya Belajar Kolb Dan Percepatan Belajar". (Kolb's Learning Style and Learning Acceleration"). No. 1992, Pp. 978–979, 2015.".

23. R. A. Destari1, A. H. Azhar2, And W. S. Negoro3, "Penentuan Kelas Mahasiswa Baru Berbasis Web Menggunakan Learning Style Inventory (LSI)". (Web based Classification of New Student Using LSI) Vol. 1, No. 2, Pp. 85–92, 2022, [Online]. Available: https://Ejournal.Abivasi.Id/Index.Php/Smartedu

24. A. Octamaya, T. Awaru, M. Syukur, A. Dodi, M. P. Agustang, And Z. Arifin, "Mapping Student Learning Styles Achieving Using Kolb's Learning Style Inventory in Sinjai Regency," 2020. [Online]. Jurnal Administrare: Jurnal Pemikiran Ilmiah dan Pendidikan Administrasi Perkantoran. Vol. 7, No. 2, July-December 2020, Pages 391-400 Available: http://Ojs.Unm.Ac.Id/Index.Php/Administrare/Index.

25. P. T. Engels & C. De Gara, "Learning Styles Of Medical Students, General Surgery Residents, And General Surgeons: Implications For Surgical Education," Bmc Medical Education, Vol. 10, No. 1, 2010, Doi: https://doi.org/10.1186/1472-6920-10-51.