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Attitude Assessment Analysis on the 2013 Curriculum Based on the Implementation of Rehearsal Pairs Practice (PRP) Model

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ABSTRACT: The purpose of this study was to know the assessment of student attitudes in the 2013 curriculum after being applied to learning with the Rehearsal Pairs Practice model (PRP). This research was conducted at Senior high school (Madrasah Aliyah) Sunan Pandanaran Yogyakarta. The application of this learning model is carried out on the buffer solution material. The population of this research is all students of class XI MA Sunan Pandanaran academic year 2017/2018. The sample in this study amounted to two classes taken by purposive sampling technique. The data collection technique was performed using a non-test technique, namely using a questionnaire. Data analysis was performed using the Independent Sample T-Test Statistical Test. The results obtained are no differences in student achievement in attitude after being applied with the Practice Rehearsal Pairs (PRP) model.

Keywords: practice rehearsal pair (PRP), attitude, buffer solution

INTRODUCTION

Education is a conscious and planned effort to create an atmosphere of learning and the learning process to actively develop their own potential to have religious spiritual strength, self-control, intelligence, noble character, and skills needed by themselves, society, nation and state [1]. Based on this law, it is explained that students must be able to develop a lot of potential in themselves through learning activities. Learning activities that are undertaken must be able to provide impacts and benefits so that the implementation of learning activities is not in vain. This is why the implementation of the learning process requires careful planning in order to achieve the expected goals. The learning process is not only limited to knowledge transfer, but there is an interaction between teachers and students. The hope is that this interaction can build emotional closeness to foster curiosity and provide learning motivation for students.

However, implementing the learning that is carried out is not as easy as the plan imagined. Careful planning also requires real action. The application of the learning model is one of the actualizations of the plan. Plans to build student potential through interaction in a lesson are implemented by applying learning models that can build student potential through student-centered learning. Learning is focused on student learning activities so that the potential that exists in students can be awakened and emerge. This potential can be in the form of cognitive abilities/knowledge, skills/psychomotor and affective/attitudes. One of the competencies that determine whether students can carry out learning activities well is competence through attitude assessment. Attitude/affective assessment is needed in the learning process because through attitude. Students are able to determine where learning will be directed. Students who have a positive attitude will make us behave well and finish academically well, and vice versa. If the student's attitude is negative/bad, then they tend to stay away, hate, and avoid something, one of which is the learning process that is or will be followed [2].

According to the 2013 curriculum used in Indonesia, the attitude assessment carried out by teachers in schools has several aspects that are assessed including an assessment of religious aspects, responsibility, tolerance, discipline, and honesty. This assessment can be generated through the learning process by applying an appropriate learning model. In addition, the implementation of the 2013 curriculum also requires students to develop soft and hard skills. Soft skills are meant as personal abilities, including

attitudes in socializing, activeness, creativity, leadership attitudes and others. Meanwhile, hard skills, such as students' knowledge abilities [3].

One of the learning models chosen to be carried out and able to generate soft skills (student attitudes) and hard skills is applying the Practice Rehearsal Pairs (PRP) learning model. Rehearsal Pairs Practice is practising a skill or procedure in pairs in learning [4]. Steps - Practices Rehearsal Pairs are 1. Students who learn a skill that has been selected by the teacher; 2. The teacher asks students to pair up; 3. Students work as an explorer demonstrating how to work on the skills that have been demonstrated by the teacher, students/other couples whose task is to observe and assess and explain the demonstration by his friend; 4. Each pair switches roles; 5. Skills already mastered means the learning process is complete [5]. Rehearsal Pairs practice has the advantage of being able to increase knowledge, abilities, and skills. Pairing practices can also increase participation between students, and interactions are easier and have flaws. If a partner is not actively eating, there will be few ideas to share [6]. So the principle of implementing the Rehearsal Pairs Practice model is to collaborate with each partner.

METHODS

Research Design

The type of research used in this study is quantitative research in the form of experimental research. Design of research used in this study is Quasi-Experimental Design with Posttest-Only Control Design. This research was conducted by comparing two classes, where the given class treatment was called the experimental class, and the class that was not treated was called the control class. The Learning Model applied in the experimental class is the Practice Rehearsal Pair (PRP) model, while the control class uses a conventional learning model. The steps of the PRP model can be seen in Table 1. [7]

TABLE 1. Syntax of the Practice Rehearsal Pairs (PRP) model

Syntax of *Practice Rehearsal Pairs* model	**Activity**
Practice	The teacher presents the core material and competencies to be achieved, namely, buffer solution material.
	The teacher demonstrates the calculation of buffer solution material.
	Learners listen and think about the material presented by the teacher.
Rehearsal	Learners submit a problem or problem and other groups work on it.
	The teacher asks students to exchange questions.
Pairs	Students are asked to pair up with friends (two people)
	Students exchange roles. Groups that give questions to other groups get a turn to work on problems given by other groups.

Place, Time and Subject Research

This research was conducted at senior high school, MA Sunan Pandanaran, Yogyakarta. Time this research from October 2017 to October 2018. Subjects in this research are MA Sunan Pandanaran Yogyakarta class XI IPA in the academic year 2017/2018 on buffer solution materials. The sample in this study consisted of two classes. The sampling technique by purposive sampling.

Data Collection

Data collection techniques used non-test methods. Form of assessment used is the Questionnaire. Questionnaires are given to students at the end of learning using the PRP model. The assessment using an attitude questionnaire was conducted on students in the control class and experimental class. Aspects of attitude consist of five aspects, namely religious, responsibility, tolerance, honesty, and discipline.

Data Analysis

The study used the Parametric Independent Sample T-Test. This is related to the preliminary test that has been done before, namely the normality test and abnormal homogeneous data test. The prerequisite results (normality test and homogeneity test) and hypothesis testing are presented in Table 2 and Table 3.

TABLE 2. Prerequisite Test Results (normality and homogeneity)

Data	Classes	Normality		Homogeneity	
		Sig.	Conclusion	Sig.	Conclusion
Student's Attitude	Experimen	0,850	Normal	0,146	Homogenous
	Control	0,369	Normal		

TABLE 3. Hypothesis Test Results

Data	Significance	Decision H_o	Conclusion
Student's Attitude	0,270	H_o Accepted	There is no difference

Furthermore, attitude questionnaires data from learning activities that have been calculated using statistical assistance is calculated using a scale to know criteria each aspect of learning activities criteria. The criteria obtained are then changed in presentations with presentation ranges, referring to TABLE 4 [8]. The results of the transformation of quantitative data from the qualitative data presented in TABLE 6.

TABLE 4. Criteria of each aspect of student learning

No	Score Range (i)	Score Range (i)	Criteria
1.	$\bar{x}$ + 1,80 SB*i* < X	88.4 < X	Very good
2.	$\bar{x}$ + 0,60 SB*i* < X ≤ $\bar{x}$ + 1,80 SB*i*	72.8 < X ≤ 88.4	Good
3.	$\bar{x}$ – 0,60 SB*i* < X ≤ $\bar{x}$ + 0,60 SB*i*	57.2 < X ≤ 72.8	Enough
4.	$\bar{x}$ – 1,80 SB*i* < X ≤ $\bar{x}$ – 0,60 SB*i*	41.6 < X ≤ 57.2	Less
5.	X ≤ $\bar{x}$ – 1,80 SB*i*	X ≤ 41.6	Not very good

Note:
$\bar{x}$ = Average ideal score
X = Average Score
SBi = Standard deviation

TABLE 5. The results of the attitude questionnaires criteria of student attitude learning achievement

Aspect	Experimental Class		Conventional Class	
	Average Score of Each Aspect	Criteria	Average Score of Each Aspect	Criteria
Religious	88.83	Very good	84	Good
Responsibility	81.25	Good	84	Good
Tolerance	85	Good	88	Very good
Honesty	87.83	Good	85.5	Good
Discipline	81	Good	81.5	Good
Average	84.78	Good	84.6	Good

RESULT AND DISCUSSION

Based on the results of statistical tests that can be seen in Table 2 and Table 3, it can be concluded that there is no difference in the application of the PRP and conventional learning models to aspects of student attitudes. Furthermore, the results of the questionnaire assessment are then recalculated in detail through the criteria reference assessment to see qualitatively about the assessment of student attitudes, especially for assessment in every aspect of the attitude that students must have in the learning process.

Based on the criteria reference assessment results shown in Table 5, of the five aspects used to measure student attitudes when implementing the PRP learning model, two aspects of which have criteria that are "very good" and the rest have criteria "good".

The results of the two tests carried out can be discussed that although through statistical tests there is no difference in the assessment of students' attitudes between the experimental class applying the PRP model with the conventional class, when tested qualitatively and in more detail, the students' attitudes in learning are assessed from five aspects attitudes show good results, religious attitudes, responsibility, tolerance, honesty and discipline are shown with satisfactory scores for each class (experiment and control).

This phenomenon can be explained that applying the learning model in a learning condition has a good impact on student attitudes in learning. It is possible that between the experimental and control classes both have a good impact, which can make the attitude score balanced (have almost the same score). This shows that the application of the PRP and Conventional models both have a good impact on attitude assessment so that when these two classes are compared to find out differences in learning in the attitude aspect, there will be no different even though the actual application of the model has a good impact on the experimental class.

Factors that influence this can occur, namely, factors that come from outside (external) and factors that come from within the student (internal). Factors that come from outside (external) such as the school environment (curriculum, learning media, learning methods/models used, school suggestions and infrastructure, interactions between teachers and students and binding rules at school). Meanwhile, internal factors influence motivation and interest in learning, student attention, and readiness in learning [9].

In addition to the factors above that affect learning achievement, especially aspects of attitude, external factors regarding the model's application are crucial, which affect the most. The implementation of the learning syntax in the selected model is carried out following the syntax in detail. If it can be seen based on the syntax, the first syntax is Practice. In this syntax, the teacher demonstrates the material to be studied on that day. Students are asked to observe what the teacher has demonstrated. The results of this first syntax hope that students will be able to learn the skills that the teacher has when demonstrating the material to be delivered that day. The next syntax is Rehearsal, where students are asked to discuss what they have seen with their group partners, namely demonstrations from the teacher regarding the material. The last syntax is Pairs, where students are asked to pair, and role-playing material that has been demonstrated by the teacher for Return is carried out by students in pairs. Based on the identification of the learning syntax, it can be seen that the application of this model strengthens the ability of skills because what is observed and seen by students is the skills of the teacher in chemical material, namely the experiment of buffer solutions. This is one reason why the application of the PRP model has more influence on skills than attitudes.

CONCLUSION

Based on the results of this study, there is no significant difference in chemistry learning with Practice Rehearsal Pairs (PRP) model toward students' attitude on the learning achievement of class XI MA Pandanaran students in the buffer solution in the academic year 2017/2018.

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The Application of The PjBL Model uses WhatsApp and Zoom Meetings in Learning

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ABSTRACT: The current covid-19 pandemic has an impact on Capita Selecta Chemistry lectures. One of the efforts made is by implementing the PjBL model and utilizing several e-learning platforms in learning. The platforms most often used today are group whatsapp and zoom meetings. The aim of the present study was to use a knowing how the effect of implementing the Project Based Learning (PjBL) model assisted by WhatsApp Group (WAG) and zoom meetings on student learning outcomes and student responses to the applications used. This research is a research pre-experimental research with one-group pretest posttest design, experiments conducted in one class without a comparison class. The research was conducted at a State University in Bengkulu. With the research subjects as many as 24 students who took capita selecta Chemistry course. The instruments used in this study are learning outcomes tests and response questionnaires towards applications that used in learning. Data analysis techniques include average value, normality test, and hypothesis testing using the t-test using SPPS computer program for windows version 23. The results showed that there was an increase in student learning outcomes with the implementation of PjBL model assisted by WhatsApp and Zoom applications with pretest scores of 66.042, postest scores of 84.625 and the N-gain value data obtained was 0.547 in the moderate category. Student's response toward the use of WAG and Zoom Meeting applications was very positive. As many as 91.67% of students considered that WAG application was a very practical application and it was easily accessible to students, especially access to learning materials. The use of zoom meeting according to 70% of students is also very interactive and can replace face-to-face meetings.

Keywords: PjBL Model, WhatsApp, Zoom Meeting, Learning Outcomes, Capita Selecta

INTRODUCTION

Capita selecta in chemistry is one of the compulsory subjects in Chemistry Education Study Program at a State University in Bengkulu, Indonesia. The purpose of this course is to determine the latest developments in chemistry based on the results of research in the fields of Chemistry and Education. The course content includes the latest research developments in chemistry and chemistry education. So far, learning still applies the usual discussion method, assignment method and question and answer method. The application of the active learning model has not been implemented in the classroom.

In the midst of the current covid-19 pandemic, it is very difficult to do face-to-face learning so solutions are needed to help lecturers in delivering learning. One of the methods used is by implementing the Project Based Learning (PjBL) model assisted by the WhatsApp Group (WAG) application and face-to-face through the zoom meeting application.The PjBL model is a learning model that requires students to be able to produce a real product, and related to the knowledge aspect of creative thinking skills [1]. The PjBL learning model involves student activeness in solving problems, it can be done in groups / independently through several scientific steps to produce a product at a certain time which will later be communicated to others. In its implementation, students will be given assignments independently through the WAG application. Completion of tasks is carried out independently starting from the planning stage, preparation, to product exposure. Students are fully responsible for the project that will be produced by involving the roles of peers, lecturers, parents, and even the community.

Currently, mobile technology in learning has been widely used in online teaching at universities around

the world [2]. This online learning takes the form of using applications or web-based courses using computers or mobile devices. In practice, the PjBL model is usually applied with the help of WAG or zoom only. In this study, both the WAG platform and the zoom meeting were used in learning.

WhatsApp or known as WA is very popular application in the community. WhatsApp is an internet-based application that allows each user to share various kinds of content according to its supporting features [3]. In the past, communication was still via telephone or SMS, now using WA application, you can simultaneously use it to sending news via short messages, calling even a video call. This application is a lot of enthusiasts because it is more economical, it can take advantage of several application features with only internet quota.This internet-based application has the potential to be used as a communication medium, because it makes easier for users to communicate and interact with each other without spending a lot of money in its use, because WhatsApp does not use credit, but uses internet data [4]. According to Larasati, WhatsApp is an application that can be used to send messages to each other quickly and can send photos, videos, pictures, stickers, voice notes, send lecture materials in pdf or word form also can share other information and discuss each other [5].Almost all smartphones, android support this WA application, so that it becomes popular quickly compared to other similar applications, the features in it are also easier. Even today, this application is able to make group meetings for 8 people. The latest information can be more than 10 people. Based on Rahartri [6] states that WhatsApp is superior to other chat applications, because it is simple and easy to understand; the WhatsApp application is quite lightweight, saves battery, and can save internet data. Along with the current development, lecturers and students must be more creative in taking advantage of current technological developments. Among them is the use of WA in learning. In WA, you can send documents in the form of photos, PPT files, pdf files and even send learning videos. In groups, lecturers and students can discuss directly. It can also be set up where only lecturers teach and send lecture materials.WhatsApp as an alternative media in providing information, improving performance, an effective learning discussion tool also being an effective and useful communication medium for its users [7,5,8]. In implementing learning, the Zoom Cloud Meeting application is used for face-to-face lectures. The Zoom Meeting application is a video-based learning media, which can be used for learning as well as for meetings, seminars and others. The zoom meeting platform is free to use for 40 minutes. For paid zoom accounts there is no time limit. With the Zoom Meeting application, students and lecturers are able to communicate directly using the video feature in the application.

This research is important, because besides utilizing existing applications in learning, it also applies the PjBL learning model which requires students to think critically and creatively. Students are assigned to make projects about the latest developments in the field of chemistry and in the field of chemistry education through the Capita Selecta Chemistry course and communicated through the applications that will be applied, they are WAG and Zoom. The expected results include complete documents regarding the latest developments in chemistry and chemistry education and can be used as a reference for students to make their final project/thesis.

METHODS

This research is a pre-experimental research with one-group pretest posttest design, experiments conducted in one group/class without comparison groups/classes. The aim is to compare student learning outcomes before being treated and after treatment or posttest [9]. In this study, the treatment given was learning using the PjBL learning model assisted by the WAG and zoom meetings application.

Place, Time and Subject Study

The research was conducted at a State University in Bengkulu. With the research subjects as many as 24 students who took the Capita Selecta Chemistry course, with details of 3 men and 21 women.

Data Analysis

The instrument used in this study was an essay test of 10 questions. The tests used are in the form of pretest and posttest which aim to determine the ability of students before and after learning using the PjBL learning model assisted by WAG and zoom meetings applications. In addition to the test, a response questionnaire was also distributed to the applications used in learning. Data analysis techniques include

average value (mean), normality test, and hypothesis testing using the t-test using SPPS computer program for windows version 23. Hypothesis testing was carried out to determine whether there were differences in student learning outcomes in the capita selecta lecture before and after learning using the PjBL learning model assisted by WAG and zoom meetings applications. The response questionnaire is seen from the percentage of student positive responses to the application that used.

RESULT AND DISCUSSION

Capita Selecta in chemistry learning applies a project-based learning model. Where students are given project assignments which are done in groups, where each group consists of 4-5 students. The assignment of this project is announced in the WAG application. The use of wag is very effective and fast in conveying important information related to learning. Many previous researches have made use of learning materials and have shown positive responses. Based on previous research, WhatsApp mobile learning activities show that the learning process facilitates learning, helps students find solutions to learning difficulties and easily construct and share knowledge, and supports research into useful information for learning for a majority of students in experimental sample [10].In this study, combining the pjbl model with the wag application and the zoom meeting application in the discussion process in class. Students are required to observe, read and make project assignments. Learning activities using the PjBL model can be seen in Table 1.

TABLE 1. Learning Activities with PjBL model

Phase	Learning Activities
Determination of project assignment	The initial stage of students looking for their own problems, related to the latest educational research developments, designing activities to be carried out, looking for information from the latest journals
Develop project planning	The project assignment is to write articles with browsing a lot of literature both from books and journals.
Arrange a schedule	Lecturer and students agree together to create a timeline and deadline for when the project can be completed
Monitor students and project progress	Lecturers monitor project assignments done by students and evaluate them continuously while consulting and getting direct guidance with lecturers via WhatsApp
Rating results	At this stage students make presentations and questions and answers via zoom meeting application. The lecturer assesses the results of the article that students have completed as well as discussing the topic of the latest research developments in chemistry education.
Evaluating experience	Lecturer and students reflect on the activities and results of projects that have been carried out. The lecturer evaluates the progress of each group, giving feedback about the level of understanding that students have achieved. The final project is an article which will be reviewed for its feasibility through a review process by a lecturer who teaches the Capita Selecta in Chemistry course. Eligible articles will be published in the journal / proceeding.

Capita selecta in chemistry materials as well as group project assignments were carried out in 6 meetings and presented in the Table 2 below:

TABLE 2. Learning Implementation

Meeting	Implementation date	Theory
1	23 October 2020	Higher Level Thinking Skills (HOTS)
2	30 October 2020	Model Problem Based Learning (PBL)
3	06 October 2020	TGT Cooperative Learning Model with Truth or Dare Game Media
4	13 November 2020	The STEM approach and the Kahoot application
5	20 November 2020	Project Based Learning (PjBL) model based on STEM
6	27 November 2020	Learning Model Team Assisted Individualization (TAI) and Creative Problem Solving (CPS)

Before the PjBL model treatment assisted with the WhatsApp and zoom meeting application, students were given pre-test questions in the form of essays on the capita material. And after applying the model and application, students were again given post test questions. The following are the results of the students pretest and posttest, can be seen in Table 3.

TABLE 3. Average Pretest Scores, Postest Scores, Gain and N-Gain

Average				
Pretest scores	Post test scores	Gain	N-gain	N-Gain category
66,042	84,625	18,583	0.547	Moderate

Based on Table 3 above, it can be seen that the value has increased, from pretest to postest. N-gain (normalized gain) is used to measure the increase in cognitive learning outcomes between before and after learning [11]. From the N-gain value data, it was obtained 0.547 in the medium category. This means that there is an increasing in student learning outcomes with the implementation of the PjBL model assisted by the WhatsApp and Zoom applications. Improved learning outcomes can also be seen in the Figure 1:

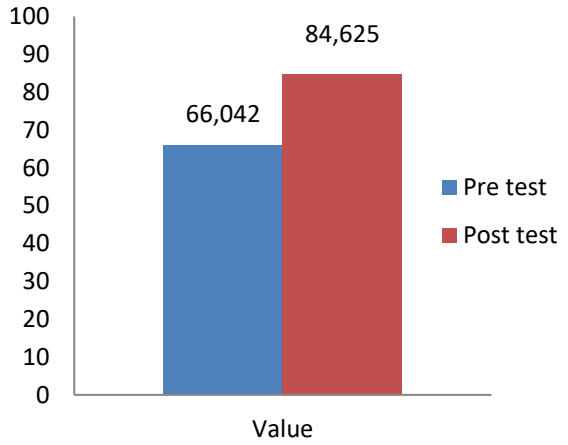

FIGURE 1. Graph of pretest and posttest scores

Based on the results of the normality test using SPSS for windows version 23, a significance value of 0.773> 0.05 was obtained. This means that the value data is normally distributed. The results of the t test on the experimental class, the sig (2-tailed) value is 0,000, which means less than 0.05. So it can be concluded that there is a significant difference between the pretest and posttest scores (after

being given treatment).The application of the PjBL model in teaching makes students more active, creative and more responsible for a given project. The PjBL model makes students build knowledge based on what they experience themselves, will be more enthusiastic, increase student learning motivation, make students enjoy learning and collaborate with friends in a team has a sense of responsibility for each other to complete a given project [12,13,14]

The use of applications in learning makes student learning outcomes increase, students do not feel bored and enjoy learning that taking place. This is in line with previous research which states that the use of learning applications, one of them is Adobe Flash, it can increase student's motivation and enthusiasm for practicing. Adobe Flash can be used to create interactive learning media effectively and efficiently also easily accessible to students. The development of science and technology is very fast in line with the rapid use of ICT (Information and Communication Technology) as media, and learning using media is very effective compared to traditional learning [15,16]. Alperi also states that the use of learning methods, learning media, can improve student achievement and competence [17].

In the implementation, students were created WhatsApp Group (WAG). Then the group assignments will be shared via WAG. Other students / groups discuss through the WAG. The final results of the discussion will be recapitulated by group members and shared again in the WAG. The difficulty in this WAG is that you cannot see in detail the ongoing discussion process because you have to scroll up first. Active students can be seen, but have a little trouble because sometimes their writing is overwritten by their friends' comments. The following is a graph of the students' pre-test and post-test scores in the experimental class 1 using PjBL model and WAG application.

Below is a display of the WAG of the Capita Selecta course in the class, can be seen figure 2:

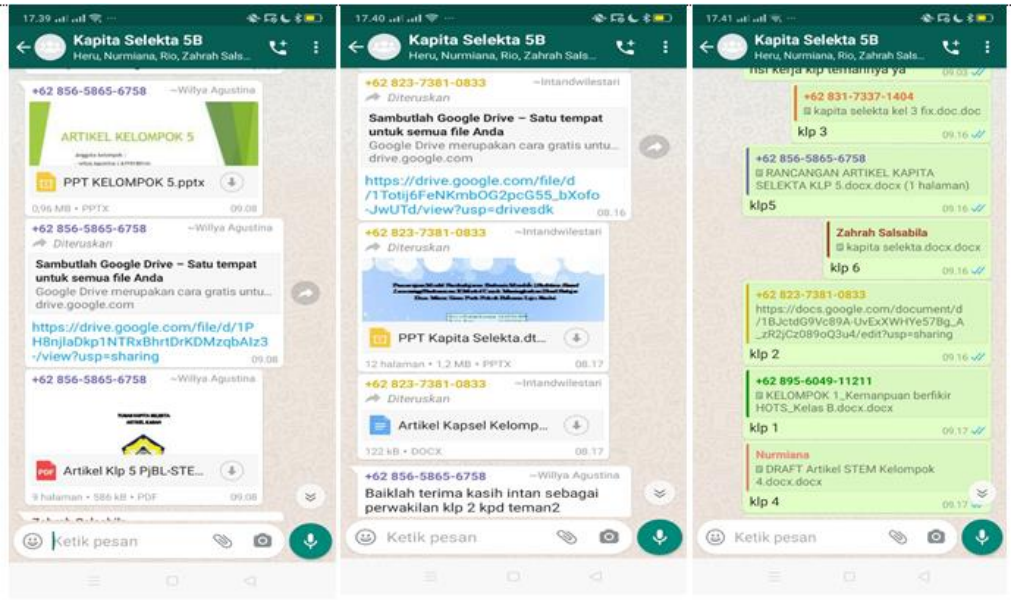

FIGURE 2. WhatsApp Group (WAG) student display

PjBL learning steps with the help of the WhatsApp application and zoom meeting have been carried out as follows:

1. Lecturers make WAG for Capita Selecta Class
2. Students are given a link to join the group
3. Lecturers open the lesson, convey learning objectives, divide students into groups for project assignments to be carried out
4. Students are asked about the latest developments / issues related to education. Then together with the group began designing an assigned article project.
5. The given project assignment is given a deadline for submitting the assignment
6. The lecturer still controls the project assignments per group and its progress
7. Submission of assignments sent directly by representatives of group members through the WAG
8. The lecturer first checks the resulting project assignments before they are presented in the forum.

9. Group presentations are conducted at the WAG. Before learning is carried out, the presentation group must send their project assignments to the lecturer and the class WhatsApp group and the presentation group must be ready to master the material and discuss in the WhatsApp group.
10. The next step is for the presenter group to present the material, giving the opportunity to ask questions, input, and suggestions from other groups and answer questions raised by other groups. Finally, an evaluation of the presentation and questions and answers was conducted by the lecturer.
11. Presentations were made through the Zoom Meeting. Zoom meeting is used so that the material presented can be well received by other groups. The discussion process will also be more interactive.

WhatsApp is used as a medium for discussion. Interaction through the WhatsApp application is used to support classroom learning [18]. Capita Selecta's lecture discussions on the development of the latest issues in education are becoming more interesting and creating a more pleasant atmosphere. Thus, students get a lot of the latest information about the current development of educational science. Through WAG, students can send and receive photos/images, videos, files in the form of word, pdf and others.

Below is a summary of the strengths and weaknesses of the WhatsApp application, based on the results of the research that has been done, can be seen in Table 4:

TABLE. 4. Strengths and weaknesses of the WhatsApp application

Strengths	Weakness
For the task deadline, the lecturer as admin has the right to deactivate messages from students	There is no notification / special column for sending assignments
Comments given individually can be done by 'Reply Privately' by tapping and holding your finger on the message on student assignments / comments privately on the WAG. By clicking on the 3 vertical dot symbol at the top right of the screen.	The memory of files / folders, photos, or videos that can be sent to WAG is limited to 16 MB. So that for the experimental class assignment 2 there is a sending assignment via email.
Students are all familiar with the WA application. Easy / uncomplicated application interface.	There is no special column for student assignment assessment.
Applications can be via Android, it can also be via WhatsApp Web.	
There is already a video conference feature, but it's limited to a few people.	

The response of 24 students to the effectiveness of application that used, WhatsApp and zoom meetings application, can be seem in Table 5:

TABLE 5. Percentage of student responses to the WAG and Zoom Meeting Applications

NO	INFORMATION	PERCENTAGE (%)
1	I like learning to use online learning systems like WhatsApp.	25
2.	Using the zoom application is effective as a substitute for face-to-face meetings in class	70
3	WAG is an interesting medium in capita selecta learning	58.33
4	WAG makes me more responsible, disciplined and makes it easier to collect assignments.	79.17
5	WAG makes it easy for me to access learning materials.	91.67
6	I can improve my understanding of the development of selective Capita through learning videos / group presentations uploaded through WAG	70.83

From the Table 5, students prefer face-to-face learning rather than using the WAG application. Only 25% of students enjoy studying through WAG. Students consider that face-to-face learning is more effective, it can be seen from the percentage of students using the zoom application 70%. 91.67% of students considered that the WAG application was a very practical application and was easily accessible to students, especially access to learning materials.

Based on direct observation to students, some of the disadvantages of the Zoom Meeting application include: (1). The signal must be good, so that the meeting can run well. (2). Before using the zoom, it is certain that students have a quota first, because the quota is quite wasteful. (3). The language used has no choice of Indonesian. However, the use of the Zoom Meeting application is considered very practical and attractive. This is due to the direct interaction between lecturers and students. Lecturers can observe activities carried out by lecturers, through the video feature displayed by students. Communication can be done well, because it is done orally / not in writing. The oral communication process has better results and can be received more clearly than written communication [19]. Then, besides that, the use of the Zoom Meeting application is one of e-learning media that makes easier for students, saves costs and is more flexible.

CONCLUSION

From the research results, it can be concluded there was an increase in student learning outcomes with the application of the PjBL model assisted by the WhatsApp and Zoom applications with a pretest scores of 66.042 and postest scores of 84.625 and the N-gain value data obtained was 0.547 in the moderate category. And there is a significant difference between the pretest and posttest scores marked by the sig (2-tailed) value, 0.000, which means less than 0.05. Student response to the use of the WAG and Zoom Meeting applications was very positive. 91.67% of students considered that the WAG application was a very practical application and was easily accessible to students, especially access to learning materials. The use of Zoom Meeting according to 70% of students is also very interactive and can replace face-to-face meetings.

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The Effectiveness of Software As Learning Media To Detect And Reduce Misconception In Stoichiometry Material

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ABSTRACT: In chemistry, an abstract material could be perceived by three levels of representations that are macroscopic, sub-microscopic, and symbolic. However, many students have misconceptions due to the difficulty of shifting between the three levels of representations. Misconceptions should be reduced or prevented as early as possible because it will be resistant and difficult to change. Stoichiometry tends to abstract concepts that were challenging for some students that usually lead to misconceptions. In this study, these misconceptions were detected using a four-tier diagnostic instrument and were reduced using a conceptual change text strategy. The instrument and strategy was presented in the form of software named *Stoichiometry Reconstruction,* which was made by PHP programming language supported by XAMPP application because it has two functions as an assessment and learning tool. Software must be said effective before it is used by the student. This study aims to know the effectiveness of software to detect and reduce misconceptions in stoichiometry material. This study used Research and Development method. The result of this study shows that software is effective to detect and reduce misconceptions. It is proved by the average percentage of misconception shift to understand the concept about 80,13%, which is categorized as effective.

Keywords: Software, misconception, stoichiometry, effectiveness

INTRODUCTION

Chemistry represents an abstract material because it deals with reactions and an atomic constituent of compounds that cannot be observed [1]. It consists of three representation levels, namely macroscopic, sub-microscopic, and symbolic. The moving between macroscopic, sub-microscopic, and symbolic is very important in teaching chemistry. However, many students have misconceptions due to the difficulty in understanding the moving between the three representation levels [2]. The misconception is the viewing of a concept that is different from the expert believing. It should be reduced or prevented as early as possible because it is resistant and difficult to change [3]. There are several concepts in chemistry material that have a high percentage of misconceptions. Most concepts that have a high percentage of misconceptions are coming from stoichiometry material. The existing experiment results prove it stated that from 73 pupils of Grades XI in SMA Negeri 1 Sukoharjo have misconceptions in stoichiometry material with a percentage about 40.46% in chemical equation concept, 38.36% in relative atomic or molecular mass concept, and 53,77% in mole concept [4]. The misconception in stoichiometry concepts must be reduced because stoichiometry is the important basic concept of analytical chemistry.

Misconceptions can be detected by the diagnostic and non-diagnostic test. One example of a non-diagnostic test is the essay. This test is less effective because it needs many times [5]. Therefore the diagnostic test is believed as an effective way to detect misconceptions. There are several examples of a diagnostic test, such as two-tier diagnostic test [6], three-tier diagnostic test [7], and four-tier diagnostic test [8]. The four-tier diagnostic test represents the best instrument to detect misconceptions because it can hold all the strengths provided with a three-tier diagnostic test and truly assess misconceptions free

of errors and lack of knowledge [9]. This instrument is the modifications of a three-tier diagnostic test. The modifications were located in the second and fourth-tiers, namely the confidence levels [10]. The test contains four tiers: questions with several options, confidence levels of the answer in the questions, reasons for the answer in the first tier, and the confidence levels of the reasons. Based on all tiers' results, the student's understanding of a concept was classified as understanding, did not understand, and misconceptions [11]. In this way, students can immediately know about their understanding of a concept to be dissatisfied with their understanding if it is classified as misconceptions or did not understand the concept. This condition is suitable to use in changing misconceptions.

According to Posner, four conditions have to create to change the misconceptions. These conditions are people must be in dissatisfaction with their existing conceptions, a new concept must be intelligible, a new concept must appear initially plausible, and a new concept should suggest the possibility of a fruitful research program. The strategy that is appropriate for cheating these conditions is the conceptual change text (CCT) strategy. CCT is a strategy for reducing misconceptions using the text to show the differences between the scientific conception and the reader's conception [12]. In this condition, cognitive conflict will happen to reconstruct the new concepts in the reader's mind.

The new concept is easier to explain if the information served in visual and verbal [13]. This statement is supported by the dual coding theory based on the Paivio. The information that is served in visual and verbal increases the usage of working memory. People will easier process new information on their mind when it is served in both visual and verbal. Basic computer multimedia such as software can present information in both visual and verbal simultaneously. The software can present pictures to help teachers in explaining the abstract concept of chemistry material. The software also has two functions as an assessment tool and learning tool. Therefore, software is suitable to detect misconception using four-tier diagnostic instruments and reduce misconceptions based on the CCT strategy.

Based on the background that has already explained, this study aims to determine the effectiveness of software to detect and reduce misconceptions on stoichiometry material. This purpose can be reached by answering the research question: "how is the effectiveness of software to detect and reduce misconceptions on stoichiometry material?".

MATERIALS

This study used the Research and Development (R&D) method written by Sugiono [14]. There are 10 stages in this method, namely 1) potentials and problems, 2) data collection, 3) product design, 4) design validation, 5) design revision, 6) product trial, 7) product revision, 8) trial use, 9) product revision, and 10) wide production. The software named Stoichiometry Reconstruction was made PHP programming language supported by XAMPP application. It has been validated by the experts and revised based on their comments. It has been categorized as valid with a content validity percentage of 85,37% and a construct validity percentage of 76,67%. Thus, this study only discussed the results of product trials at the sixth stage to determine the effectiveness of software, while the seventh to the tenth stages were not carried out.

The effectiveness of software was analyzed from the shift in student's conceptions when working on diagnostic test. The test used four-tier diagnostic test instrument, which consisted of four-tiers. The fourth tiers are concept question, believing of question answer, reason, believing of reason. The questions consisted of the definition of molar mass concept, definition and application of percent composition by mass concept, and definition and characteristics of limiting reactant concept. The result of student's answer classified as misconception (M), understand the concept (U), or did not understand the concept (DU) based on Table 1.

TABLE 1. Four-tier diagnostic classification

Answer	Confidence	Reason	Confidence	Category
True	Sure	True	Sure	Understand (U)
True	Not	True	Not	Did not Understand
True	Sure	True	Not	(DU)
True	Not	True	Sure	
True	Not	False	Not	
False	Not	True	Not	
False	Not	False	Not	

Answer	Confidence	Reason	Confidence	Category
True	Sure	False	Not	
False	Not	True	Sure	
True	Not	False	Sure	Misconceptions (M)
True	Sure	False	Sure	
False	Sure	True	Not	
False	Sure	True	Sure	
False	Sure	False	Not	
False	Not	False	Sure	
False	Sure	False	Sure	

[11]

The data collecting in this study uses four-tier diagnostic test. The test was doing twice as pretest and postest. Pretest was doing before passing the reduction part in by the software while posttest was doing after that. The pretest and post-test results were classified based on Table 1, so that we get the initial and last student's conception. The data were compared to know the conception shifts. Both the initial conception and conception shift results were analyzed. There are several conception shifts, first conception shift from misconception to understanding the concept (M-U), second from misconception to did not understand the concept (M-DU), third from did not understand the concept to misconception (DU-M), and fourth from did not understand the concept to understand the concept (DU-U). M-U and DU-U represent a positive shift, while M-DU and DU-M represent a negative shift. The cognition conflict data supported the conception shift data from the student's anwer when they passed the second stage of the reduction part. In this part, student are given three questions about the cognition conflict that may be happened in their mind. The effectiveness of software is analyzed by calculating the number of M-U then coverting it to percent using the formula below.

$$\%M_{shift} = \frac{\Sigma M-U}{\Sigma M_{initial}} \times 100\% \quad [15]$$

Information:
Σ M – U = Number of M-U shift
Σ M = Number of initial misconceptions

The percentage is then interpreted based on Table 2. The software is said effective if its effectiveness percentage ≥ 61% [16].

RESULT AND DISCUSSION

This study had conducted from September 2019 to February 2020, located in SMA Negeri 1 Gedangan. The subject of this study is 15 students. These students were selected based on the results of a diagnostic test that has already done before. The diagnostic test used four-tier diagnostic test instrument. Then the results are presented in the form of percent. Students who have the highest percentage of misconception were selected as the subjects of this study.

Students have to try the software using a personal computer that has already connected to a server via school WiFi. According to their concept classification of four-tier in Table 1 after they did pretest, the software detected their initial conceptions. The pretest results on stoichiometry material can be seen in Figure 1 to Figure 3.

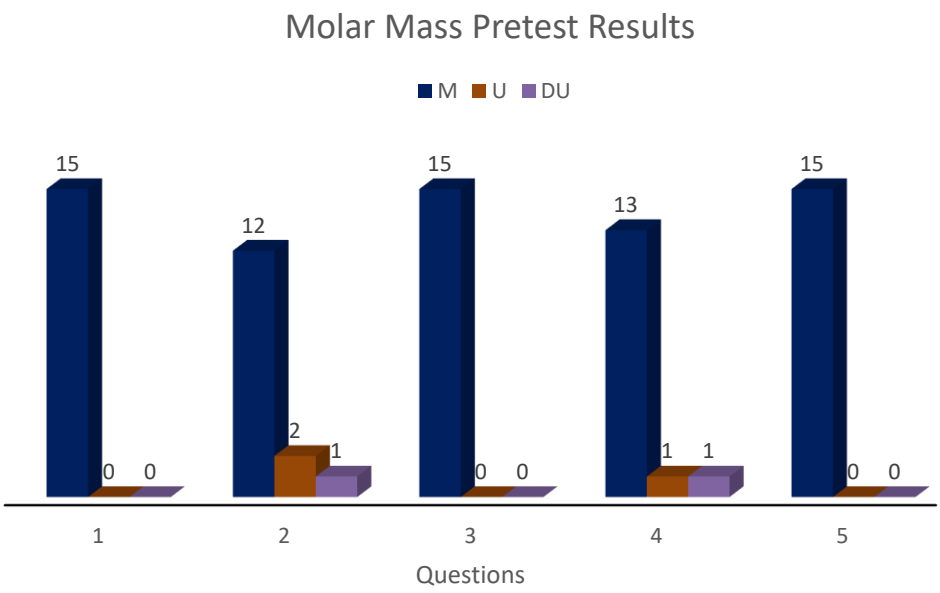

FIGURE 1. Pretest Results of Molar Mass Concept

There are 5 questions about a molar mass concept that has to answer by students in the pretest. Figure 1 shows that all of the students hold misconceptions (M) in answering question number 1,3, and 5. For question number 2, there are 12 students hold misconceptions (M), 2 students have understood the concept (U), and 1 student did not understand the concept (DU). While in question 3, there are 13 students who hold misconceptions (M), 1 student has understood the concept (U), and 1 student did not understand the concept (DU).

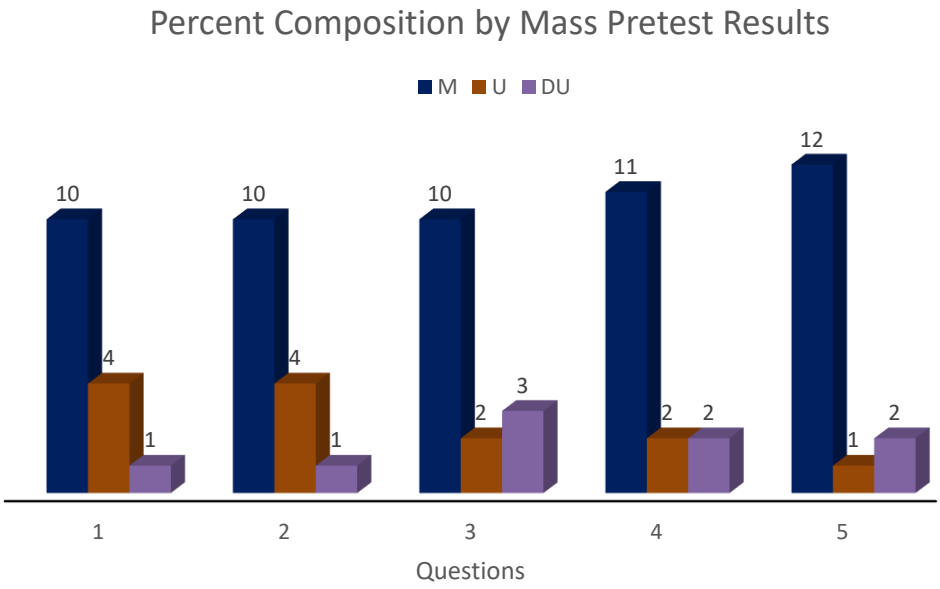

FIGURE 2. Pretest Results of Percent Composition by Mass Concept

There are also 5 questions about percent composition by mass concept in the form of four-tier diagnostic test format which is the same as in the molar mass concept. Figure 2 shows that there are 10

students hold misconceptions (M), 4 students have understood the concept (U), and 1 student did not understand the concept (DU) in answering question number 1 and 2. For question number 3, there are 10 students hold misconceptions (M), 2 students have understood the concept (U), and 3 students did not understand the concept (DU). For question number 4, there are 11 students who hold misconceptions (M), 2 students have understood the concept (U), and 2 students did not understand the concept (DU). While for question 5, there are 12 students hold misconceptions (M), 1 student has understood the concept (U), and 2 students did not understand the concept (DU). Generally, the number of students who have understood this concept are many more than the first concept, while the number of students who hold misconceptions is less more than the first concept.

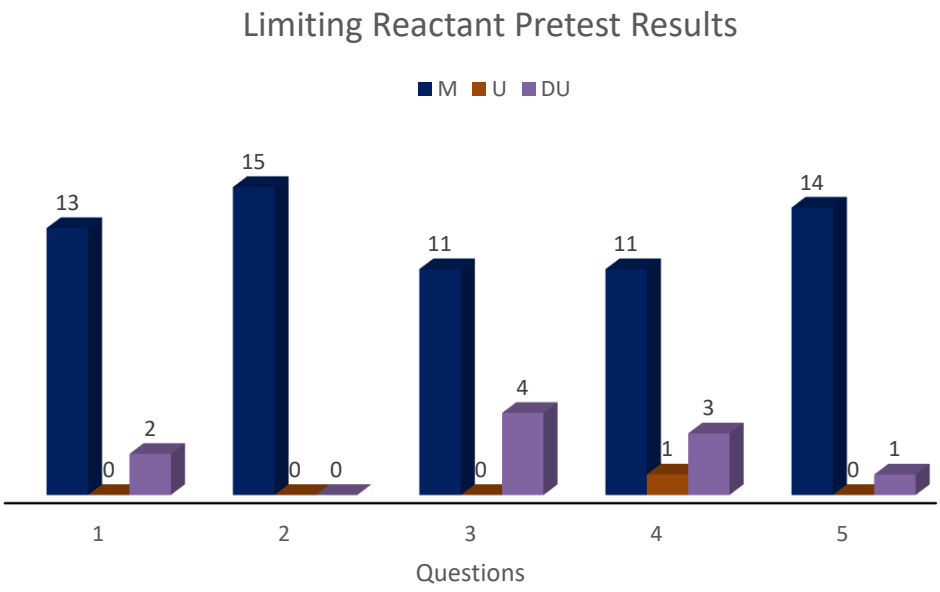

FIGURE 3. Pretest Results of Limiting Reactant Concept

There are also 5 questions about limiting reactant concept in the form of four-tier diagnostic test format, which is the same as in both concepts. Figure 3 shows that there are 13 students hold misconceptions (M), no one has understood the concept (U), and 2 students did not understand the concept (DU). All of the students hold misconceptions (M) in answering question number 2. For question number 3, there are 11 students hold misconceptions (M), no one has understood the concept (U), and 4 students did not understand the concept (DU). For question number 4, there are 11 students hold misconceptions (M), 1 student has understood the concept (U), and 3 students did not understand the concept (DU). While for question number 5, there are 14 students who hold misconceptions (M), no one has understood the concept (U), and 1 student did not understand the concept (DU). Based on the data, the number of students who have understood the concept was less than both concepts before. It means that many students hold misconceptions and do not understand this concept.

Students identified misconception and did not understand the concept have to pass the reduction part based on CCT strategy. There are four stages in CCT strategy, first showing the initial conception, second making cognitive conflicts, third making equilibration condition, fourth reconstructing the new concept [15]. In the first stage, students have presented their diagnostic test results. Then in the second stage, students have presented the statements that may be suitable for their misconceptions. If students believed that it is the true statement, they would be presented the right explanation about these statements. In the third stage consists of a complete explanation of molar mass concept, while the fourth stage consists of questions based on the explanation in the third stage to construct their new concept. After passing all of the stages, students are asked to do posttest for knowing their conception changes. It was the conception shift data that used to determine the effectiveness of the software. This data can be seen in Table 3 to Table 5.

TABLE 3. Conception Shift Results of Molar Mass Concept

No	Conception Shifts	Question Number				
		1	2	3	4	5
1	M – U	11	10	11	11	11
2	M – DU	0	0	0	1	0
3	M – M	4	2	4	1	4
4	DU – U	0	0	0	1	0
5	DU – DU	0	0	0	0	0
6	DU – M	0	1	0	0	0
7	U – U	0	2	0	1	0

Table 3 shows 11 students out of 15 students who hold misconceptions shifted to the understanding concept (M-U) while the other 4 students did not experience concept shifts (M-M). The percentage of M-U shift in the first number is 73,33%. For question number 2, 10 students out of 12 students who hold misconceptions shifted to the understanding concept (M-U) while the other 2 students did not hold concept shifts (M-M). The percentage of M-U shift in the second question is 83,33%. For question number 3, 11 students out of 15 students who hold misconceptions shifted to the understanding concept (M-U) while the other 4 students did not hold concept shifts (M-M). The percentage of M-U shift in the third question is 73,33%. For question number 4, 11 students out of 13 students who hold misconceptions shifted to the understanding concept (M-U), 1 student shifted to did not understand the concept (M-DU). In contrast, the other 1 student did not hold concept shifts (M-M). In this question, there was 1 student did not understand the concept in answering pretest then it has shifted to understand the concept (DU-U). The percentage of M-U shift in the fourth question is 84,62%. For question number 5, 11 out of 15 students who hold misconceptions shifted to understanding concept (M-U) while the other 4 students did not hold concept shifts (M-M). The percentage of M-U shift in the fifth question is 73,33%. Thus, the average percentage of M-U shift in the molar mass concept is 77,59%. It means that software is categorized as effective for detecting and reducing misconceptions in molar mass concept.

TABLE 4. Conception Shift Results of Percent Composition by Mass Concept

No	Conception Shifts	Question Number				
		1	2	3	4	5
1	M – U	7	7	7	8	11
2	M – DU	0	0	1	0	0
3	M – M	3	3	2	3	1
4	DU – U	0	1	1	2	1
5	DU – DU	1	0	1	0	0
6	DU – M	0	0	1	0	1
7	U – U	4	4	2	2	1

Table 4 shows that 7 students out of 10 students who hold misconceptions shifted to an understanding concept (M-U) while the other 3 students did not hold concept shifts (M-M). The percentage of M-U shift in the first question is 63,64%. For question number 2, 7 students out of 10 students who hold misconceptions shifted to an understanding concept (M-U) while the other 3 students did not hold concept shifts (M-M). The percentage of M-U shift in the second question is 63,64%. For question number 3, there were 7 students out of 10 students who hold misconceptions shifted to an understanding concept (M-U), 1 student shifted to did not understand the concept (M-DU), while the other 2 students did not hold concept shifts (M-M). The percentage of M-U shift in the third question is 70%. For question number 4, there were 8 students out of 11 students who hold misconceptions shifted to an understanding concept (M-U) while the other 3 students did not hold concept shifts (M-M). The percentage of M-U shift in the fourth question is 66,67 %. For question number 5, 11 students out of 12 students who hold misconceptions shifted to an understanding concept (M-U) while the other 1 student did not hold concept shifts (M-M). The percentage of M-U shift in the fifth question is 91,67%. So, the average percentage of M-U shift in percent composition by mass concept is 71,12%. It means that software is categorized as effective for detecting and reducing misconceptions in percent composition by the mass concept.

TABLE 5. Conception Shift Results of Limiting Reactant Concept

No	Conception Shifts	Question Number				
		1	2	3	4	5
1	M – U	12	14	9	10	14
2	M – DU	0	0	1	1	0
3	M – M	1	1	1	0	0
4	DU – U	1	0	4	3	0
5	DU – DU	0	0	0	0	0
6	DU – M	1	0	0	0	1
7	U – U	0	0	0	1	0

Table 5 shows 12 students out of 13 students who hold misconceptions shifted to an understanding concept (M-U) while the other 1 student did not hold concept shifts (M-M). The percentage of M-U shift in the first question is 92,31%. For question number 2, 14 students out of 15 students who hold misconceptions shifted to an understanding concept (M-U) while the other 1 student did not experience concept shifts (M-M). The percentage of M-U shift is the second question is 93,33%. For question number 3, there were 9 students out of 11 students who hold misconceptions shifted to an understanding concept (M-U), 1 student shifted to did not understand the concept (M-DU). In contrast, the other 1 student did not experience concept shifts (M-M). The percentage of M-U shift in the third question is 81,82%. For question number 4, 10 students out of 11 students who hold misconceptions shifted to an understanding concept (M-U) while the other 1 student shifted to did not understand the concept (M-DU). The percentage of M-U shift in the fourth question is 90,91%. For question number 5, 14 students out of 14 students who hold misconceptions shifted to an understanding concept (M-U). It means that all of the students who hold misconceptions in this question shifted to understand the concept; therefore, the percentage M-U shift in the fifth question is 100%. The average percentage of M-U shift in limiting reactant concept is 91,67%. It means that software is categorized as very effective to detect and reduce misconceptions in limiting reactant concept.

According to the conception shifts, the average percentage of M-U shift in limiting reactant concept is the biggest one. It is caused by the animation presented in the third stage of CCT part to help students in understanding the abstract concept. The animation is used to explain the abstract material [17]. Whereas in the molar mass and percent composition concept, most of the information is explained in texts. The information is better presented in both pictures and texts because it can make students understand the concept more easily than presented only. Thus, the average percentage of M-U shift in stoichiometry material is 80,13%. This percentage is in the range of 61%-81% with the effective category. So that it means that software is categorized as effective to be used to detect and reduce misconceptions in stoichiometry material.

CONCLUSION

Based on the results of this study, software named Stoichiometry Reconstruction is categorized as effective to detect and reduce misconceptions in stoichiometry material. It is proved by the average percentage of M-U shift about 80,13% which is in the range of 61%-81% with the effective category. This percentage is obtained from the average M-U shift percentage of each concept that is 77,59% in the molar mass concept, 71,12% in the percent composition by mass concept, and 90,67% in the limiting reactant concept.

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Virtual Laboratory in Chemistry: Recent Information and Communication Technologies (ICT) in Chemistry Practical Course

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ABSTRACT: The covid-19 has impacted many sectors to change how they run their activity, including the learning and teaching activity at higher education. Many departments at the educational institution have been affected seriously due to the physical laboratory closing, especially for the chemistry laboratory activity. The physical laboratory has been transformed into the online laboratory or distance laboratory to accommodate the student to study the experimental course. Using the Information and Communication Technology (ICT) innovation in teaching and learning methods, the student can still experiment and continue the lecture through the online system. In this mini review, we will review the recent ICT application that may contribute to providing the chemistry practical course activities to support online studies. We focus on providing the role of digital tools, such as online video conferences, virtual laboratory and these combinations as an alternative to teach chemical experiments. Finally, This effort may help the lecturer, instructor, and the student choose the best method to play an active role even while participating in the learning process.

Keywords: virtual laboratory, Information and Communication Technology (ICT), chemistry, teaching, learning method

INTRODUCTION

The Corona Virus Disease 2019 (Covid-19) pandemic that is befalling the world today forces us to change the entire order of life that we have lived so far. All sectors of activity have felt the impact of Covid-19, including the education sector. Through concerning Implementation of Education Policies in an Emergency for the Spread of Covid-19, the Ministry of Education in every country issued an appeal to learn from home with an online learning system[1]. As a response to this issue, the readiness of educators and students at the Higher Education level is the main thing that must be considered. Changing a physical learning system into an online learning system requires careful preparation, especially in the practical course[2, 3]. The student needs the physical laboratory to do the experiment to get the specific skill based on their study program.

Before covid pandemic happens, chemistry educators have already created the online learning media for the practical course such as computational chemistry as the simulation and virtual laboratory as the supplementary data to support the experiment in the laboratory[4, 5]. However, the number of sudents who have used those digital media for their learning process to replace the laboratory's physical activities is very low. One of the main reasons is the online media's reality for chemistry. The student must handle the real apparatus, equipments, and also chemicals to know their function in the practical course.

The importance of getting knowledge of the laboratory activities is the main consideration in the practical course. To overcome this issue, we discuss the recent Information and Communication

Technology (ICT) innovation in teaching and learning methods to provide some approaches to providing the online laboratory for practical chemistry courses during covid pandemic and post pandemic. The combination between ICT and internet development have been implemented deeply in chemistry study program to strengthen the comprehension of chemistry concepts, students' attitudes and interests, and other skill achievements [2, 5-7].

This mini review provides detailed insight for the chemistry educators and the students, from the early, middle, and the last grade in Higher Education level, to prepare and do chemistry laboratory activities during online chemistry practical course. We will highlight some of the online activities and good methods that possibly supported to achieve the students' learning outcome in the practical course as mentioned by Reid (i. skill related to chemistry learning, ii. practical skill, iii. scientific skills, iv. general and transferrable skills.) [8, 9].

The Updated Information and Communication Technologies (ICT) in Chemistry

Incorporating Information, Communication, and Technology (ICT) in the chemistry study program usually uses computer-based communication into learning and teaching. The chemistry educators use the program or application to predict, analyze, and simulation for the chemical reaction to support their teaching media. This effort aims to help the student better understand some of the course, i.e., organic chemistry, chemical kinetic, chemical instrumentation, etc. They are expected to be the key participant in using ICT to deliver the materials to the students in achieving the learning outcome [10]. Some researchers suggested that the chemistry educators who used the ICT to support their teaching methods are more effective than those who only used conventional teaching methods (seldom used the integration of internet and technology [11-13].

It is noteworthy that chemistry educators' readiness and skills in using ICT are very important in using ICT in the lecture. Osborne and Hennessy [14] suggested to the educators to effectively used the ICT in chemistry learning activities:

1) Verifying that ICT use is relevant and enrich to the chemistry lectures,
2) Designing the activity to presenting students responsibility and opportunities for the active learning,
3) Encourage the students to think about new concepts, to actively engage in discussions, and to focus on research tasks
4) Connect the integration of ICT to teaching and learning activities so that it encourages students to share their ideas and findings
5) Find the readiness of the students in using the ICT for their learning methods

The application of ICT in chemistry lecture has gain many advantages for the students[15]. The student's profile in the 21th century has been changed on how they learn the chemistry. The young generation now refers to using the smartphone, iPad, tablet, or electronic pen to make the note on the lecture instead of using the traditional pen-based ink and traditional book [16]. They also used the e-platforms to search for the chemical information through online database such as youtube, google, and website related to chemistry. The application and programs for ICT-based learning applications for the young generation has become new learning tools and important needs in the chemistry program [17]. The students can access the chemistry information through online media whenever and wherever they want.

ICT supported achieving the learning outcome in the chemistry curriculum whether its theoretical skills or practical laboratory skills. ICT enables the comprehensive visualization contents that ease the student to fully understand the concept of some chemistry courses, especially in the practical course. To up to date, students now prefer to use programs like ChemDraw or ChemSketch to draw the compound's chemical structure compared to drawing in conventional paper or on the board using chalk.

The students can use chemical programs to study more information like 2D and 3D chemical structure, chemical properties, with characterization of its spectra, or even predict the result of chemical reaction [18]. However, based on our experience teaching the chemistry practical course, the chemistry educators still use the conventional physical laboratory activities, i.e. face-to-face meeting and hand-on with chemicals and instruments. But, suddenly all learning methods and approach for the practical course change 360 degree due to COVID-19 pandemic. They can not use the physical laboratory for the students to do the experiment directly to achieve the learning outcomes.

Chemistry Laboratory at Distance

Preparing the chemistry laboratory for the practical courses at a distance needs to pay more attention for chemistry educators and students. It is not easy to convert the physical face-to-face laboratory work to online laboratory work at a distance. But currently, the advanced digital technologies and the easiness of using the internet give the advantages for doing chemistry experiment although it is at the distance. The digital platform on e-laboratory, usually called by virtual laboratory, consists of figures and tables supporting the video and effortless discussion between the educators and the students. In addition, it is also more feasible compared to the physical laboratory.

Some institutions and universities have implemented the ICT to the online-based lecture even before pandemic happens [19-22]. Nais used the virtual chemistry laboratory (virtual chem-lab) and integrated it into blended learning on chemical bonding lecture [23]. Ratamun and Osman studied the effectiveness of virtual and physical laboratories when implemented in High School in Malaysia [24, 25]. It was noteworthy that the virtual laboratory would be a good program for the students to do and understand the laboratory work with no mistakes and problems.

This mini review is delimited to detailed study of ICT integration on preparing the virtual laboratory, how to start our own virtual laboratory to the chemistry practical course, and how the virtual laboratory can help the student achieve the learning outcome from the laboratory work.

Virtual Laboratory

In this section, we discuss more how do we develop the virtual laboratory for the chemistry practical course. Most of the chemical educators prepared the virtual laboratory based on the Kemp's Model. The Kemp's Model are posted at the list as follows:

1) Identify instructional problem
2) Identify student characteristics
3) Task analysis
4) Determine instructional objectives
5) Determine content sequencing
6) Determine instructional strategies
7) Planning messages in learning
8) Planning the ways to deliver content
9) Develop evaluation instrument

To develop and prepare our own virtual laboratory we can choose, from the Kemp's Model, which one is suitable for our practical course. Chemical educators need to built the storybroad before deciding to further convert all the information and content into multimedia or digital tools. Figure 1. Describe the step for preparing the virtual laboratory for the practical course.

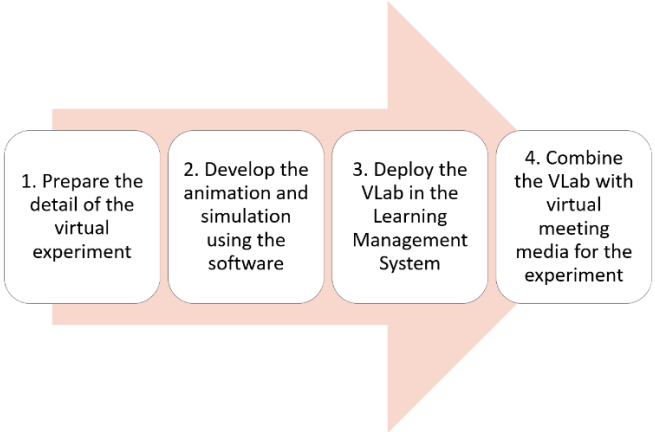

Figure 1. The step for preparing the Experiment based on Virtual Lab

Step 1: Prepare the detail of the virtual laboratory.

This step is crucial due to the design and storyboard of the product. The chemistry educators need to identify the title of the experiment for the syllabus, module, and the learning outcome of the practical course. The storyboard itself will determine how much time to convert the whole story of the design into digital tools. The storyboard's composition usually includes an introduction, materials and methods, experiments, discussion, results, and summary. Other than the composition of the storyboard, we can use more points from the Kemp's Model.

Step 2: Develop the animation and simulation using the software.

Using the virtual laboratory rather than the physical laboratory in practical chemistry courses must pay attention to the visualization of the animation and simulation of the chemical reaction prediction. In chemistry, the visualizations generate the students' understanding of the concept of modelling. The model and modelling are used as tools to make a hypothesis, descriptions, processes, and evidence of chemical reaction [26]. This model connects the knowledge from the theoretical and practical courses.

Step 3: Deploy the virtual laboratory in the Learning Management System (LMS)

The digital tools that have been created must be accessed by the students easily. Deployment and integration of the ICT with the internet server become essential to ensure that the storyboard has been inserted in the media. Each university must provide a good Learning Management System that can be used to deploy the media later this LMS. The student will be familiar with the system, and they can use it any time, anywhere, and there is no restriction for the student to access the LMS.

Step 4: Combine virtual laboratory with virtual meeting media conference.

We realize that the virtual laboratory can change the physical laboratory in conducting practical courses. But, the face-to-face meeting between the educators, the tutors and the student is still essential. Therefore, the virtual laboratory needs to combine with the virtual meeting media conference such as zoom meeting, google meeting, skype, etc. Figure 2. Shows the general scheme for combining the virtual laboratory with the virtual meeting media. When performing the virtual laboratory, the student must accompany the educator's assistant to explain what phenomena happen when they do the experiment virtually.

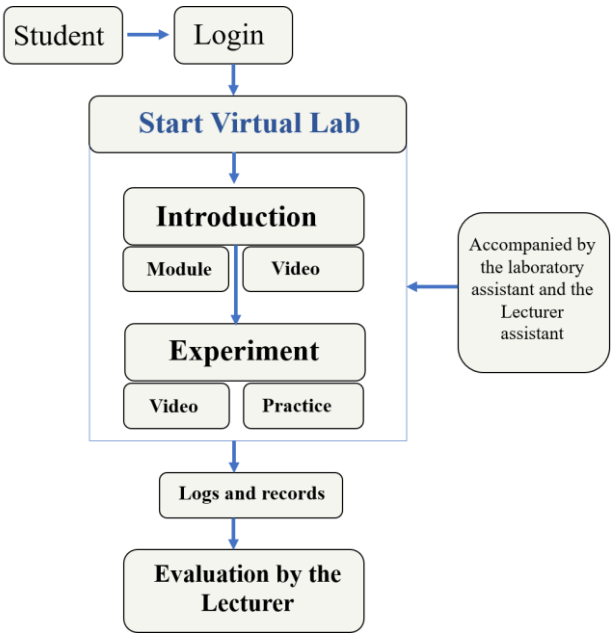

Figure 2. General Scheme for Chemistry Practical Course using Virtual Lab

Future Trends

The rapid development of technology in chemistry for the visualization and simulation and the major drives like Covid-19 pandemic directly changed the way we perform the practical chemistry course. Although many academicians suffer from the pandemic condition, there are still many rooms and opportunities to develop the novel virtual laboratory for the practical course. Virtual laboratory acts as the supplementary tools to achieve the learning outcome and the primary activities on gaining scientific knowledge and practical skill in chemistry. The chemical educators can enlarge the role of the virtual laboratory and specifically put it on the title of the practical course. Finally, university citizens need to improve significantly for the quality of education at the higher education level. As a result, they are ready to perform any education model that will be happening in the future.

SUMMARY

The internet and communication technology (ICT) innovation can be one of the solution to conduction online and virtual laboratory activity. The virtual laboratory can provide the alternative solution for the experimental course in a higher education during covid-19 pandemic. By using the virtual laboratory, the students can feel the atmosphere as if they are doing an actual experiment in the laboratory. This effort help the student to actively engage the activity and complete the experimental course.

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The Effect of Integrating DARTs on Learners Academic Performance in Rates of Chemical Reaction

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ABSTRACT: This research examined the effect of integrating DARTs (Directed Activities Related to Texts) on learners' academic performance in rates of chemical reactions at Raphael Kombe Secondary School in Kabwe, Zambia. A total of 105 participants (N=105) was assigned randomly into control and experimental groups. The control group was taught using collaborative method and the experimental group was taught using DARTs strategy. DARTs strategy is a teaching method which demands a learner centered activity in order to explain the terms and concepts in any science topic hence helps to break the science language barrier. Quantitative data was collected from both groups on three different times using Pre-test, Post-test and Counterbalance test. Quantitative data was tested for normality using Shapiro-Wilk test and normally distributed data was later tested using the Independent samples t-test to compare the achievement mean scores of the two groups. The mean score for the pre- test to both groups was similar at 38, but after intervention in the post test set at $\alpha = 0.05$, the experimental mean score was much higher at 71 compared to a mean of 51 for the control group. (p-value = 0.001). The mean scores from counterbalance test set at $\alpha = 0.05$ showed that the mean score for the control group rose to 62 as compared to the mean score for the experimental group which dropped to 41. (p-value = 0.001). The findings of the study were that DARTs had a positive effect on the learners' academic performance and on the interpretation and retention of scientific terms in rates of chemical reactions. Qualitative data was collected using a questionnaire and it was analyzed using Mann Whitney U-test. The p-value from the Mann Whitney U-test was 0.474 greater than the level of significance set at 0.05. Therefore, DARTs technique had no impact on the attitude of learners towards teaching and learning of rates of chemical reactions.

Keywords: DARTs strategy, Performance, Interpretation, Attitude, Rates of Chemical reactions

INTRODUCTION

Most learners in Zambian secondary schools are taught in English language. This is in line with the government policy, recommended and approved language of instruction in all schools by the Curriculum Development Centre [1]. However, most of science education learners are Limited English Proficiency (LEP) students because they do not use English regularly for everyday communication. Therefore it was prudent that, Directed Activities Related to Terms, DARTs strategy was investigated in order to ascertain its merits and demerits when using it during science lessons as a means to ease the science language barrier. DARTs strategy was originally developed by Lunzer and Gardner [2]. DARTs strategy was developed in order to encourage learners to master concepts or terms in different disciplines in a more detailed and developed cognitive way. The developers of this teaching technique came up with the following advantages for all teachers that used DARTs teaching strategy;

i. DARTs activity is a problem-solving activity hence it promoted and developed analytical skills.
ii. DARTs activity increased engagement as learners got involved in physical activities in order to manipulate the texts.
iii. DARTs activity provided active learning situations in which learners collaborated and cooperated

to solve problems.

iv. DARTs activity helped to internalize learning and therefore supported the subject teacher's objectives.

v. DARTs tasks enabled learners go beyond the literal level of understanding.

vi. DARTs activity was an excellent way of introducing a new topic, difficult topic or to revise and consolidate a topic at the end of a unit.

The trend for Science performance mean scores at both school and national levels for grade 12 learners in most secondary schools had been poor as depicted in Figure 1. [3].

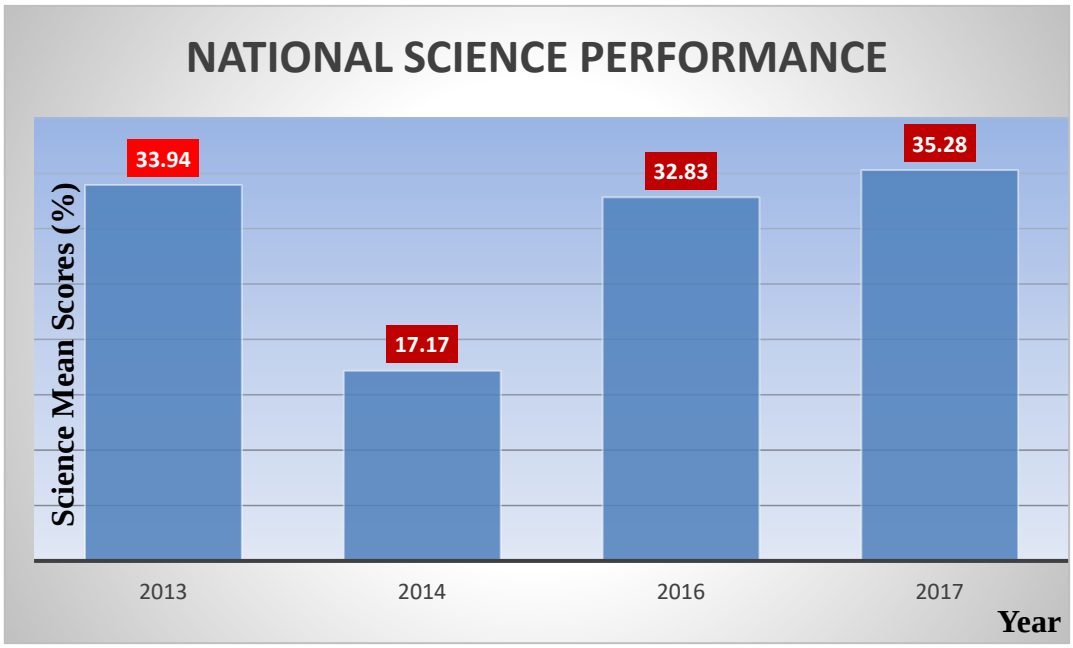

Figure 1. National Science Performance Mean Scores

Some of the reasons highlighted in the Chief Examiner's Report (2017) were that candidates failed to describe in detail all experimental procedures. At both school and national levels, section C of the science paper two (II) was poorly attempted because candidates lacked understanding of key scientific concepts involved [4]. Examination Council of Zambia (ECZ) chemistry examination paper consists of three sections namely; section A, section B and section C. Section C comprises of descriptive type of questions which tests candidates' abilities to describe experimental procedures. Most teaching methods do not simplify the language of science hence lead to poor performance of candidates during examinations. Based on ECZ performance statistics it is evident that there is a gap between conceptual understanding of key scientific (terms) concepts and the interpretation of those scientific concepts. Therefore, this study was worthy undertaking because it explored the effects of integrating DARTs activities into learners' attitude, performance and comprehension of the scientific terms, concepts and theories during the teaching of rates of chemical reactions using a Zambian Secondary School Curriculum.

Theoretical Framework

This research is based on two theories: Bruner's Theory of Experiential and Discovery Learning and Ausubel's Meaningful Learning Theory. Theory of Experiential and Discovery Learning [5] suggested that teachers and teacher educators should provide experiences for inquiry learning in which learners can discover facts and establish relationships for themselves.

Meaningful Learning Theory (Ausubel, [6]) viewed learning as an active process. He suggested that learners must be actively involved in a lesson or activity and they must seek to make sense of their environment by integrating new knowledge being taught in class with what they already learnt.

Literature review

Shaw (2002) [7] suggested that teachers and teacher educators should help their learners to analyze their language needs in order to create appropriate learning materials. He emphasized on the need by the teachers to apply more specific strategy in order to help learners comprehend certain passages like reading a simple graph.

DARTs strategy was originally developed by Gardner and Lunzer (1980) [2]. DARTs strategy was developed in order to encourage learners to master concepts or terms in different disciplines in a more detailed and developed cognitive way.

According to Khusniati [8] used DARTs worksheets, focusing on science texts, to improve reading comprehension for science students. Research had suggested that the biggest problem in learning science was from language barrier aspect Wellington [9].

Hilton suggested that science or mathematics education cannot be learned without understanding its language. Further he points out that it is not a matter of committing chemical equations or formulae to learners' memory but acquiring a systematic thought. Bruner [5] stated that teachers do not teach a subject in order to produce little libraries on that subject but rather get learners think scientifically or mathematically for themselves.

METHOD

Research Design

This study was based on the positivist paradigm or quantitative approach. A paradigm is a set of basic beliefs that represent a world view, defines the nature of the world and the individual's place in it and helps to determine criteria used to select and define research inquiry. A paradigm guides the types of research questions that will be posed, the methodological approach to the inquiry and the criteria for assessing the trustworthiness of the inquiry. A study by Kirk [10] advocated for the use of a quasi-experimental design in a situation where two or more groups possess the same variables. A quasi- experimental design was used for this study and the results obtained were true reflection of this research inquiry. The Pre-test, Post-test, Counterbalance-test Control group Quasi-Experimental research design was used.

Description of Research Site

Raphael Kombe Secondary School is a girls' government school located in Ngungu Township, about 8 km from the Central Business District, (CBD), of Kabwe District, Central Province of Zambia. At the time of the study, the school had a total population of 690 learners, of which 190 were grade eleven learners (Grade 11A = 46, 11B = 51, 11C = 53, 11D = 40), the target population for this study.

Sampling Design

The simple random sampling technique was employed in drawing the sample. Two grade eleven classes were picked at random with replacement and this was done by writing class names (11A, 11B, 11C, 11D) on pieces of paper, then putting them in the container and finally randomly select two papers from the container. Thereafter the classes that were randomly selected into a research sample were further randomly assigned into either experimental group or control group. Raphael Kombe secondary school has well-structured classes and therefore learners were not individually assigned into either experimental group or control group in order to prevent the disruption of the normal running of the school calendar.

Research Instruments

This study used the Chemistry Assessment Tests (CAT) and the questionnaire.

Chemistry Assessment Tests

In order to measure the learners' performance in rates of chemical reactions, performance tests were administered. The performance scale in the tests ranged from 0% to 100% and all the test items were

prepared using Blooms Taxonomy Learning Outcomes. CAT 1 was the pre-test, CAT 2 was the post-test and CAT 3 was the counterbalance test.

Questionnaire

Questionnaire was developed in order to measure the learners' attitude towards understanding of the concepts of chemical kinetics. The questionnaire contained a five-point Likert scale which was for measuring attitude as a latent variable. The five-point Likert scale ranged from 1 = strongly disagree to 5 = strongly agree. Attitude is a latent variable comprising of cognitive component, affective component and behavioral component which could be observed in learners Tzougraki [11]. The questionnaire consisted of six questions measuring cognitive component, six questions measuring affective component and six questions measuring behavioral component of attitude.

RESULTS

Pre-test data set presentation

The first set of quantitative data was collected from the experimental and control groups of the study at the beginning of data collection process. Both the experimental and control groups were tested on their performance and understanding in rates of chemical reactions before an intervention was implemented. The Chemistry Assessment Test (CAT) administered at this stage was called a Pre-test. The purpose of the pre-test was to assess whether the experimental and control groups were homogeneous or heterogeneous before the commencement of the research process. Knowing either the two groups were homogeneous or heterogeneous helps the researcher identify the likely effects of the outcome from the participants' scores. The results from CAT 1 show that the two groups were homogenous before the start of the research. Experimental (M = 37.5, SD = 2.29), Control (M = 38.1, SD = 2.5)

Table 1. Pre-Test Scores for Participants (N = 105).

Group statistics					
	GROUPS OF PARTICIPANTS	N	Mean	Std. Deviation	Std. Error Mean
Pretest scores for participants	Experimental Group	53	37.5472	2.29184	0.31481
	Control Group	52	38.1731	2.50271	0.34706

Post-test data set presentation

The second set of quantitative data was collected from both the experimental and control groups. The second test of CAT was called Post-test, and was administered immediately after implementing the intervention (DARTs). The post-test was used to assess the impact of DARTs on the academic performance of the learners in rates of chemical reactions. After the intervention the experimental group scored much higher in the CAT at a mean of 71 (M = 71, SD = 4.3) compared to the control group at 50 (M = 50, SD = 4.5) who were taught using the conventional method as shown in table 2. DARTs strategy had an impact on academic performance of learners.

Table 2. Group Descriptive Statistics for Post-Test (N = 105)

Group Statistics					
	GROUPS OF PARTICIPANTS	N	Mean	Std. Deviation	Std. Error Mean
Post-Test Scores For Participants	Experimental Group	53	70.9623	4.28756	0.58894
	Control Group	52	50.25	4.45401	0.61766

Counterbalance Test

The third set of quantitative data was collected from both the experimental and control groups. However, the control group was tested by subjecting it to the DARTs technique as a counter balance measure and the experimental group was taught using conventional method. The results shown in Table 3 indicates that mean score for the control group rose to 62.2 (M = 62.2, SD = 9.6) while the mean score of the experimental group fell to 41.4 (M = 41.4, SD = 2.9). The results show that DARTs strategy had a significant impact on the interpretation and retention of scientific terms in rates of chemical reactions.

Table 3. Group Descriptive Statistics for Counterbalance-test (N = 105)

GROUP STATISTICS

Counterbalance test scores	Participants	N	Mean	Std. Deviation	Std. Error Mean
	Experimental Group	53	41.4423	2.94001	.40771
	Control Group	52	62.2264	9.63895	1.3240

DISCUSSION

What is the impact of DARTs technique on performance in rates of chemical reactions?

The research question was tested by using Independent samples t-test and the level of significance was set at 0.05. The performance of the experimental group in the post-test was compared to the performance of the control group in the post-test. The p-value (0.001) for the test was less than the level of significance at 0.05. Hence, there was enough evidence to reject the null hypothesis. DARTs strategy had an impact on the performance of learners in rates of chemical reactions.

Table 4. Post-Test Independent Samples t-Test (N = 105)

INDEPENDENT SAMPLES t-TEST

Post-test scores		Levene's test for Equality of Variances		t-test for Equality of Means		
		F	Sig	t	df	Sig(2-tailed)
	Equal Variances	7.105	0.043	24.278	103	0.000

Assumed			
Equal Variances not Assumed	24.269	102.663	0.000

What is the impact of DARTs technique on the interpretation and retention of concepts (terms) in rates of chemical reactions?

The achievement or performance in the post-post-test (counterbalance) of the experimental group was compared to the achievement in the post-post-test of the control group. This test was done to assess whether DARTs technique had any significant impact on learners' interpretation and retention of scientific concepts in rates of chemical reaction. The p-value (0.001) for the t-test was less than the level of significance at 0.05. There was enough evidence to reject the null hypothesis and accept the research hypothesis. DARTs strategy had an impact on the interpretation and retention of concept (terms) in rates of chemical reactions.

Table 5. Post-Post-Test (Counterbalance Test) Independent Samples t-Test (N = 105)

INDEPENDENT SAMPLES t-TEST

Counterbalance test scores		Levene's test for Equality of Variances		t-test for Equality of Means		
		F	Sig	t	df	Sig(2-tailed)
	Equal Variances Assumed	42.608	0.000	14.883	103	0.000
	Equal Variances not Assumed			15.003	61.763	0.000

What is the impact of DARTs on learners' attitude towards rate of chemical reactions?

The Principle Component Analysis (PCA) could only be done on normally distributed attitude score data sets therefore the KMO Measure of Sampling Adequacy and the Bartlett's Test of Sphericity were conducted first. According to Tzougraki [11] PCA empirically examines the interrelationships among the items of the questionnaire, identify clusters of items that share sufficient variation and justify the existence of constructs.

Table 6. KMO Test of Sampling Adequacy and the Bartlett's Test of Sphericity.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.911
Bartlett's Test of Sphericity	Approx. Chi-Square	3260.145
	df	136
	Sig.	.000

Table 6 shows the KMO test value of 0.911 which is greater than the recommended KMO test value of 0.8. As a rule of the thumb, KMO values between 0.8 and 1 indicate that the sampling is adequate and suitable for Factor Analysis.

The third research question was tested in order to assess whether DARTs had any statistically significant impact on the learners attitude towards rates of chemical reactions. The research question was tested using the Mann Whitney U-test because the data was non parametric.

The level of significance was set at 0.05 and the attitudes of the two groups were compared using the SPSS.

Table 7. Mann Whitney U-test.

Attitude Comparison using Mann Whitney U-test	
Mann-Whitney U	1266.500
Wilcoxon W	2644.500
Z	-.716
Asymp. Sig. (2-tailed)	.474

Table 7 indicates the Mann Whitney U-test value of 1266.500 and its p-value of 0.474. The p-value from the Mann Whitney U-test is greater than the level of significance set at 0.05. The null hypothesis could not be rejected. Therefore, there was no statistically difference in the attitude scores towards rates of chemical reactions between the learners taught through DARTs technique and learners taught through collaborative method.

This study sought to establish the impact of integrating DARTs teaching strategy on learners' academic achievement in rates of chemical reactions. There were three main variables which came out from the study and these were; performance (achievement), interpretation and attitude.

Table 2 showed the Post-test mean scores for the two groups. The experimental group had a higher mean score in achievement in rates of chemical reactions than the control group. Table 4 showed the post test independent samples t-test in which the p-value (0.001) for the test was less than the level of significance at 0.05. Hence, there was enough evidence to reject the null hypothesis. Despite other minor factors at play, the large difference in the achievement scores between the experimental group and the control group could only be attributed to the teaching methods used. It was concluded in this research that DARTs technique had a positive impact on learners' achievement in learning rates of chemical reactions.

In Table 3 the control group was tested by subjecting it to the DARTs technique as a counter balance measure and the experimental group was taught using conventional method. The mean score for the control group rose to 62.2 while the mean score of the experimental group fell to 41.4. These results showed that learners had a better understanding and interpretation of scientific terms in rates of chemical reactions. Table 5 showed the counterbalance test independent samples t-test in which the p-value (0.001) for the test was less than the level of significance at 0.05. Hence, there was enough evidence to reject the null hypothesis. It was also concluded in this research that DARTs technique had a positive impact on learners' interpretation and understanding of scientific terms in learning rates of chemical reactions.

Table 7 showed that there was no statistically significant difference in the attitude ranks between the learners taught using DARTs technique ant those taught using conventional methods. There was no evidence to reject the null hypothesis therefore it was concluded that DARTs technique had no impact on the learners' attitude towards learning rates of chemical reactions.

CONCLUSION

The study had three research questions and it was concluded that DARTs technique had a positive impact on both the achievement scores and improved interpretation and retention of scientific terms in learning of rates of chemical reactions in chemistry. However, DARTs technique had no significant impact on the learners' attitude towards learning of rates of chemical reactions.

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