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Description of Differentiated Instruction Implementation in SMAN 9 Padang as Driving School on Thermochemistry Topic in F Phase

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Abstract: Description of Differentiated Instruction Implementation in SMAN 9 Padang as Driving School on Thermochemistry Topic in F Phase. The purpose of this study is to describe of the implementation of differentiated instruction (DI) in one of the driving schools in Padang on thermochemistry topic. Type of this research was using a qualitative approach. Data was collected from observation, interview, and documentation. The sample of this study was one of chemistry class in 11th grade consisting of 28 students and one chemistry teacher in the class. The data analysis was processed using the Miles and Huberman interactive model consisting of three stages namely data collection, data reduction and conclusion. The results of the data show that teachers implement differentiated learning proses on thermochemistry topic based on student readiness and differentiated the process. The data indicates that teachers have implemented process differentiation well, but some criteria should be adjust DI based on student readiness. Therefore it can be concluded that teachers still need adjustments in implementing differentiated teaching based in the principles of differentiation to maximize differentiated instruction.

Keywords: *Differentiated Learning, Driving School, Thermochemistry*

Abstrak: Deskripsi Pelaksanaan Pembelajaran Berdiferensiasi di Sekolah Penggerak SMAN 9 Padang Pada Materi Termokimia Fase F. *Tujuan penelitian ini adalah untuk mendeskripsikan pelaksanaan pembelajaran berdiferensiasi di salah satu sekolah penggerak di kota Padang pada materi termokimia. Penelitian termasuk jenis penelitian deskriptif kualitatif. Data diperoleh dari observasi, wawancara dan dokumentasi. Sampel penelitian ini merupakan salah satu kelas XI Fase F kimia yang terdiri dari 28 orang siswa dan guru kimia yang mengajar pada kelas tersebut. Data yang diperoleh dioleh menggunakan model interaktif Miles dan Huberman yang terdiri dari tiga tahapan yaitu pengumpulan data, reduksi data, dan penarikan kesimpulan. Hasil data menunjukkan bahwa guru menerapkan pembelajaran berdiferensiasi pada materi termokimia berdasarkan kemampuan awal siswa dan dilaksanakan pada proses. Data menunjukkan bahwa guru sudah menerapkan diferensiasi proses dengan baik namun masih perlu penyesuaian dengan prinsip differensiasi berdasarkan kesiapan belajar. Sehingga dapat disimpulkan bahwa guru masih perlu penyesuain dalam pelaksanaan pembelajaran berdiferensiasi berdasarkann prinsip differensiasi agar pembelajaran berdiferensiasi optimal diterapkan.*

Kata kunci: *pembelajaran berdifferensiasi, sekolah penggerak, termokimia*

▪ INTRODUCTION

Chemistry is a natural science that studies matter and its changes (Chang, 2010). Thermochemistry is one of the materials studied in chemistry. Thermochemistry studies heat changes in chemical reactions which consist of several concepts about chemical reactions (Chang, 2017). Based on the questionnaire that has been distributed to 60 students, it is found that 17 students consider it quite easy and 43 students consider it difficult. The concepts contained in thermochemistry topic are quite a lot, making students think that this material is quite difficult to understand. Ways or efforts are needed so that in the learning process students become more interesting to learn, especially in material that has been considered difficult. The implementation of an interesting learning process is inseparable from the curriculum that is applied because in the curriculum there are directions regarding learning activities.

The current curriculum is *merdeka curriculum*. There is a term independent learning in *merdeka curriculum*. The learning process in *merdeka curriculum* that applies independent learning provides opportunities for students to learn happily, relaxed, and fun to support the talents of each student. Independent learning also provides freedom for teachers to organize, compile and plan learning materials or content and become facilitators for students in the learning process. In accordance with the demands of *merdeka curriculum* that implements independent learning, (DI) is learning that is in accordance with the demands of an *merdeka curriculum*. (DI) is a learning process that is tailored to the needs of students (Tomlinson, 2001). There are 3 aspects of learner diversity: learning readiness, learning style (learning profile) and learning interest (Tomlinson, 2017). Strategies that can be differentiated in (DI) are content differentiation, process differentiation and product differentiation (Marlina, 2019).

The implementation of (DI) in schools has several obstacles such as in applying differentiated instruction to learning styles or learning profiles where the learning process must be adapted to the learning styles of students. Students' different instruction styles make teachers have to think about learning media that are suitable for each learning style. In addition, there is still a lack of information regarding the application of (DI). In accordance with the thermochemistry topic which has many concepts that make students consider this material difficult, interesting learning is needed so that this material is more easily understood by students. (DI) that adapts to students and can make learning more interesting is very suitable to increase student understanding of this material. (DI) can improve student learning outcomes (Rani, S & Tri, 2022).

Based on the results of interviews that have been conducted at several schools in Padang such as SMAN 7 Padang, SMAN 8 Padang, SMAN 9 Padang, SMAN 10 Padang, SMAN 15 Padang, SMAS Adabiah 2 Padang and SMA 1 Pertiwi Padang, it is known that at SMAN 7 Padang and SMAN 9 Padang the school has implemented (DI) during the learning process. At SMAN 10 Padang and SMAS Adabiah 2 Padang, the school has not implemented (DI) fully because it still adjusts to the material. If the material that can be applied (DI) then it will be applied but if the material that cannot use differentiation then do not apply it while at SMAN 8 Padang, SMAN 15 Padang and SMA 1 Pertiwi Padang it is known that the school has not applied (DI). The reason why teachers have not implemented (DI) in schools is because of the lack of knowledge about (DI) and how to apply it in the learning process.

Based on the results of interviews at several schools in Padang city, one of the driving schools that has implemented (DI) is SMAN 9 PADANG, it is known that after implementing (DI) there is an increase in student learning outcomes in the knowledge

aspect and the skills aspect which can be seen from student activeness in the learning process. One of the driving school programs is to improve the quality of learning in the school and then can be an example for other schools in an effort to improve similar quality. Based on this, it is necessary to explain the implementation of (DI) in the driving school so that the author wants to explain the Implementation of Description of Differentiated Instruction Implementation in SMAN 9 Padang as Driving School on Thermochemistry Topic in F Phase.

▪ METHOD

This research is classified as descriptive research, wherein descriptive research is a type of study that describes, portrays, and delineates information based on the facts discovered by the researcher from the population under investigation (Abdullah, 2018). The method employed in this research is qualitative method. Qualitative method is a research method used to investigate natural conditions by employing data triangulation techniques, presenting data in the form of words rather than numerical figures (Sugiyono, 2018). The instruments used consist of student questionnaires, differentiated learning implementation instruments, and teacher interviews. These instruments serve as measurement tools in the research (Sappaile, 2007).

This research was conducted at SMAN 9 PADANG in one of the Class XI/Fase F classes during October-November of the academic year 2023/2024. The reason the researcher conducted the study at SMAN 9 Padang is because the school has been implementing the curriculum for three years. The *merdeka curriculum* is an improved curriculum from the previous one, which implements intra curricular learning and optimizes content so that students can explore themselves. Therefore, students are given the freedom to choose which field they will study and how they will learn it (Hasim, 2020). The school is considered one of the driving schools in the city of Padang. A driving school is a program-oriented school aimed at enhancing the quality of learning within the institution, intending to realize the profile of Pancasila learners (Khofifah & Syaifudin, 2023). "Differentiated learning is a diverse teaching approach employed by educators in the classroom. It encompasses various methods of acquiring content, processing, building or reasoning ideas, developing learning products, and assessment criteria, enabling all learners in a single classroom with diverse abilities and backgrounds to effectively engage in learning (Suwartingsih, 2021).

Based on the interview results, it is also known that SMAN 9 has implemented (DI). In this study, the researcher acted as an observer collecting data through teachers and students. The data in this research consisted of questionnaires from the (DI) implementation instrument obtained by the researcher during the teachers' classes. This instrument for (DI) implementation contains criteria for applying (DI) according to standards. Additionally, data on students' scientific processes during the learning sessions were gathered to understand how students undergo the (DI) process. The student questionnaires were also administered after the students learned about thermochemistry through differentiated instruction. These questionnaires contained several inquiries to gauge the students' experiences and their understanding after participating in the (DI) sessions on thermochemistry. Furthermore, other supporting data were gathered from documentation during the learning process and interviews conducted with chemistry teachers as confirmation from the teachers themselves who have implemented (DI) in thermochemistry. The teacher interviews comprised several questions regarding the

outcomes of implementing (DI), the perceived challenges after implementing it, and how teachers plan for subsequent applications to maximize (DI).

The data analysis conducted in the qualitative approach used the interactive model proposed by Miles and Huberman, consisting of three stages: data collection, data reduction, data display, and conclusion drawing/verification (Miles & Huberman, 2014). After obtaining data through interviews, observations, and documentation, it is necessary to conduct tests on this data. One test that can be performed is using the technique of triangulation, which involves merging data obtained from these three sources. This enables the researcher to draw conclusions regarding the implementation of (DI) in thermochemistry (Miles & Huberman, 1992).

▪ RESULT AND DISCUSSION

This research was conducted in November 2023, focusing on differentiated learning implementation in thermodynamics at SMAN 9 Padang. Based on observations and interviews, it was found that prior to commencing the lesson, the teacher mapped the students' readiness in thermodynamics. The teacher administered a pre-test related to prerequisite topics before delving into thermochemistry. The pre-test consisted of questions on chemical bonds, which are connected to energy calculations within the realm of thermochemistry. Additionally, the teacher conducted interviews with students regarding their readiness to learn. The teacher took initial steps before initiating (DI) (McTighe et al., 2017). Selecting one of the fundamental bases for differentiated learning: readiness based on students' preparedness (Tomlinson, 1999). The thermodynamics module spanned three sessions. The teacher began by checking in with the students and had assigned independent reading tasks at home to provide students with an overview of the upcoming material. After stating the learning objectives, the teacher showed a video illustrating an example of thermochemistry benefits in developed countries. The video presented in both Indonesian and English languages. In addition to the video, the teacher distributed journals and supplementary materials for students to use as learning resources. Following the video presentation, students were asked to share the information they gathered in their own words. The teacher provided options for presenting their arguments: students could express themselves through written work in their notebooks, via messages in the WhatsApp group, or by verbal communication. The teacher's approach of providing diverse learning resources aligns with the principle of differentiation—creating a learning environment based on students' preferences through varied learning materials. Moreover, the teacher applied differentiation principles by offering multiple options for student expression.

After students understood the learning objectives, the teacher proceeded to introduce the concept of systems and environments using a glass containing a solution as a visual aid for students to observe. The teacher explained that the water inside the glass represented the system, while everything outside the water in the glass represented the environment. Then, the teacher asked the students to provide definitions of systems and environments after the example provided. The teacher actively engaged the students in discovering concepts during the learning process. Once the students grasped the concepts of systems, environments, and the types of systems, the teacher moved on to exothermic and endothermic reactions by conducting a practical experiment. The teacher utilized the experimental design outlined in the student's workbook. Throughout this learning process, the teacher grouped the students, but the formation of student study groups was left to the students themselves. The teacher did not categorize students based on their readiness

levels, which had been assessed by the teacher. Instead, based on observations, students determined their own groups. According to the interviews conducted, the reason why the teacher did not group students based on their assessed readiness was due to the potential disparity the students might feel if grouped according to their readiness levels. The teacher considered the potential gap that might arise if students were grouped solely based on their learning readiness. The appropriate step, as outlined in the assessment mapping, is to use assessment results as a basis for student grouping (McTighe et al., 2017). Upon obtaining assessment results, there are three alternatives available, and the teacher can choose one of these options. The instructional alternative that aligns with students' readiness includes:

1. The teacher can group students based on their learning achievements, and the school can provide additional learning programs for students who are not yet ready to learn according to their phase.
2. The teacher can divide students into groups based on their learning achievements and offer guidance during the learning process.
3. The teacher can instruct a heterogeneous group of students and provide assistance after class hours for those who still require guidance (McTighe et al., 2017)."

The teacher did not group students based on their learning readiness, hence the students' preparedness levels within heterogeneous groups were not apparent. Even though the teacher approached each group during the practical session to observe their progress, there were still several groups where almost all members felt confused throughout the experiment. If indeed the teacher intends to form heterogeneous groups, the responsibility for grouping should not be left to the students. During this practical session, it becomes evident how students understand not only the tools and materials but also how to utilize them. Hence, heterogeneous groups are crucial in this learning process because dividing students based on diverse learning achievements can aid them in completing the experiment. Since the teacher is aware of each student's readiness, it is advisable for the teacher to be the one to assign groups, allowing for a better understanding of how to allocate students within these groups.

When the students had obtained the data from the experiment, the teacher fostered an enjoyable learning atmosphere. The teacher inquired about the results of each group's experiment and asked students whose data showed an increase in the final temperature of the solution during the first trial to stand on the left side, while those who observed a decrease stood on the right side of the teacher. The teacher then asked for opinions from groups with different data and explained the expected outcomes. The same process was repeated for the data obtained in the second experiment. The teacher applied differentiated learning principles by offering various expressions in the learning process. In the second session, the class proceeded to use a calorimeter. The teacher explained the subject matter on the whiteboard, and students learned individually without grouping. The teacher assigned the same set of problems to each student for every sub-topic covered. While working on the given tasks, students were asked to place their water bottles on the right side of their desks when they finished, in the middle if they were still working on it, and on the left if they felt confused while working on the problems.

The teacher did not provide different problems according to the students readiness, resulting in many students feeling confused while solving the questions. In line with the principle of differentiation based on students readiness, the teacher should have offered varying problems to students according to their readiness levels, presenting knowledge and skills at different levels based on their readiness (Marlina, 2019). When

the teacher doesn't tailor the problems or knowledge to match the students readiness, the problems presented might not challenge all students equally. Some students might find the given problems too difficult because their learning hasn't reached that level yet. For each student to feel challenged in their learning, it's necessary to provide different problems, skills, and tasks according to their readiness levels (Tomlinson, 2001). Upon noticing many water bottles placed on the left side of the desks, the teacher decided to conduct a group-based learning approach. After dividing the students into groups, the teacher used the water bottles to gauge the progress of each group while they were working on the problems. The teacher visited each group that had placed their water bottles on the left side of the desk.

During the group learning process, the teacher approached each group that had placed their water bottles on the left side of the desk. The teacher offered more opportunities for all students to ask questions, providing explanations to groups that felt confused. The teacher spent more time assisting groups still struggling rather than those who had completed the given problems. Instructing the groups that finished problem number 1 to proceed to problem number 2, the teacher continued to support groups that were still working through difficulties. The teacher provided guidance to each student feeling confused during learning, allocating different amounts of time for guidance based on the students' understanding levels (Tomlinson, 2001). Based on observations, the teacher implemented differentiation principles in the process. The teacher offered various options for expression when students shared opinions, introduced topics to be learned, created learning activities that supported students by providing diverse learning materials, and provided assistance to students facing learning challenges.

The other data obtained by the researcher includes the students' science process, their learning outcomes, and a survey regarding students' preferences during the learning process. Data on students' science processes were collected during both discussion sessions and practical experiments conducted throughout the learning sessions. In the first meeting, the teacher conducted an experiment, while discussions were carried out in the second and third meetings. The observed data on students' science process skills are as follows:

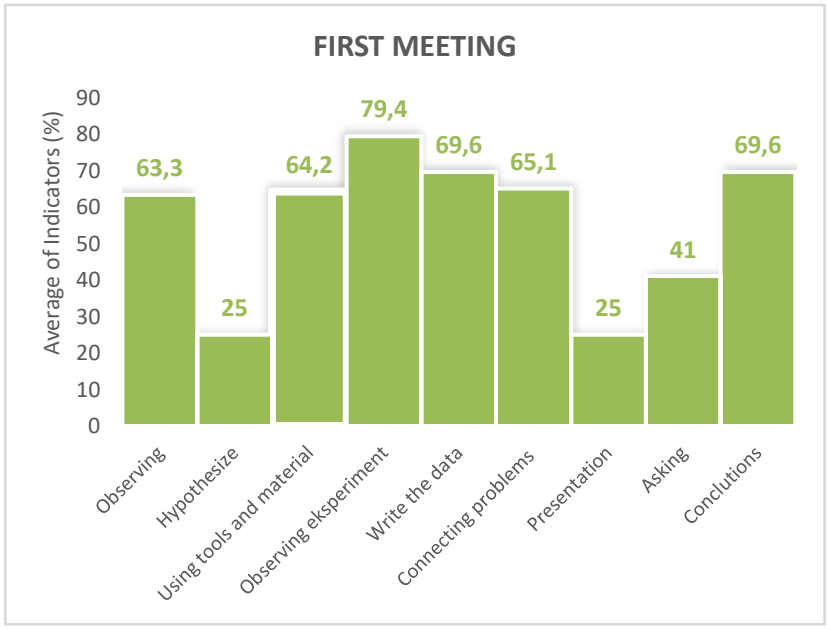

Figure 1. Persent Indicators of Science Process Skills in Eksperiment

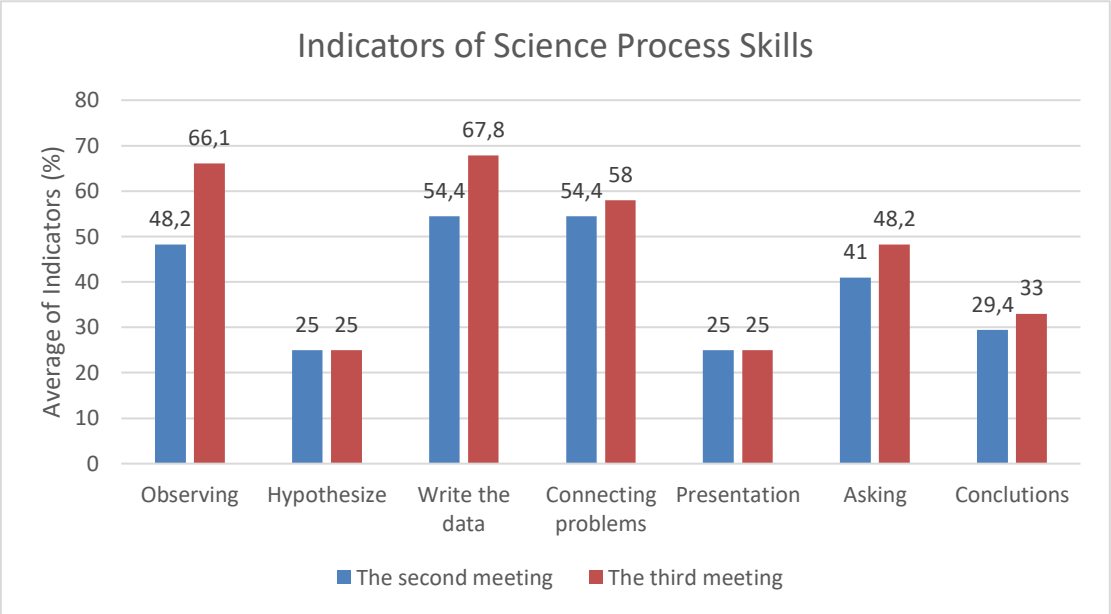

Figure 2. Persent Indicators of Science Process Skills in Discusion

Based on the observational data on students science process skills during the first meeting, the teacher conducted a practical activity. There were seven indicators observed during the experiment, and students demonstrated their science processes. Among these indicators, students showed a relatively high level of competence in five indicators. However, in the indicators of hypothesis and presentation, students did not engage in these aspects because the experiment worksheet did not include a hypothesis, and students did not make presentations. Consequently, in the indicator of asking questions during discussions, students achieved a relatively low score due to the absence of presentations. In the second and third meetings, students engaged in discussion activities. It was observed that there was an improvement in students' science process skills except for the indicators of hypothesis and presentation. Since the teacher did not use worksheets during the learning process, it was not evident how students developed hypotheses. Additionally, students did not present their discussion outcomes, hence the lack of observation on their questioning skills during other groups' presentations. Consequently, progress in the science process indicators of hypothesis, presentation, and questioning during presentations was not noticeable. Regarding the learning outcomes in thermodynamics, it appears that there are still students who achieved low learning outcomes. After daily assessments, the attainment of students' mastery in thermodynamics is as follows:

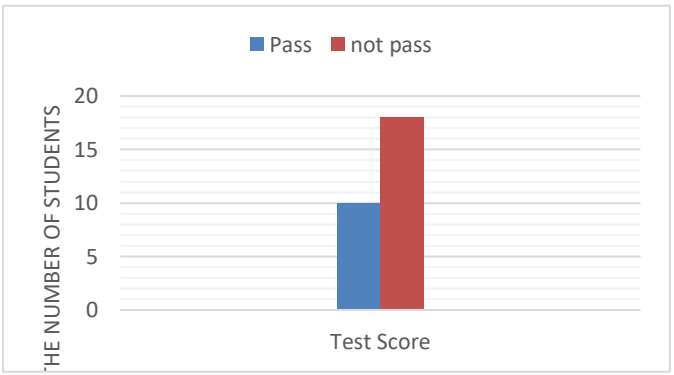

Figure 3. Student daily assessment completeness

The other data obtained was from a survey regarding students' preferences during the implementation of (DI) conducted by the teacher. The survey results are as follows:

Table 2. Favorability Level

No.	Favorite level of learning	Student response (person)	Percentage (%)
1	Very like	18	64,3
2	Like	10	35,7
3	Dislikes	0	0
4	Very Dislikes	0	0
Total		28	100

Based on the data above, despite the students' relatively low learning outcomes, the student responses indicate a high level of satisfaction. About 64.3% of students responded with very much like and 35.7% responded with like, indicating that students appreciate the method of teaching used by the teacher in thermochemistry. There were no students who expressed dislike towards the teacher's teaching methods.

▪ CONCLUSION

The basis for implementing (DI) at SMAN 9 Padang in the subject of thermodynamics is founded upon the readiness of students and executed throughout the process. The implementation of (DI) at SMAN 9 Padang still requires alignment with the principles of (DI). The outcomes of implementing (DI) can be supported by students' comprehension of thermochemistry following the differentiation and the active participation of students throughout the learning process. The research findings could serve as additional information for chemistry teachers regarding differentiation strategies suitable for thermochemistry and how to execute (DI) effectively.

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