5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Identification of Chemical Basic Cognitive Ability and Learning Styles as References for Chemical Learning Optimization

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Abstract. This study employed a correlational study aimed to identify basic cognitive abilities in chemical materials and their relationship to learning styles. The sampling technique used purposive sampling. Data collection techniques were an instrument of cognitive matter, a learning style questionnaire, and an interview. The involved samples were Chemistry Education Department students batch 2017 taking Chemistry School Course. Data analysis techniques were Rasch model and SPSS. The results showed that the value of person reliability of 0.00 and item reliability of 0.89. In addition, the value of INFIT MNSQ and OUTFIT MNSQ for each student on the average value of 0.97 and 0.93. Then, for INFIT ZSTD and OUTFIT ZSTD were 0.1 and 0.2. These can be concluded that the consistency of their answers is in the weak aspect, whereas the quality of items is in the good aspect, and they can answer many questions correctly as can be seen through scalogram. Another thing is that some students do not meet the criteria of person fit data, as well as on item fit data, and their inconsistent pattern of answers. As much as 62% of students were on the Visual learning style, 63% of them were on Audio learning style, and 59% of the students were on Kinesthetic learning style. Then, their basic cognitive abilities have no correlation. Even though the learning styles do not improve their academic ability, this identification helps in detecting the students' tendency to learn even there is a strong correlation between the learning style one another.

Keyword: learning style, chemical basic cognitive, chemical learning

INTRODUCTION

Science (chemistry) is not only about explaining the science macroscopically and microscopically but also the relationship between the science content being studied and its implementation in the environment [1] [2]. This chemical excellence must be initiated from the school environment to produce superior, broad-minded and skillful people [2]. Understanding the intact chemical content will prepare them for the application of science and technology at a high level [2]. Knowledge and skills fulfilled through chemical learning will train students to have intellectual abilities such as critical thinking, creative, and innovative. Then, students' knowledge and skills are expected to be actualized on the values and attitudes of science and technology. It aims to realize a caring, prosperous, and cooperative society [2]. Value and scientific attitudes possessed enable students to make decisions, adapt, and solve problems effectively. The proximity of chemistry to the human environment is proven by [3] on salt that, understanding chemical content in a potentially strengthening and enhancing cognitive basis of students.

The concept of salt actually cannot be directly understood, because this concept is an interdisciplinary topic and close to physics, chemistry, and biology. Understanding of basic concepts in chemistry will increase misconceptions

about the concept of salt itself eg [3]. Reinforcement of chemical content can be the greatest energy in learning, if their basic understanding is fully met, such as atomic structure [4] [5], stoichiometry [6], chemical equilibrium [7], chemical bonds [8] [9] [10], and electrochemistry [11]. This study illustrates that high-level knowledge will be difficult to achieve if the chemical content is not compounded by their understanding. The diversity of knowledge teaches students to relate concepts to each other, thereby reducing perceptual errors in content and ease in solving learning problems [12] [13] [14].

Reference [15] defines the problem-solving process in learning to build students mentality and to connect what they know, their knowledge, and their empirical experience. These things put pressure on the students positively to find much in solving any problem. It is also considered a new type of learning and is a detection of how students build their knowledge with scientific procedures [16]. Generally, every individual needs knowledge and skills to solve problems [17]. Reference [18] stated that problem-solving in a study is a very complex human behavior. This is documented in a large number of studies published in research and teaching journals. This shows that the study of how students solve problems is an important issue for experts, especially those involved in the educational aspect. This issue has always been a stumbling block for students who are studying chemistry in depth, and most chemistry teachers are aware of this. Departing from the understanding that chemistry is difficult, chemical solutions require high levels of analysis, chemical symbols, microscopic inability to touch chemistry, chemical habits at school, and hidden confidence. Thus, it takes a kind of approach to determine the level of students' chemical understanding in solving problems scientifically. This can be an evaluation material for optimizing students' potentials such as learning style analysis, character, mindset, mental, and basic cognitive skills [19].

The concept of learning style is an alternative way to understand students' cognitive abilities in learning [19]. The striking differences in learning style depart from the influence of differences in intelligence and cognitive abilities, thus, causing the individual to have his own way of experiencing the learning process, doing the task, understanding the lesson content, and the learning style itself [20] [21]. Reference [22] reinforces that learning styles are a condition in which learners are able to receive, process, store, and recall their knowledge content. Reference [23] also believes that learning style is a powerful alternative method used by teachers in preparing the learning process. This is needed by teachers, school managers, and everyone involved in organizing the learning process [23] [19]. The effectiveness of learning occurs when the environment supports students' psychological emotions, reduces interactions due to diversity, and students understand their learning styles [24]. Research also shows that teachers who do not pay attention to differences in student learning styles will have an impact on their academic achievement, so indirectly learning style is closely related to the improvement of student academic achievement [25] [26].

Reference [24] argues that one of the challenges of educators in college is how they think and plan to learn strategies that accommodate students' learning styles (graduate candidates) so that their academic achievement graphs increase significantly. Later, it came to an understanding that if academic improvement is influenced by learning styles, then how to make the right learning strategy. The answer is to analyze students' learning needs, learning environment, initial perspective on the material, unstructured interview, and identification of students' basic skills. These then become a definitive measure of how teachers design and optimize the learning process. This optimization is expected to increase the students' energy, emotions, and enthusiasm in learning so that their academic ability is slowly increasing. As proved by numerous studies that, the match between teaching strategies and learning styles has a positive impact on students' academics [27] [28] [29] [30] [31] [32], motivation [33] [34] [35] and their attitudes in learning process [28] [36] [37]. Although, another view reveals the exact opposite [38] [39]. This contradiction comes from many factors that make every individual different, such as differences in intelligence, motivation, perspective, psychology, background, learning environment, maturity, and diversity [40] [41].

The statement provides an understanding that analysis of students' learning styles is an important point that teachers need to know, although there are sometimes changes in the process [42] [43] [44]. This can be a material assessment and evaluation in optimizing the learning process, making it easier for teachers to achieve goals [42] [43]. Achieving these goals, teachers must bring intimate learning conditions to encourage interaction, concentration, relationships, emotions, and self-confidence, so that the learning process fully touches students' learning styles [45] [46] [47] [42] [41].

The identification of students' learning styles will give many alternative ways of learning, particularly classroom management problems. It is in line with Reference [48] who states that every individual has different characters that lead to different learning styles [49]. Then, learning style is an indicator of how each individual receives information and reacts to their learning environment [50]. It is also reinforced by other experts such as [51] that defines learning styles as the preferred habits of students. Reference [47] views learning styles as a way of accepting, interacting, and assessing their environment, and by [46] who assessed the learning styles as innate biological characters.

Thus, it can be interpreted that learning style is a cognitive, affective, and psychomotor characteristic [48] and can be a guide or approach that can be used by teachers in designing a model of learning such as experiential learning model [45] and this process very decisive what kind of student in facing problem in class. Thus, a learning style analysis is needed to determine students' learning styles [27] [48] [36]. In addition to their learning and cognitive style information, this identification is a pre-service chemistry analysis especially in teaching to eliminate incorrect concepts in chemistry, improving the learning environment and preparing for future generations of exceptional quality [51].

METHODS

This study employed a correlational research with the samples were Chemistry Education Department of Faculty of Teacher Training and Education, Universitas Lambung Mangkurat students batch 2017 taking Chemistry School Course in 2018. Their basic cognitive identification is of the material of the atomic structure. This material was chosen to accurately gauge their basic ability to slowly increase their cognitive level. Purposive Sampling Technique was used in this study for special reasons such as the samples were those who were taking Chemistry School I Course and low knowledge as well as understanding of the basic chemistry material namely atomic structure. These were seen from the observation, interview, and teaching experience of the previous material.

Data collection techniques were done through the spread of instrument data ie, cognitive test instruments to determine their basic skills and learning style instruments. Data analysis used was Model Rasch [52] and SPSS 22 (Correlation Analysis).

RESULTS AND DISCUSSION

The research aimed to identify the students' basic cognitive by using RASCH Approach Model and their learning style. It aims to identify the pattern of students' response to the given cognitive instruments. The results of this identification were then linked to student learning style data. With this, lectures/teachers have guidelines in planning a suitable lesson. Here are the results of research that has been done with RASCH Model (Cognitive Ability) and learning styles through the instrument.

Figure 1 is a wright (person-item map) analysis, showing the distribution of students' abilities and the difficulty level of the item (on the same scale). On the right side of the map is the item difficulty level and the left side is the level of student ability. From top to bottom is the level of difficulty of items from the highest to the lowest and also the ability of students from high to low. Figure 1 shows that the items with the highest difficulty level are S22 items and the students with the code 02L 05P 10P 11P 16P 27P 28P are rated as students who have the same ability. The items with the lowest difficulty level are S11 S12 S2 S21 S23 S23 with the same logit value. While the students with the lowest ability is 19P. (See Table 1 for more complete data).

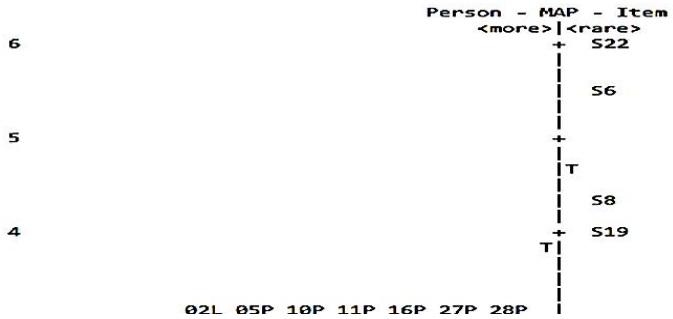

Fig 1. Person-Item Map

Table 1. Item Measure Table

Items Data Code	Measure *(Logit Value)*	S.D	Mean
S22	6.77	2.88	-0.54
S6	5.53		
S8	4.31		
S19	3.96		
S4	2.62		
S3	0.10		
S15,S24	-0.16		
S20	-0.47		
S10,S16,S18	-0.84		
S5,S7	-1.33		
S1,S9,S14,S17,S25	-2.11		
S2,S11,S12,S13,S21,S23	-3.38		

Table 1 is an analysis of the items with Rasch model. The Item Measure table aims to determine the difficulty level of items. The entry number column is the serial number of the item, then aligned with the logit value of the item. The rightmost column is the name of the item being analyzed. The logit value in table 1 shows the difficulty level of distributed items, from top to bottom is the logit value from high to low. The item with the highest difficulty level is shown by item S22, its logit value (+6.77). Item S11 S12 S13 S2 S21 S23 is the item with the lowest difficulty level, their equivalent logit value is (-3.38). Table 1 also shows that item S23 (logit -3.38) has a difficulty level doubled with the item S22 (logit +6.77). Items with high difficulty level are S6 (logit +5.53), S8 (logit +4.31), S19 (logit +3.96), S4 (logit +2.62), etc (See: Item Measure Table 1 with red square).

Items having the same logit values that are, S2, S11, S12, S13, S21, S23 indicate that the item has no different difficulty level (logit -3.38). That is, those items have the same level of difficulty. This is a reminder for lecturers to be in the learning process, they can be equipped with knowledge and skills, especially in solving problems with different levels of difficulty. The goal is that teachers are thoroughly able to see participants' abilities especially their basic chemical cognitive. These items also motivate teachers to be more creative in providing tiered and varied levels of questions. The solution can also eliminate boredom in working on problems with the same criteria, improving the ability to think creatively, critically, deeply, logically, and increase their energy in solving problems at a high level.

The aforementioned items condition is as the same as S1 S9 S14 S17 S25 items which can be seen in Table 1 with the logit value of -2.11. Alternative ways to reduce this type of problem are to group participants who have different characters (learning styles), create more authentic questions, create problems with difficulty levels (starting from easy to difficult), assign tasks with levels more difficult than ever before, giving each participant the opportunity to interpret their understanding in their own way, and stimulate through apperception to strengthen their emotions, energy, motivation and enthusiasm, so that their academic ability will slowly increase [27] [28] [30] [31]

[32] [33] [34] [35]. These strategies can empower lecturers or teachers to detect students' learning styles and full academic achievement [19]. Early detection is of particular importance in avoiding learning saturation, misconceptions, the superficiality of chemistry, ignorance of the learning process, and low academic value, so the need for a suitable learning design to optimize learning in the classroom and its instruments.

Person Measure

Tabel 2 is a description of each students' logit score person measure. These logit values indicate their basic cognitive abilities, by looking at their response patterns to work items. Entry number is the sequence number of the students, while the rightmost column is the student code, which starts from the highest to the lowest. The total score in Table 2 is students total correct answers, such as 02LB, 05PB, 10PB, 11PB, 16PB, 27PB, and 28PB got the correct answer 21 out of 25 questions (logit +3.11). When compared to the students 01LB, 06PB, 08PB, 12PB, 13LB, 24PB, 25PB, and 30PB, which got the correct answer 20 out of 25 (logit +2.12). That means, they only differ from one answer, group with logit (+3.11) right 21, while the group with logit value (+2.12) only true as many as 20 questions. Then, the 19PB student got the correct answer as much as 14 out of 25 (logit -0.85). Students of this 19PB certainly have very much difference with the previous students, either from the logit score or their total correct answers. 19PB with logit (-0.85) if juxtaposed with previous student logit (+3.11 and +2.12), has a very significant difference. Students who have a logit score of +3.11 can be said to have basic cognitive abilities twice the ability of students 19PB (-0.85). (See Table 4 for more complete data).

Table 2. Person Measure Table

Students Data Code	**Measure** *(Logit Value)*	**S.D**	**Mean**
02LB,05PB,10PB,11PB,16PB,27PB,28PB	3.11	1.03	1.76
01LB,06PB,08PB,12PB,13LB,18PB,20PB,24PB,25PB,30PB	2.12		
03PB,04PB,14LB,17PB,21PB,22PB	1.32		
07PB,23PB,26PB	0.72		
09PB,15PB,29PB	0.25		
19PB	-0.85		

Guttman Scalogram of Responses

Figure 2 is a Guttman Scalogram of responses to know inconsistency patterns of student answers. the scalogram data is also supported by the data in table 1 and table 2. In addition to the person fit table used to determine the student's response pattern to the item, or the mismatch of answers to their abilities compared to the ideal model, the Guttman Matrix shows directly why their response patterns are not appropriate. Students with the same logit score (+3.11) notice a different response pattern, such as a 02LB student with 05PB. 02LB students tend to be less consistent with the given response pattern compared with 05PB, 02LB on S3 and S4 items giving wrong answers, whereas 05PB students answer correctly so, 02LB students are considered less accurate. Now we compare the responses of students who have different logit. Like, 11PB students (logit +3.11) with 08PB (logit +2.11), the item number of 18/S18 was answered wrongly by the 11PB student, while 08PB student answered correctly even though their logit ability is different. Although 08PB has a logit lower than 11PB, the 08PB student is more consistent with the response given than the response by 11PB (careless).

Next, 03PB and 04PB students have the same response pattern. In addition to having the same logit score (+1.32), they also exactly provide the wrong answer on item number 15/S15, so they are indicated to cheat each other. Then, students who have a log of +0.72 and +0.25 have inconsistent, inaccurate, and careless repetition patterns. This is because they are able to give the right answer to a difficult item, but it is wrong for an easy item, and vice versa. So, they are being guessed (lucky guess). The same is true for 19PB students (logit -0.85) with very inconsistent response patterns, easy and difficult items cannot be answered. Although a small number of items are correct, these students are judged to have a lower ability than others. (See Figure 2 for more complete data).

```
Person |Item
       | 11122  112  111212  1  2
       |2123131947557068054349862
       |-------------------------
     2 +1111111111111111111001100  02LB
     5 +1111111111111111111110000  05PB
    10 +1111111111111110111111000  10PB
    11 +1111111111111110111101100  11PB
    16 +1111111111111111111110000  16PB
    27 +1111111111111111111110000  27PB
    28 +1111111111111111111110000  28PB
     1 +1111111111111110011100110  01LB
     6 +1111111111111111111100000  06PB
     8 +1111111111111111111100000  08PB
    12 +1111111111111111111010000  12PB
    13 +1111111111111011111101000  13LB
    18 +1111111111111111111100000  18PB
    20 +1111111111111111111100000  20PB
    24 +1111111111111111111100000  24PB
    25 +1111111111111111111100000  25PB
    30 +1111111111111111111100000  30PB
     3 +1111111111111111101100000  03PB
     4 +1111111111111111101100000  04PB
    14 +1111111111111011111100000  14LB
    17 +1111111111111111110010000  17PB
    21 +1111111111111110111100000  21PB
    22 +1111111111011111110110000  22PB
     7 +1111111111111111011000000  07PB
    23 +1111111101111111110010000  23PB
    26 +1111111111101111011100000  26PB
     9 +1111111111111011101000000  09PB
    15 +1111111011110111101100000  15PB
    29 +1111111111110101110100000  29PB
    19 +1111110110101101000110000  19PB
       |-------------------------
       | 11122  112  111212  1  2
       |2123131947557068054349862
```

Fig 2. Guttman Scalogram of Responses

Item Fit

Rasch model, in addition to detecting item difficulty level, this model also explains the suitability of items with the model or this term is called an item fit. Item fit explains whether the item of normal function is measured or not. If it is found that there is an unfit item, then there is an indication that there is a misconception on the student against the item is not fit. This information becomes a reference for lecturers to improve the quality of learning and avoid students' misconceptions, so that optimization of learning can be realized.

Reference [53] explains that outfit means-square, out-z-standard, and correlation points are the criteria used to look at the item-fit conformity. Here are the criteria:

- Outfit Mean Square (MNSQ) points received: 0,5 < MNSQ < 1,5
- Outfit Z-Standard (ZSTD) points received: -2,0 < ZSTD < +2,0
- Point Measure Correlation (Pt Mean Corr) points received: 0,4 < Pt Measure Corr < 0,85

Table 3 shows that item S18 has values beyond the required criteria ie ZSTD +2.6, MNSQ 4.22, and Pr Measure Corr -0.33. Likewise, item S4 value of ZSTD is 2.7, MNSQ is 2.04, and Pt Measure Corr is 0.17. Although on the ZSTD criteria their value is not too far from the criteria, the other two criteria are also not included in the required value domain. In conclusion, this item may have to be revised or untenable. Other items like S3 just do not meet the value of Pt Measure Corr (0.19), but at ZSTD & MNSQ values have met the criteria with consecutive values (1.0 and 1.46). Some items meet all the required criteria and other items simply do not meet one criterion only, so they are retained or unnecessarily changed.

For the record, the ZSTD value is severely affected by the sample size. When the sample size is very large, it can be ascertained that the ZSTD value will always be above 3. Thus, the expert recommends not to use the ZSTD value when the sample size used in the calibration is large (N> 500) [52].

Table 3. Item Fit

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
18	27	30	-.84	.64	1.43	1.6	4.22	2.6	A-.33	.31	86.7	89.9	S18
4	10	30	2.62	.42	1.13	.8	2.04	2.7	B .17	.39	76.7	72.1	S4
3	24	30	.10	.50	1.21	.8	1.46	1.0	C .19	.39	76.7	81.4	S3
10	27	30	-.84	.64	1.17	.5	1.14	.4	D .17	.31	86.7	89.9	S10
25	29	30	-2.11	1.04	1.11	.4	1.07	.5	E .08	.20	96.7	96.6	S25
14	29	30	-2.11	1.04	1.06	.4	.60	.1	F .19	.20	96.7	96.6	S14
6	1	30	5.53	1.02	1.04	.3	1.05	.5	G .06	.14	96.7	96.6	S6
9	29	30	-2.11	1.04	.99	.3	.39	-.1	H .27	.20	96.7	96.6	S9
7	28	30	-1.33	.76	.95	.1	.39	-.4	I .39	.27	93.3	93.3	S7
8	3	30	4.31	.63	.93	.0	.62	-.2	i .33	.24	90.0	89.9	S8
20	26	30	-.47	.58	.91	-.1	.80	-.1	h .41	.34	90.0	87.2	S20
19	4	30	3.96	.56	.87	-.3	.57	-.5	g .42	.27	86.7	86.5	S19
24	25	30	-.16	.53	.85	-.4	.59	-.7	f .52	.37	86.7	84.3	S24
16	27	30	-.84	.64	.79	-.3	.50	-.5	e .49	.31	93.3	89.9	S16
15	25	30	-.16	.53	.79	-.6	.55	-.8	d .56	.37	86.7	84.3	S15
5	28	30	-1.33	.76	.77	-.2	.37	-.5	c .47	.27	93.3	93.3	S5
1	29	30	-2.11	1.04	.70	-.1	.15	-.5	b .47	.20	96.7	96.6	S1
17	29	30	-2.11	1.04	.70	-.1	.15	-.5	a .47	.20	96.7	96.6	S17
MEAN	23.2	30.0	-.54	1.05	.97	.1	.93	.2			90.4	90.1	
S.D.	10.1	.0	2.88	.52	.19	.4	.92	1.0			6.3	6.5	

Person Fit

Table 4 aims to map students' abilities according to the interests of achievement grouping, Rasch modeling through table 4 is able to detect unsuitable students response patterns. By bringing the same criteria beforehand that students are in the pattern according to the model if they meet the following requirements [53] (Look at the criteria in item fit. Based on the person fit data, it can be seen that from all students, there are some students who meet the criteria such as, 13LB, 17PB, 15PB, 12PB, 29PB, 26PB with the value of each MNSQ Outfit (1.49, 0.70, 1.15, 0.56, 0.71, 0.76), Outfit ZSTD (0.8, 0.0, 0.5, 0.0, 0.0, 0.0), and Outfit Pt-Measure Corr (0.73, 0.77, 0.71, 0.81, 0.75, 0.78). The value is within the required criteria, meaning students with 13LB, 17PB, 15PB, 12PB, 29PB, 26PB codes have response patterns corresponding to the model. Compared with 07PB which only meets the criteria of Pt-Measure Corr (0.82), while Outfit MNSQ (0.41) and Outfit ZSTD (-0.5). Next, 03PB students actually have values outside the criteria with MNSQ Outfit value (0.34), ZSTD (-0.6), and Pt-Measure Corr (0.86) so that this student indicates an unusual response pattern. (Details, see Person Fit Table).

Table 4. Person Fit

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Person
1	20	25	2.12	.96	3.43	2.3	4.06	1.8	A .51	.81	77.8	92.8	01LB
11	21	25	3.11	1.03	2.58	1.9	3.30	1.5	B .62	.79	77.8	93.1	11PB
10	21	25	3.11	1.03	1.76	1.2	3.07	1.4	C .68	.79	88.9	93.1	10PB
19	14	25	-.85	.58	1.49	2.0	2.75	1.4	D .54	.67	61.1	73.6	19PB
2	21	25	3.11	1.03	2.52	1.9	1.55	.8	E .65	.79	77.8	93.1	02LB
22	19	25	1.32	.83	1.65	1.1	2.25	1.3	F .70	.80	83.3	90.6	22PB
13	20	25	2.12	.96	1.70	1.1	1.49	.8	G .73	.81	88.9	92.8	13LB
23	18	25	.72	.73	1.50	1.1	1.66	.9	H .69	.77	77.8	86.7	23PB
17	19	25	1.32	.83	1.37	.8	.70	.0	I .77	.80	83.3	90.6	17PB
15	17	25	.25	.66	1.13	.5	1.15	.5	J .71	.74	83.3	82.0	15PB
12	20	25	2.12	.96	1.14	.4	.56	.0	K .81	.81	88.9	92.8	12PB
29	17	25	.25	.66	.99	.1	.71	.0	L .75	.74	83.3	82.0	29PB
26	18	25	.72	.73	.95	.1	.76	.0	M .78	.77	88.9	86.7	26PB
9	17	25	.25	.66	.74	-.7	.47	-.3	N .79	.74	83.3	82.0	09PB
14	19	25	1.32	.83	.71	-.3	.58	-.2	O .83	.80	94.4	90.6	14LB
21	19	25	1.32	.83	.71	-.3	.58	-.2	o .83	.80	94.4	90.6	21PB
7	18	25	.72	.73	.70	-.6	.41	-.5	n .82	.77	88.9	86.7	07PB
3	19	25	1.32	.83	.60	-.6	.34	-.6	m .86	.80	94.4	90.6	03PB
4	19	25	1.32	.83	.60	-.6	.34	-.6	l .86	.80	94.4	90.6	04PB
5	21	25	3.11	1.03	.32	-1.3	.09	-.7	k .86	.79	100.0	93.1	05PB
16	21	25	3.11	1.03	.32	-1.3	.09	-.7	j .86	.79	100.0	93.1	16PB
27	21	25	3.11	1.03	.32	-1.3	.09	-.7	i .86	.79	100.0	93.1	27PB
28	21	25	3.11	1.03	.32	-1.3	.09	-.7	h .86	.79	100.0	93.1	28PB
6	20	25	2.12	.96	.20	-1.5	.09	-.9	g .90	.81	100.0	92.8	06PB
8	20	25	2.12	.96	.20	-1.5	.09	-.9	f .90	.81	100.0	92.8	08PB
18	20	25	2.12	.96	.20	-1.5	.09	-.9	e .90	.81	100.0	92.8	18PB
20	20	25	2.12	.96	.20	-1.5	.09	-.9	d .90	.81	100.0	92.8	20PB
24	20	25	2.12	.96	.20	-1.5	.09	-.9	c .90	.81	100.0	92.8	24PB
25	20	25	2.12	.96	.20	-1.5	.09	-.9	b .90	.81	100.0	92.8	25PB
30	20	25	2.12	.96	.20	-1.5	.09	-.9	a .90	.81	100.0	92.8	30PB
MEAN	19.3	25.0	1.76	.88	.97	-.1	.93	.0			90.4	90.1	
S.D.	1.6	.0	1.03	.13	.81	1.2	1.09	.9			9.7	4.6	

Summary Statistic

Table 5 is a summary of statistics that provides overall info on the quality of student response patterns, the quality of the instruments used, as well as the interaction between the person and the item. Person measure (+1.76) shows the average value of all students in working on the items given. An average score greater than 0.0 indicates that students' abilities are considered good. Alpha Cronbach (measuring reliability, the interaction between person and item as a whole), was 0.39 meaning that it is poor because the value is less than 0.5.

Table 5. Summary Statistic

Person Reliability	Items Reliability	Cronbach Alpha	INFIT MNSQ	OUTFIT MNSQ	INFIT ZSTD	OUTFIT ZSTD	Separation Value
0.00	0.89	0.39	0.97	0.93	0.1	0.2	4.0

Person Reliability in table 5 is 0.00, whereas Item Reliability is 0.89. It can be concluded that the consistency of answers from students is weak (<0.76 = Weak), but the quality of items in the instrument has a good reliability (0.8-0.9 = Good). When viewed from the scalogram, that student is able to answer the given problem, but the consistency of the weak response indicates that the student is still experiencing a weak understanding of the basic concept (chemical matter) or misconception. In fact, the item (0.89) indicates that the instrument is made of good quality. Table 5 and previous data are important information for lecturers or teachers to make the learning based on the students' needs. Associated with learning style analysis data obtained, the planned learning strategy is problem-based learning with the method of brainstorming. This is seen from the consistency of student response patterns, in which some students correctly answer items with high difficulty level (difficult), but false on items with low difficulty level (easy). Then, there is a problem (item) that has the same logit value so that the lecturers need to create a problem that has various difficulty levels. The goal is that students are challenged in solving and solving problems scientifically, precisely, logically, and in accordance with procedures. This strategy also helps students build students' knowledge slowly and indirectly their academic ability increases. This enhancement of academic ability helps students to solve the next problem at a high level.

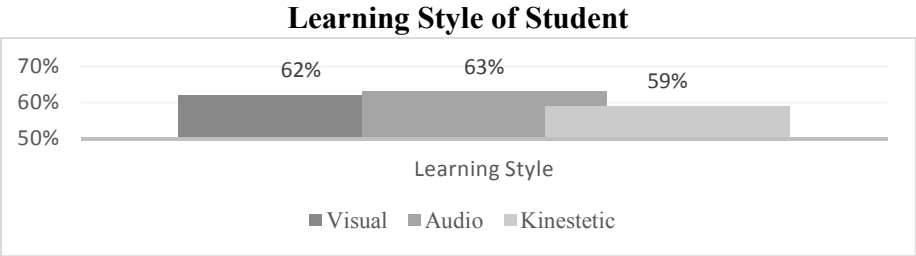

Fig 3. Learning Style Presentation

Figure 3 is a description of the students' learning styles. Based on Figure 3, it can be concluded that the students' average learning styles are almost no dominance of Visual, Audio, or Kinesthetic learning style. This can be seen from the visual percentage (62%), audio (63%), and kinesthetic (59%), so their learning style is almost the same. The value of this learning style becomes an additional assessment for lecturers to accommodate the students' learning style specifically in learning chemistry. Implementationally, they are not so difficult to be given the learning process as previously planned (the application of problem-based learning & Brainstorming) because they have the same learning style so integration as a learning model and media becomes easier.

Relationship of Cognitive Ability and Learning Styles

Data analysis performed on basic cognitive abilities and learning styles, then those data were searched for the correlation using Kendall's Tau b and Spearman. This correlation was used because the data is not normally distributed statistically, this is seen from Asymp Sig 0.042 <0.05. Then, Table 6 shows that their basic cognitive

abilities have no correlation, although the variables between learning styles have a strong correlation. The correlations of basic cognitive abilities with the study were -0.165 (LSV / Visual), 0.165 (LSA / Audio), and -0.104 (LSK / Kinesthetic). This indicates that there is no relationship between them. The data is also reinforced with a significant value greater than 0.05 (0.277, 0.266, 0.469> 0.5) so it does not correlate significantly. However, when looking at the correlations between learning style variables, they have a strong correlation of LSK-LSV (0.622 **) and LSK-LSA (0.400 *). That is, mutually correlated significantly.

Table 6. Correlations Data

Correlation Data	**Cognitive-Visual**	**Cognitive-Audio**	**Cognitive-Kinesthetic**	**Kinesthetic-Audio**	**Kinesthetic-Visual**
	-0.160	0.165	-0.104	0.400	0.622

The absence of correlation based on Table 6 data is due to the given instrument being not fully understood by them, thus affecting their psychology in filling out the learning style instrument sheet. That means learning styles are not the main thing in motivating their learning such as, from their learning environment, mindset, background, teamwork skill, teaching methods, etc [53].The absence of correlation is also not the first time, but other researchers say although learning styles do not add to their academic ability, the identification helps to identify students' tendency to learn [53]. The results of this study are also helpful for students to recognize their original person in learning and become a guide for teachers in optimizing the teaching process.

CONCLUSION

From the data presentation along with the given explanation, it can be concluded that the Person Reliability was 0.00 while Item Reliability was 0.89, meaning the consistency of students' answers is weak (<0.76 = weak), but the quality of the item has good reliability (0.8-0.9 = Good). The scalogram data shows that almost all students answer the question well, but the consistency of a weak response indicates that they still have low knowledge of basic chemical concepts or misconception. In fact, the item created has a good category (0.89). Then, through this study, the authors plan to make a breakthrough for learning chemistry such as the realization of problem-based learning model and brainstorming method. All in all, it is expected that this identification can assist the lecturers or teachers in optimizing the chemistry learning processes.

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