Analysis of Student Cognitive Ability Using The K-Means Cluster and Rasch Model (Winsteps) on Chemical Materials through Zoom Meeting

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ABSTRACT

This study aims to determine students' learning difficulties in chemistry by using zoom in achieving cognitive, sociological and psychological aspects and to further examine the difficulties faced by students. Data collection using questionnaires and tests, then using the K-Means Cluster data analysis technique, with three clusters (groups) followed by crosstab and graph analysis, using SPSS IBM 22 and followed by the RASH model. the results obtained are that (a) cognitive aspects in the form of student thinking, followed by sociological aspects and psychological aspects related to students' internal factors (b) cognitive results are tested more deeply with the Expended Score Graph. The ICC is in accordance with the RASH Model, the difficult questions to work on are questions 10 and 13 are in the analysis (C4), the Outfit MNSQ value is between 0.5-0.15 and then from the Probability graph of Student Cognitive Ability is well distributed, thus the difficulty in the cognitive aspect lies in the questions presented. These results are very useful for identifying students' cognitive limitations in chemistry learning. Thus, from the results, it is explained that cognitive is the main difficulty, with the RASCH test it is known that the level of difficulty is at the analysis.

Keywords: *Cognitive Ability; K-Means Cluster; Model RASH; Zoom Meeting*

INTRODUCTION

The development of higher education learning since 2019 to date is very varied, especially using platforms that facilitate distance learning. Learning that is very meaningful for lecturers, students and staff in developing digital learning in universities. Based on experience at the Al Washliyah University Muslim Nusantara (UMN) Mathematics Study Program, universities continue to develop learning Siakad, to make it easier to control learning, as is the case with the North Sumatra Islamic University (UISU) Agrotechnology Study Program, the learning process uses Siakad. But unfortunately, the first year of 2019 used digital learning, UMN Al Washliyah and UISU had difficulties in the learning process, learning was only based on whatsapp. As a result, learning is complicated and uncomfortable, complexity is obtained with

the results of a Likert scale questionnaire, it is explained that 75% of students experience difficulties in understanding chemistry, both theory and/or calculations, in 2020 the development of Siakad is getting better, by integrating it with the learning platform, but the same In the case of difficulties that students still experience in achieving learning, it is explained that the results of the Likert scale questionnaire have experienced difficulties of 68%, meaning that there is a reduction.

In 2021, learning has used zoom meetings, which make it easier to generate interactions between lecturers and students or students and colleagues. The results of studies that have been carried out by several researchers state that the experience of using Zoom technology as a substitute for face-to-face learning has positive aspects (for example, convenience, technological skill development, and interactive features) and negative aspects (for example, social connectedness, anxiety, and technology problems). Powell et al. (2021), continued by Irugalbandara (2021) explained that zoom can strengthen understanding of the potential of virtual technology-based approaches in accordance with changing learning and teaching conditions, as well as signposts of possible future research directions in terms of integrating technology and delivery online for Drama and Theater teacher education and continued with Totanan (2022) stating that learning with zoom is more interesting than whatsapp and google class room.

From the results of research that has been carried out by previous researchers, it is explained that zoom meeting technology contributes to learning activities and can be used as face-to-face learning, so that interactions become more real. The results of previous studies are the basis for updating the results of the study. This study focuses on analyzing the use of zoom on several aspects of the difficulty in the learning process, including sociological, psychological and cognitive aspects.

From this explanation, the purpose of this research is to find out the aspects that are the most difficult to achieve and explain the aspects that have difficulty using zoom. Thus, this research will reveal some of the difficulties experienced in the process of learning chemistry, learning chemistry with the characteristics of applied materials, theory and calculations. This study focuses on applied and theoretical chemistry; the material is delivered using zoom meeting technology.

LITERATURE REVIEW
   Learning Aspects
   Anmarkrud et al. (2019) also confirmed that the literature that had been studied failed to explain the relationship between students' cognitive load and students' working memory. There are two things that are of concern to researchers, namely (1) many studies have not completely explained how much working memory and conceptualization the cognitive load theory should have; (2) the assessment carried out to analyze the subjective relationship of cognitive load is very small, even though psychometric information is needed, a combination of instruments to measure other cognitive loads, clearly implements the combination of cognitive load with working memory and uses descriptions (instructions) clearly; (3) the need to conduct early testing, especially on instruments including validity and reliability.

This also confirms that Anmarkrud et al. (2019) states that one solution is using multimedia that is applied using a network (internet) will provide opportunities for students to build their own knowledge in themselves, a good mentality will be reflected in readiness in dealing with the material to be delivered by the teacher, educators either teachers or lecturers.

Furthermore, researchers who are no less concerned with the cognitive abilities of students proposed by Bohloko et al. (2019), researchers focus more on research by applying audiovisual media in the form of using videos from YouTube. The youtube video in the study

was applied in solving chemistry to measure the cognitive ability of the Bloom aspect. Research conducted by projecting videos onto the classroom wall, not onto the laptop or computer of each student. The amazing thing is that youtube videos shown in the chemistry learning process are a solution to the limitations of research locations that are not complete in terms of laboratory tools and materials. This is different from previous research which only studied cognitive abilities in a literal manner, which was associated with the mental readiness of students.

Thus, the cognitive aspect becomes one of the important assessments in determining the success of chemistry learning. The level of the cognitive domain consists of six levels, including knowledge, understanding, application, analysis, synthesis and evaluation, this is stated by Benjamin S Bloom. In addition to the cognitive aspect, the psychological and sociological aspects are also of concern in learning.

Psychological aspects according to Syafi'i et al. (2018) are things that affect humans in obtaining a change in overall behavior, psychological aspects that are considered in learning include (a) perception enters the human brain, (b) thinking is personal activity Human beings that result in discoveries that are directed to a goal, (c) interest is a persistent tendency to pay attention and remember some activities, (d) motivation is a tendency of mental strength in the form of desire, attention, willingness and ideals that encourage someone to take action. which is in accordance with the desired purpose and (e) memory is a mental process that includes the storage and retrieval of information and knowledge.

Sociological aspects are aspects related to interactions in the classroom. There are several sociological aspects which include, including (a) social distance, which shows the closeness of the relationship between lecturers and students or vice versa, (b) social status, where communication activities can run well, regardless of age, gender, individual personality, social class, social structure and ethnicity (Isbowo et al., 2014), (c) formality, situations that lead students to use standard and standard language.

Thus, the three aspects above greatly affect the symptoms of activities carried out by students, from these three aspects it will be known that the dominant difficulties received by students in the learning process and the three aspects are interrelated and mutually supportive.

Zoom Technology in Chemistry Learning

The development of digital-based multimedia learning, contributing both to the learning process in universities, Kessler and Bokowski (in Lenkaitis, 2020) explained that with the ability of students to participate in learning, the results show that collaborative learners, instructors are asked to contribute independently and are able to use strategies appropriate for communicating as a collaborative member of a group. Changes in learning with the transition from synchronous text exchange technology to exchanges that include audio and video are able to change the way students learn and explore the perceptions of instructors and students who use online video conferencing tools (Godwin-Jones, 2011; Kozar, 2015).

Zoom meetings are widely used during distance learning, Powell et al. (2021) emphasize that zoom is one of the face-to-face learning solutions based on digital technology, Ajder and Lumley (2021) use zoom as a substitute for communication in keeping children at home. It can be concluded, zoom is able to be a learning solution, the results of the implementation of learning at UMN Al Washliyah and the UISU Faculty of Agriculture with zoom are able to produce learning interactions and open discussions to solve chemistry material.

METHODS

This research was conducted using quantitative research methods and focused on descriptive research. The samples used in this study were 70 students of the Muslim Nusantara

University from three Study Programs (Mathematics Education, Agriculture and Pharmacy), 70 students of the Islamic University of North Sumatra in the Agrotechnology and Technology Study Program of Agricultural Products and 60 students of the Padangsidimpuan College of Health Faculty, so that the total The sample used was 200 students.

The research will be carried out in May 2022, using the technique of collecting test data in the form of multiple choice as many as 12 questions with 5 answer choices, the indicator used is the cognitive aspect of Bloom starting from Application (C3), Analysis (C4), Synthesis (C5) and Evaluation (C6). The data analysis technique uses the RASCH model with the help of WINSTEPS Version 3.73 and SPSS 27 for windows. The result by Darmana et al. (2021) the main reason for choosing the RASCH model is to review the opportunity to answer correctly on the questions given by comparing students' abilities with the level of difficulty of the questions, then the instrument validation aspects analyzed include the prerequisite tests for the RASCH model, namely local unidimensional tests and independence, appropriate questions, problem difficulties and abilities, students (wright map), bias test with DIF (differential item functioning), reliability and calculation of instrument results.

Conclusions will be drawn according to the graph generated by the questionnaire for the psychological and sociological aspects of students, while for the cognitive aspect it will be taken from the ability of students to answer each Bloom's taxonomy indicator that has been provided, then describe the K-Means results from the SPSS results and describe all the results, according to the expected problem formulation.

RESULTS AND DISCUSSION

A. Difficulty of Achieving Chemistry Learning Assessment with Zoom via K-Means Cluster

Determining the difficulty in learning zoom in both cognitive, psychological and sociological aspects of the chemistry course, using the K-Means Cluster, obtained clusters (groups) of difficulties with three groups, namely with 1 (high level of difficulty), 2 (middle level difficulty) and 3 (difficulty level is low/not difficult), the results can be seen in appendix I. After the clusters in each indicator are obtained in detail, conclusions can be drawn according to the Final Clusters Centers table 1, as follows:

Table 1. *Final Cluster Centers*

Learning Aspect	Cluster		
	1	2	3
psychological aspect	77.29	107.77	95.36
sociological aspect	100.29	108.52	7.00
cognitive aspect	10.43	12.58	2.57

From the table 1, each cluster can be explained according to the data above:

a. Cluster 1 explains that respondents who answered the questionnaire statements and questions have lower scores than the others, this group also has difficulties in every aspect of assessment, both psychological, sociological and cognitive aspects, with these characteristics it can be assumed that almost all of the students answered disagree in each questionnaire and answered incorrectly in each question. Thus, cluster 1 can be declared a high level of difficulty.

b. Cluster 2 explains that respondents are better than other clusters both in answering questionnaires and questions, this group only has a little difficulty in solving them, although it appears that the cognitive aspect is better than other aspects, with these characteristics it can be assumed that some of the students answered disagree in each questionnaire and answered incorrectly in each question. Thus, cluster 1 can be declared medium difficulty.

c. Cluster 3 explains that respondents are lower than other clusters both in answering questionnaires and questions, this group only has no difficulty in solving them, both from psychological, sociological and cognitive aspects, with these characteristics it can be assumed that some of the students answered agree in each questionnaire and answered correctly in each question. Thus, cluster 3 can be declared low level difficulty or no difficulty.

It is clear that the largest F is in the sociological aspect of 193.733 with the number in the Sig column being 0.000 which means the significance is real. This means that the sociological aspect greatly distinguishes the characteristics of the three clusters or in other words the sociological aspect by respondents in the three existing clusters is very different from one cluster to another, while the psychological aspect has an F number of 35.103 and the Sig number is 0.000 and so also with the cognitive aspect with F of 7.536 and the Sig number is 0.001 (0.001 < 0.05), it can be interpreted that in cluster 1, cluster 2 and cluster 3 have significant differences, in other words that cluster 1 is relatively difficult compared to other clusters.

From these results, it is clear that each cluster has a significant difference. Thus, it will be known further, the main aspects that cause difficulties in following the chemistry courses. By continuing the analysis, the following results are obtained:

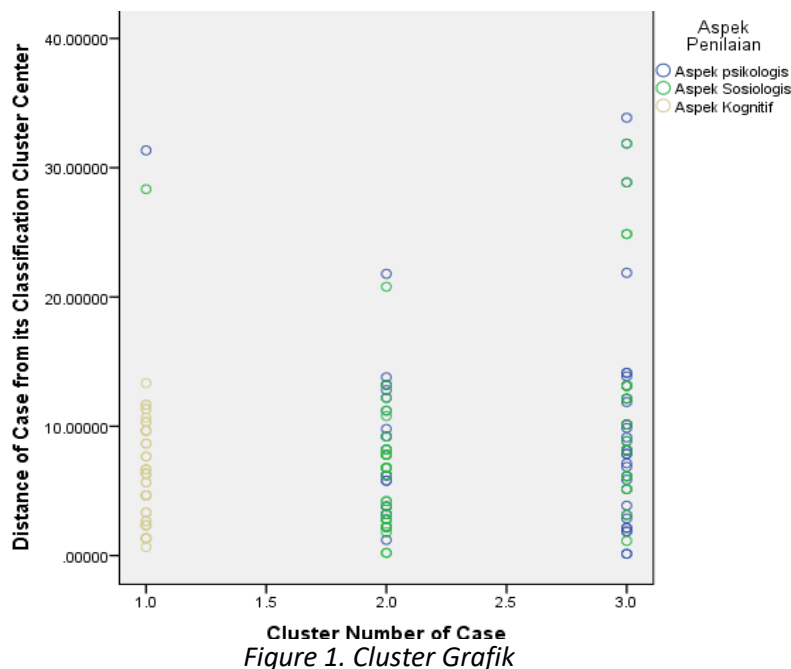*Table 2. Case Processing Summary*

| | Cases | | | | | |
| | Valid | | Missing | | Total | |
	N	Percent	N	Percent	N	Percent
Value aspect * Cluster Number of Case	200	100.0%	0	0.0%	200	100.0%

a) In the psychological aspect, most of the students (respondents) are in the low level difficulty (not difficult) of 60.6% or are in cluster 3, while the rest are in cluster 2 or are in the medium level difficulty of 37.9% and cluster 1 or are on a high difficulty level of 1.5%. In other words, the psychological aspect is of low difficulty.

b) In the sociological aspect, most of the students (respondents) are in cluster 2 or have medium level difficulty of 61.1%, while the rest are in cluster 3 or are in low level difficulty of 37.0% and cluster 1 or are in the level of difficulty high rate of 1.9%. In other words, the psychological aspect is of low difficulty.

c) In the cognitive aspect, it is different from other aspects, in the cognitive aspect, all students (respondents) are in cluster 1 or are at a high level of difficulty of 100%.

In other words, it can be concluded that students (respondents) who experience a high level of difficulty in the cognitive aspect, it is clearly seen that all students (respondents) are in cluster 1, then followed by the sociological aspect in the medium level difficulty, this is shown in part Most of the students (respondents) are in cluster 2 and the psychological aspect is at a low level of difficulty, it is clear that some of the students are in cluster 3.

Figure 1. Cluster Grafik

From figure 1, according to the guidelines for each symbol for each aspect of the assessment in the upper right box, cluster 1 (light brown) almost all students (respondents) are cognitive aspects, then in cluster 2 most of them are green which means sociological aspects meets in the cluster and in cluster 3 is filled with blue which means that the psychological aspect spreads in the cluster.

Theoretically, that the cognitive aspect is in the form of student thinking in taking the knowledge given either from the lecturer or the results of the discussion, from this research it is known that the cognitive aspect is very difficult for students to do.

This is in accordance with what was stated by Hutto et al. (2017) which states that cognitive is very closely related to understanding brain understanding, so it must be able to contribute to understanding in accordance with learning adaptation, the same thing was also found by Adbo and Taber (2014), explained that learning chemistry really requires the ability to think and develop in different instructional contexts to support the development of a more effective science pedagogy. Thus, the results of this study are in accordance with the theory which states that cognitive aspects become difficulties in learning, especially in using zoom technology.

B. Studying Cognitive Aspect Difficulties with the RASCH Model

Darmana et al. (2021) confirms that the analysis using the RASCH model with MFRM shows interesting and more complete results so that it can provide more precise information about the quality of the questions. Assessments that are intended to avoid bias can be carried out more precisely through MFRM where item interactions, items and raters are calibrated on the same interval scale.
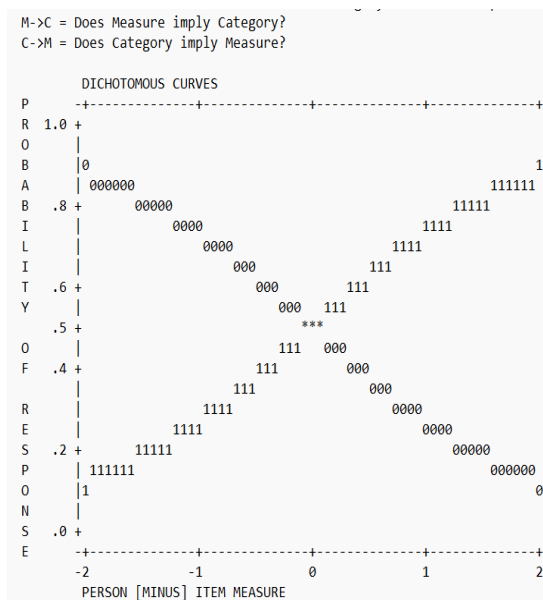
Figure 2. Student Cognitive Ability Probability Graph

From Figure 2, it is clear that the probability distribution of the answers corresponds to the distribution of the sample, so that the resulting data is able to describe a good distribution, both those who answered incorrectly with 0 points and answered correctly with 1 point.

Figure 3. Result Outfit MNSQ

The provisions of the mean Square control is 0.5 -0.15; the results from Figure 4 clearly know that the MNSQ outfit is in the right position, there is no more or less than each item of outfit and this is in accordance with the RASCH model.
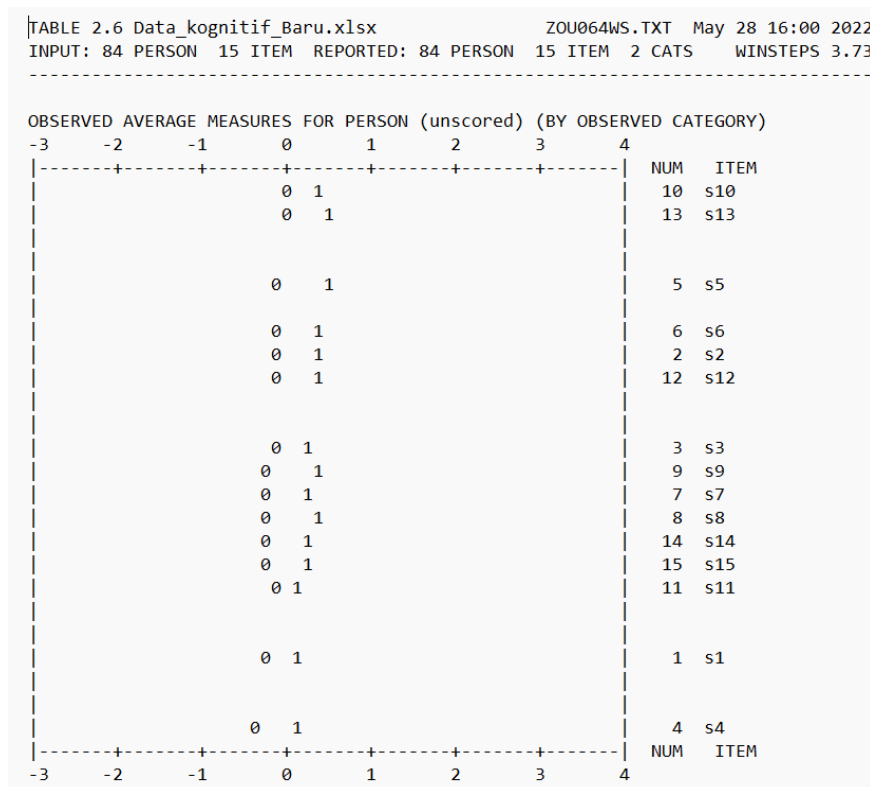
```
TABLE 2.6 Data_kognitif_Baru.xlsx              ZOU064WS.TXT  May 28 16:00 2022
INPUT: 84 PERSON  15 ITEM  REPORTED: 84 PERSON  15 ITEM  2 CATS    WINSTEPS 3.73
--------------------------------------------------------------------------------

OBSERVED AVERAGE MEASURES FOR PERSON (unscored) (BY OBSERVED CATEGORY)
-3    -2    -1     0     1     2     3     4
|-------+-------+-------+-------+-------+-------+-------|  NUM   ITEM
|                       0  1                          |  10  s10
|                       0   1                         |  13  s13
|                                                     |
|                                                     |
|                         0    1                      |   5  s5
|                                                     |
|                       0  1                          |   6  s6
|                       0  1                          |   2  s2
|                       0  1                          |  12  s12
|                                                     |
|                                                     |
|                        0 1                          |   3  s3
|                      0    1                          |   9  s9
|                      0  1                            |   7  s7
|                      0   1                           |   8  s8
|                      0  1                            |  14  s14
|                      0  1                            |  15  s15
|                       0 1                            |  11  s11
|                                                     |
|                                                     |
|                      0  1                            |   1  s1
|                                                     |
|                                                     |
|                    0   1                             |   4  s4
|-------+-------+-------+-------+-------+-------+-------|  NUM   ITEM
-3    -2    -1     0     1     2     3     4
```

Figure 4. Item Map

Furthermore, Figure 4 explains that there are two questions that students have difficulty solving problems at the analysis level (C4), the difficulty obtained by students when determining to collaborating acid-base materials used in everyday life and making the basis for grouping colloids, this difficulty confirms that students are lacking in determine exactly what chemical materials and processes involve in everyday life.

In this case, it is very clear that although using zoom learning, teaching materials are needed according to the needs of students, because chemistry is part of science, this is in accordance with the results of research conducted by Prins et al. (2018) that chemistry (science) requires a conceptual framework of Cultural historic activity theory (CHAT), which focuses on habits in the use of chemistry in life, even Danckwardt-Lillieström et al. (2020) explains that learning chemistry also requires creative drama in chemistry education to increase student agency in the exploration of electronegativity and Electronegativity is related to intramolecular and intermolecular bonds.

Thus, it is clear that the difficulty of learning chemistry, because it requires the ability of the brain to understand each grouping and collaborate every chemical product, material, tool and procedure in everyday life, so from this problem it is very necessary that some learning activities through zoom technology are applicable and provide the opportunity for students to detect the ability to adapt to the learning environment, learning media and teaching materials, meaning that each process will make it easier for the brain to discover chemistry learning memories.

The RASCH model is declared appropriate if a black dot followed by a blue line is obtained on the red line, if so, the RASCH model is appropriate to be used in further examining the level of difficulty in the cognitive aspect.
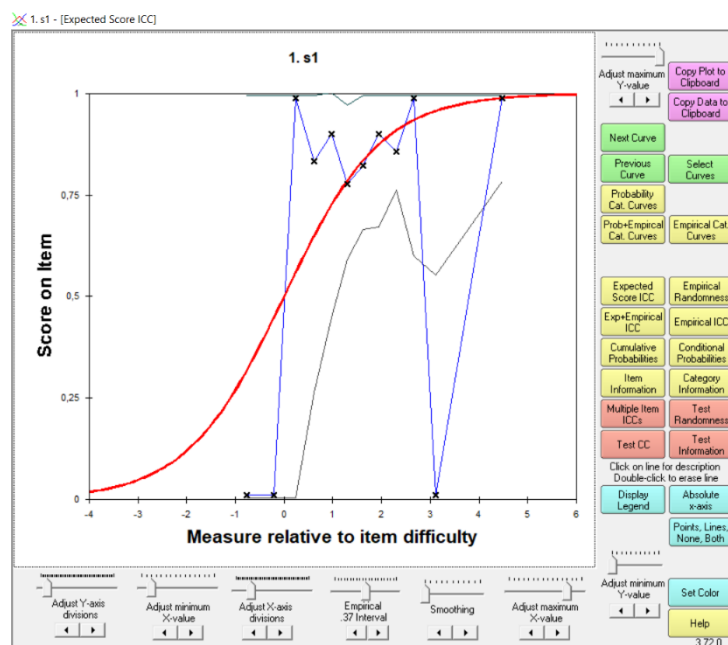
Figure 6. RASCH Model

The results obtained are very close to the results of previous research, interaction with theory as well as the ability of students to develop their own knowledge, this is in accordance with Constructivism Theory that learning is successful if it involves participants in the knowledge process, Perin (Ambrose et al., 2013) asserted also that good learning aims to bring meaning or construction of new experiences, further proposed by the Cognitive Theory proposed by Chandler (Anmarkrud et al., 2019) confirms that a good learning model is able to process information according to working memory, so it can be stored in memory long-term.

Obviously, good learning will facilitate cognitive achievement and be able to overcome cognitive difficulties, the results of the study found the same thing with the theory that the difficulty of cognitive achievement because it does not involve the needs of students in chemical processes in everyday life, the difficulties experienced by students at the analytical level are wrong. One reason students have not reached the appropriate information, so it is not stored in long-term working memory. Through the K Means Cluster and RASCH Model, it is easier to study and collect information on the difficulties experienced by students in learning chemistry using zoom technology. Technology in learning will contribute to developing student activities, this is in accordance with the results of research conducted by Susilo and Sofiarini (2020) which emphasizes that teachers must be able to use technology, especially using media, so that technology can help achieve educational goals and objectives, so that the process teaching and learning will be more effective and meaningful.

CONCLUSION

The conclusion of this research is the difficulty of learning achievement between psychological, sociological and cognitive aspects, it is known by the K Means Cluster that students experience difficulties in the cognitive aspect followed by testing using the RASCH Model, it is explained that the difficulty of cognitive aspects is at the analysis level (C4) in collaborating and grouping.

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