

International Journal on New Trends in Education and Their Implications (IJONTE)

April 2018

Volume: 9 Issue: 2

ISSN 1309-6249

http://ijonte.org



International Journal on New Trends in Education and Their Implications January 2018 Volume: 9 Issue: 2 ISSN 1309-6249

Contact Addresses



Prof. Dr. Zeki Kaya, Gazi Üniversitesi, Gazi Eğitim Fakültesi, Eğitim Bilimleri Bölümü Teknik Okullar Ankara/Türkiye E. Mail: ijonte2010@qmail.com

Abstracting & Indexing

International Journal on New Trends in Education and Their Implications (IJONTE) is currently indexed, abstracted and listed starting with the first issue in:



Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org



Editors

Prof. Dr. Zeki Kaya, Gazi University- Turkey Assoc. Prof. Dr. Ilknur Istifci, Anadolu University, Turkey

Associate Editors

Assoc. Prof. Dr. Beyhan Zabun, Gazi University- Turkey Assist. Prof. Dr. Nazan Dogruer, Eastern Mediterranean University- TRNC Assist. Prof. Dr. Ramadan Eyyam, Eastern Mediterranean University- TRNC

Assistant Editor

PhDc. Ipek Menevis, Eastern Mediterranean University- TRNC

Editorial Board

- Prof. Dr. Ali H. Raddaoui, University of Sfax- Tunisia
- Prof. Dr. Abdul Hakim Juri, University of Kuala Lumpur- Malaysia
- Prof. Dr. Ahmet Pehlivan, Cyprus International University- TRNC
- Prof. Dr. Ali Simsek, Anadolu University- Turkey
- Prof. Dr. Antoinette J. Muntjewerff, Amsterdam University- Netherlands
- Prof. Dr. Antonis Lionarakis, Hellenic Open University- Greece
- Prof. Dr. Augustyn Bańka, Nicolaus Copernicus University- Poland
- Prof. Dr. Boriss Misnevs, Transport and Telecommunication Institute- Latvia
- Prof. Dr. Charlotte Nirmalani (Lani) Gunawardena, University of New Mexico- USA
- Prof. Dr. Cevat Celep, Kocaeli University- Turkey
- Prof. Dr. Cleborne D. Maddux, University of Nevada- USA
- Prof. Dr. Coskun Bayrak, Anadolu University- Turkey
- Prof. Dr. Danièle Moore, Simon Fraser University- Canada
- Prof. Dr. Emine Demiray, Anadolu University- Turkey
- Prof. Dr. Erol Yildiz, Alpen-Adria University- Austria

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org



Prof. Dr. Esmahan Agaoglu, Anadolu University- Turkey

- Prof. Dr. Francis Glasgow, Guyana University- South America
- Prof. Dr. Gonca Telli Yamamoto, Maltepe University- Turkey
- Prof. Dr. Gul Nurgalieva, Joint-stock company,"National Center of Information"- Kazakhstan
- Prof. Dr. Harold Bekkering, University of Nijmegen- Netherlands
- Prof. Dr. H. Ferhan Odabasi, Anadolu University- Turkey
- Prof. Dr. Heli Ruokamo, University of Lapland- Finland
- Prof. Dr. I. Hakki Mirici, Hacettepe University- Turkey
- Prof. Dr. Jim Flood, Open University- United Kingdom
- Prof. Dr. Jozef Gašparík, Slovak University of Technology in Bratislava Slovakia
- Prof. Dr. Kiyoshi Nakabayashi, Kumamoto University- Japan
- Prof. Dr. K. M. Gupta, Motilal Nehru National Institute of Technology- India
- Prof. Dr. Liliana Ezechil, University of Piteşti- Romania
- Prof. Dr. Manuel Alberto M. Ferreira, Lisbon University Institute- Portugal
- Prof. Dr. Marie J. Myers, Queen's University- Canada
- Prof. Dr. Mehmet Durdu Karsli, Eastern Mediterranean University- TRNC
- Prof. Dr. Mehmet Kesim, Anadolu University- Turkey
- Prof. Dr. Meral Aksu, Middle East Technical University- Turkey
- Prof. Dr. Min Jou, National Taiwan Normal University- Taiwan
- Prof. Dr. Modafar Ati, Abu Dhabi University- United Arab Emirates
- Prof. Dr. Mohamed Abolgasem Artemimi, Zawia Engineering College- Libya
- Prof. Dr. Mufit Komleksiz, Cyprus International University- TRNC
- Prof. Dr. Mustafa Cakir, Anadolu University- Turkey
- Prof. Dr. Nedim Gurses, Anadolu University- Turkey
- Prof. Dr. Paul Kawachi, Bejing Normal University- China
- Prof. Dr. Ramesh C. Sharma, Indira Gandhi National Open University- India
- Prof. Dr. Richard C. Hunter, University of Illinois at Urbana-Champaign- USA
- Prof. Dr. Roberta E. (Bobby) Harreveld, Queensland University- Australia
- Prof. Dr. Rozhan M. Idrus, School of Distance Education, University Sains- Malaysia
- Prof. Dr. Santosh Panda, Indira Gandhi National Open University- India
- Prof. Dr. Selahattin Gelbal, Hacettepe University- Turkey
- Prof. Dr. Sharif H. Guseynov, Transport and Telecommunication Institute- Latvia
- Prof. Dr. Tamar Lominadze, Georgian Technical University- Georgia
- Prof. Dr. Tanja Betz, Goethe University- Germany
- Prof. Dr. Tony Townsend, University of Glasgow- United Kingdom
- Prof. Dr. Valentina Dagiene, Institute of Mathematics and Informatics- Lithuania
- Prof. Dr. Xibin Han, Tsinghua University- China
- Prof. Dr. Yavuz Akpinar, Bogazici University- Turkey
- Prof. Dr. Yoav Yair, The Open University of Israel- Israel
- Prof. Dr. Yuksel Kavak, TED University- Turkey
- Prof. Dr. Zeki Kaya, Gazi University- Turkey
- Assoc. Prof. Dr. Carlos Machado, Vrije University- Belgium
- Assoc. Prof. Dr. Danny Bernard Martin, University of Ilinois at Chicago- USA
- Assoc. Prof. Dr. Demetrios G. Sampson, University of Piraeus- Greece
- Assoc. Prof. Dr. Fatih Gurbuz, Bayburt University- Turkey
- Assoc. Prof. Dr. Irfan Yurdabakan, Dokuz Eykul University- Turkey
- Assoc. Prof. Dr. Natalija Lepkova, Vilnius Gediminas Technical University- Lithuania
- Assoc. Prof. Dr. Nigel Bagnall, The University of Sydney- Australia
- Assoc. Prof. Dr. Ozgen Korkmaz, Mevlana University- Turkey
- Assoc. Prof. Dr. Rositsa Doneva, Paisii Hilendarski University of Plovdiv- Bulgaria



- Assoc. Prof. Dr. Piet Kommers, University of Twente- Netherlands
- Assoc. Prof. Dr. S. Raja, ASL Pauls College of Engineering and Technology- India
- Assoc. Prof. Dr. Shivakumar Deene, Karnataka State Open University- India
- Assoc. Prof. Dr. Steve Wheeler, University of Plymouth- United Kingdom
- Assist. Prof. Dr. Katherine Sinitsa, International Research and Training Center- Ukrania
- Assist. Prof. Dr. Roxana Criu, Cuza University- Romania
- Assist. Prof. Dr. Zdena Lustigova, Charles University- Czech Republic
- Dr. Carmencita L. Castolo, Polytechnic University- Philippines
- Dr. Hisham Mobaideen, Mu'tah University- Jordan
- Dr. Simon Stobart, University of Teesside- United Kingdom
- Dr. Ufuk Tanyeri, Ankara University, Turkey



Dear IJONTE Readers,

International Journal on New Trends in Education and Their Implications- IJONTE appears on your screen now as Volume 9, Number 2. In this issue it publishes 5 articles.

Our journal has been published for over eight years. It has been followed by many people and a lot of articles have been sent to be published. 508 articles have been sent to referees for forthcoming issues. They will be published according to the order and the results. Articles are sent to referees without names and addresses of the authors. The articles who get positive responses will be published and the authors will be informed. The articles who are not accepted to be published will be returned to their authors.

We wish you success and easiness in your studies.

Cordially,

1st April, 2018

Editors Prof. Dr. Zeki Kaya, Gazi University, Ankara- Turkey Assoc. Prof. Dr. Ilknur Istifci, Anadolu University, Eskişehir-Turkey



ARTICLES

01. THE PROFILE OF STUDENTS' SELF-EFFICACY ON HYDROCARBON HYBRID LEARNING AND ANDROID- BASED- GAME
02. THE INFLUENCE OF 4MAT MODEL ON ACADEMIC ACHIEVEMENT AND RETENTION OF LEARNING IN TRANSFORMATION GEOMETRY
03. WHY ARE THEIR MATHEMATICAL LEARNING ACHIEVEMENTS DIFFERENT? RE- ANALYSIS TIMSS 2015 DATA IN INDONESIA, JAPAN AND TURKEY
04. INVESTIGATING 12 th GRADE STUDENTS' PRIOR KNOWLEDGE OF STATIC ELECTRICITY CONCEPTS
05. SOCIAL PARADIGMS IN GUIDING SOCIAL RESEARCH DESIGN: THE FUNCTIONAL, INTERPRETIVE, RADICAL HUMANIST AND RADICAL STRUCTURAL PARADIGMS



THE PROFILE OF STUDENTS' SELF-EFFICACY ON HYDROCARBON HYBRID LEARNING AND ANDROID- BASED- GAME

Nur Fitriyana Graduate School Yogyakarta State University Yogyakarta - INDONESIA

Dr. Antuni Wiyarsi Faculty of Mathematics and Natural Sciences Yogyakarta State University Yoogyakarta - INDONESIA

Prof. Dr. K. H. Sugiyarto Faculty of Mathematics and Natural Sciences Yogyakarta State University Yoogyakarta - INDONESIA

Abstract

The profile of students' self-efficacy on hydrocarbon hybrid learning mediated by video conference and android-based-game has been analyzed. This research is a quantitative descriptive study. A total of 143 grade 11th students were cluster randomly selected from two public senior high school in Purworejo regency, Central Java, Indonesia. The samples were set into three different classes, namely Class CG-1 using android-based-game only, Class CG-2 using hybrid of video conference only, and Class E using both android-based-game and hybrid of video conference. The data of students' self-efficacy was obtained through questionnaire. The analysis of the profile students' self-efficacy was conducted by categorizing the score obtained from the questionnaire into ideal rating category. The results of this study showed that the profile of students' self-efficacy in the E class was highest.

Keywords: Android-based-game, hybrid learning, video conference, students' self-efficacy

INTRODUCTION

Bandura (1994) defines self-efficacy as a person's belief about his/her ability to organize and execute an action in order to achieve the desired goal. Self-efficacy focuses on self-consideration is a knowledge of his or her ability to successfully complete a task regardless of the ability of others (Woolfolk, 2007). Based on cognitive social theory, self-efficacy will affect the choice of activities, effort and persistence, beliefs (Schunk, Pintrich, & Meece, 2010), and performance (Ormrod, 2003; Villafane, Xu, & Raker, 2016). Furthermore, students who have higher self-efficacy, have more influence on education because students have high motivation (Mataka & Kowalske, 2015).

In terms of activity choices, students who have high self-efficacy tend to choose difficult and challenging tasks rather than students' who have low self-efficacy (Eggen & Kauchak, 2010; Kurbanoglu & Akin, 2010; Ormrod, 2003; Bandura, 1994; Zimmerman, 2000; Uzuntiryaki, 2008; Santrock, 2011; Schunk *et al.*, 2010). The students' belief about their self-efficacy manage the academic task can also affect students emotionally by reducing the students' stress, anxiety, and depression (Zimmerman, 2000). High self- efficacy in the students that fosters intrinsic motivation and deep involvement in activities that students do.

In the aspect of effort and persistence, students with high self-efficacy are more likely to try harder to complete the task. Students also tend to survive by continuing to try when faced with challenging tasks. Conversely, students with low self-efficacy will soon give up when faced the challenging tasks



(Ormrod, 2003; Eggen & Kauchak, 2010; Bandura, 1994; Schunk *et al*, 2010). Students with high self-efficacy will survive to accomplish challenging tasks by taking longer to complete the task (Santrock, 2011). Students with high self-efficacy can improve and sustain their efforts in the face of failure, quickly restore their own efficacy after a failure, assume the failure occurs because the effort is not sufficient or lack of knowledge and skills acquired, have a good performance, and reduce stress (Bandura, 1994).

In terms of performance achieved, students with high self-efficacy tend to learn and perform better than students who have low self-efficacy even though the students have the same ability. Among students with the same ability, students who believe can do the task will be more successful than students who feel themselves unable to do the task. In short, there is a difference in academic performance between students with high self-efficacy compared with low self-efficacy although the ability of students is the same (Ormrod, 2003; Eggen & Kauchak, 2010; Uzuntiryaki, 2008). Therefore, the self-efficacy of students is very important to be analyzed in order to improve the performance of students in the learning process, especially in the chemistry teaching learning process.

Many students regard chemistry as a difficult subject. The abstract chemical concepts and lack of teacher support have become a cause of learning difficulties in the chemistry (Woldeamanuel, Atagana, & Engida, 2014). In example in the hydrocarbons teaching learning. The combination of letters and numbers in chemical equations or formulas causes the students to consider hydrocarbons as abstract and difficult to understand so that appropriate learning media are needed to facilitate students to understanding the material of hydrocarbon learning.

One of the learning media that can be utilized in the hydrocarbons teaching learning in accordance with the digital era is an android-based-game. Educational games can influence the behavior of students such as can provide a sense of fun in learning, a positive learning experience, and a positive impact on student learning outcomes (Jabbour, 2014). Jeng, Wu, Huang, Tan, and Yang, (2010) stated that many of the android-based-games are available and have many advantages such as can be utilized as innovative learning media that can be adjusted to the desired learning strategy. Games can provide many opportunities for students to learn more interesting. The android-based-game in this study contains a summary of learning materials and equipped with exercise questions that are packed in game form. This game media can facilitate students to learn so that the existence of interactive learning media is expected to improve the self-efficacy of students.

Another example of the use of Information and Communication Technology (ICT) in the teaching learning process is by hybrid learning. Hybrid learning is a learning that combines face-to-face and online phases (Zhao & Breslow, 2013), so that learning can take place wherever and whenever. Hybrid learning is found to be more effective and efficient (Partridge, Ponting, & McCay, 2011). The advantages of the use of hybrid learning are time efficient and one of the utilization of technological development. In hybrid learning, students and teachers increase the use of technology for teaching learning (Tayebinik & Puteh, 2012).

One of the media that can be utilized in the online phase of hybrid learning is video conferencing. The use of video conferencing in the teaching learning process allows students and teachers at different locations to see and talk each other. Among the distance learning technologies available, video conferencing is very similar to face-to-face learning in the classroom (Pandey & Pande, 2014). Hybrid learning method with video conferencing is highly dependent on self-motivation in the form of self-efficacy, self-regulated learning, self-discipline, and the ability to communicate effectively. The use of video conferencing in the online phase of hybrid learning is expected to foster the students' self-efficacy in the chemistry teaching and learning process.

This article aims to analyze the profile of students' self-efficacy on hydrocarbon hybrid learning mediated by video conferencing and android-based-game.



METHODS

Research Design

A descriptive research with a quantitative approach was set in this study. The samples in this study were set into three different classes according to the experimental manipulations, namely Class CG-1 using android-based-game only, Class CG-2 using hybrid of video conference only, and Class E using both android-based-game and hybrid of video conference. The research design can be seen in Table 1.

Table 1: Research Design

Class	Experimental Manipulations	Posttest
Compared-Group 1 (CG-1)	X ₁	Y ₁
Compared-Group 2 (CG-2)	X ₂	Y ₁
Experimental Group (E)	X ₃	Y ₁

Note: X_1 = hydrocarbon teaching learning mediated by android-based-game, X_2 = hydrocarbon hybrid learning mediated by video conference, X_3 = hydrocarbon hybrid learning mediated by video conference, X_1 = self-efficacy questionnaire.

Participants

The participants in this study came from two public senior high school in Purworejo regency, Central Java, Indonesia. Both schools were chosen because has very good school accreditation and has adequate facilities for implementation of hybrid learning such as the internet network, computer, and smartphone. A total of 143 students with 16 years old average were the participants in this study. By cluster random sampling, those 143 participants then classified into three different classes which were a CG-1 of 50 students, CG-2 of 45 students, and an E group of 48 students.

Data Collection

According to the objective of this research, the data that would be implemented were obtained from the self-efficacy questionnaire. The initial self-efficacy questionnaire consisted of 30 points of statements using 4 scales (from never to always) which was modification of the Likert scales. The self-efficacy questionnaire was developed by determined the characteristics of students who have high and low self-efficacy following Eggen and Kauchack (2010); Santrock (2011); Zimmerman (2000); Bandura (1994); and Uzuntiryaki (2008). Characteristics of students of high self-efficacy used as a reference to a positive statement whereas those of low self-efficacy to the negative one. The data of students' self-efficacy was collected through a single measurement that is after the treatment in each class.

The self-efficacy questionnaire analysis was done by validity and reliability tests. Those self-efficacy questionnaire was validated theoretically and empirically. The theoretical validity was done by asking the expert judgment in terms of material, construction, and language to an expert from the Psychology Department. The theoretical validity analysis was performed using Aikens' V analysis for each questionnaire item. The Aiken's V statistics are formulated as follows (Aiken, 1985).

$$V = \frac{\sum s}{[n(c-1)]}$$

Note: s = r - lo; r = number of raters; lo = minimum validity score; c = maximum validity score; r = number given by raters.

The criteria used in the theoretical validity analysis format for the self-efficacy questionnaire in this study has a score 1 if not necessary, score 2 if useful but not essential, and score 3 if essential (Lawshe, 1975).

The calculation result of the Aiken's V value which obtained on each item of the questionnaire statement then compared with the value of the validity coefficient based on the interpretation



guideline of uncorrected correlation coefficients in the predictive validity study according to Emery cited by Azwar (2016) presented in Table 2.

Table 2: The Interpretation Guideline of Uncorrected Correlation Coefficients On Predictive Validity Study

Validity Coefficient	Interpretation
> 0,35	Very useful
0,21 – 0,35	Useful
0,11 - 0,20	Depend on condition
< 0,11	Not useful

In this study, the item of self-efficacy questionnaire used very useful interpretation which has a value of Aiken's V greater than the value of the validity coefficient of 0,35. The analysis result showed that from 30 items of self-efficacy questionnaire statements, there were 26 items of self-efficacy questionnaire statements that have a very useful interpretation. So that, it can be said 26 items of self-efficacy questionnaire were theoretically valid.

Furthermore, empirical validity was done by testing the self-efficacy questionnaire against the other students that not used as the samples of this study. Those students used to test self-efficacy questionnaire empirically has certain criteria. The criteria in this case include having an average age of 16 years old and have studied hydrocarbons subject matter. A total of 342 students were obtained to test the self-efficacy questionnaire that has been developed. Based on the result of empirical validity analysis there were 3 items of questionnaire statements doesn't fit with Partial Credit Model (PCM). It means as much as 23 items of self-efficacy questionnaire statements fit with the PCM model. A total of 23 points of this questionnaire was used as an instrument to measure the students' self-efficacy. In addition, the analysis results show an Alpha Cronbach's reliability estimate of 0,72.

Data Analysis

The data which obtained from the self-efficacy questionnaire were analyzed by quantitative descriptive method. These students' self-efficacy score then converted into interval data scale. Furthermore, the data was classified into a category based on the ideal rating category. The rating category referred by Widoyoko (2009, p. 238) can be seen in Table 3.

Table 5. 10			
No	Score Range	Quality	
1	$\overline{X\iota}$ + 1,80 SBi < X	Excellent	
2	$\overline{X\iota}$ + 0,60 Sbi < X $\leq \overline{X\iota}$ + 1,80 SBi	Good	
3	\overline{Xi} – 0,60 SBi < X ≤ \overline{Xi} + 0,60 SBi	Fair	
4	$\overline{X\iota}$ – 1,80 SBi < X ≤ $\overline{X\iota}$ – 0,60 SBi	Poor	
5	$\chi \leq \overline{Xi} - 1,80$ SBi	Very Poor	

Table 3: Ideal Rating Category

Note: SBi = x (ideal max score – ideal min score); $X\iota = x$ (ideal max score + ideal min score); X = average score of students' self-efficacy.

FINDINGS

The students' self-efficacy data in this study was obtained from the self-efficacy questionnaire and measured after the experimental manipulations were performed in each class. The profile of students' self-efficacy in this study was based on the ideal rating category according to Table 3. The profile of students' self-efficacy was analyzed and reviewed based on the mean of students' self-efficacy score in each class, the percentage of students' self-efficacy category in each class, and based on the



percentage of self-efficacy category in terms of 4 aspects of self-efficacy. Table 4 shows the statistical descriptive of the students' self-efficacy data which obtained in this study.

Table 4. Descript	able 4. Descriptive Statistics of Statements Self Effecty							
Class	Mean	Standard Deviation	N					
CG-1	60, 8400	9, 47900	50					
CG-2	64, 4667	7, 94183	45					
E	67, 9317	9, 74435	48					

Table 4: Descriptive Statistics of Students' Self-Efficacy

Based on Table 4, it can be seen that the mean of students' self-efficacy in E class was highest and was classified as having a good self-efficacy category. In contrast, the CG-1 class has the lowest students' self-efficacy and was classified as having fair self-efficacy category. The profile of students' self-efficacy based on the mean which obtained in each class in this study can be seen in Figure 1.



Figure 1: The Profile of Students' Self-Efficacy Based on the Mean of Students' Self-Efficacy Score in Each Class

The profile of students' self-efficacy then reviewed based on the percentage of students' self-efficacy category in each class. The profile based on the percentage of students' self-efficacy categories were obtained by counting the number of students who have self-efficacy categories excellent, good, fair, poor, and very poor in each class. The data from a number of three classes then made a percentage of ideality and compared. The students' self-efficacy profile can be seen in Figure 2.





Figure 2: Students' Self-Efficacy Profile Based on Percentage of Students' Self-Efficacy Criteria in Each Class

Based on Figure 2, it can be concluded that in the CG-1 the most dominant students have fair selfefficacy criteria (17%). In the CG-2 class a total of 17% of students have good self-efficacy criteria. As for class E that is a number of 15% of students have self-efficacy good criteria and 6% have very good criteria. In short, self-efficacy in class E is better than the other two classes.

The last profile of students' self-efficacy in this study was reviewed based on a number of 4 aspects of self-efficacy. A number of 4 of those self-efficacy aspects were based on the task orientation, effort and persistence, beliefs, and performance. The students' self-efficacy profile based on the aspect of task orientation can be seen in Figure 3.



Figure 3: The Profile of Students' Self-Efficacy Based on Task Orientation Aspect



Based on Figure 3, from the task orientation aspect, students in the class E most dominant have excellent task orientation. As for the CG-2 class, the students most dominant have good category self-efficacy and in the CG-1 class most dominant have fair category self-efficacy. Furthermore, the profile of students' self-efficacy based on effort and persistence aspect can be seen in Figure 4.



Figure 4: The Profile of Students' Self-Efficacy Based on Effort and Persistence Aspect

Based on Figure 4, in terms of effort and persistence, students in E and CG-1 class have a dominant effort and persistence on fair criteria. As for the CG-2 class, the students more dominant on good criteria of self-efficacy. The next, the self-efficacy profile based on beliefs aspect can be seen in Figure 5.



Figure 5: The Profile of Students' Self-Efficacy Based on Beliefs Aspect



Figure 5 shows the students' self-efficacy profile in terms of the beliefs aspect. Students in E and CG-2 class have a good dominant criteria of self-efficacy. But, in the CG-1 class, the students more dominant have a category fair of self-efficacy. The last, the profile of students' self-efficacy in the performance aspect can be seen in Figure 6.



Figure 6: The Profile of Students' Self-Efficacy Based on Performance Aspect

Figure 6 shows the students' self-efficacy profile on the performance aspect. Based on performance aspect, the students in E class more dominant have a good self-efficacy category. While in the CG-1 and CG-2 classes were dominant have fair category self-efficacy.

DISCUSSION AND CONCLUSION

The utilization of ICT in the teaching learning gives positive impact on the students' self-efficacy. The profile of students' self-efficacy in this study was analyzed after ICT based learning was applied. The analysis of the profile of students' self-efficacy was reviewed based on the mean of the students' self-efficacy score in each class, the percentage of students' self-efficacy criteria in each class, and the percentage of students' self-efficacy criteria in terms of task orientation, effort and persistence, beliefs, and performance aspect.

The Profile Based on Average of Students' Self-Efficacy Score and Percentage of Students' Self-Efficacy Criteria in Each Class

Based on the mean of the students' self-efficacy score in each class, the results of this study showed that the students' self-efficacy in E class was highest compared to other two classes. The same results are shown when the self-efficacy profile was analyzed based on the percentage of the students' self-efficacy criteria in each class. Class E has the dominant self-efficacy criterion with good category while the CG-1 class is only dominant in the fair category. The differences of students' self-efficacy in this study was caused by the different of experimental manipulations in each class. High self-efficacy in class E was caused by the use of hybrid learning mediated by video conference and android-based-game.

Hybrid learning is a learning which combines two types of learning phases namely face-to-face and online phases to form a new kind of learning (Zhao & Breslow, 2013; Tayebinik & Puteh, 2012). The use of hybrid learning makes the learning process flexible and was one of the utilization of



technological developments in the teaching learning process. Therefore, by using hybrid learning the students and teachers increase the use of technology for teaching learning process (Tayebinik & Puteh, 2012). Students can access the teaching learning materials wherever and whenever the students need it, therefore the students can easily understand the learning materials that hasn't been mastered.

E-learning in the online phase of hybrid learning can be either synchronous or asynchronous (Pandey & Pande, 2014). The synchronous learning occurs directly where the students can interact each other at the same time. While the asynchronous learning occurs rapidly enabling students to engage in the exchange of ideas or information without the dependence of the involvement of other students at the same time. Both asynchronous and synchronous methods depend heavily on self-motivation in the form of self-efficacy, self-regulation in learning, self-discipline, and the ability to communicate effectively.

The online phase of hybrid learning in this study uses video conferencing which is one example of synchronous e-learning. Video conferences are very similar to face-to-face lessons in the classroom. Hybrid learning methods with video conferencing depend on self-motivation, self-regulation, self-discipline, and the ability to communicate effectively (Pandey & Pande, 2014). This technology-based learning offers innovative methods to train students ' self-efficacy and can influence students' learning achievements through the interaction in online-phase of hybrid learning (Abulibdeh & Hassan, 2011). Through video conferencing, students can practice their self-efficacy. Students believe by involving the use of technology in learning will facilitate himself to understand the learning materials, so that the students' self-efficacy become good.

In addition to video conferencing, the online phase of hybrid learning in this research is assisted by the use of one of the asynchronous e-learning media that is a web based learning management system. Kim (2007) states that some of the advantages of using learning management system are improving learning effectiveness and academic achievement of students, increasing students' comfort in obtaining learning materials, and can increase learning time by using technology in learning. The results of Kaypak, Canbek, Bozna, and Tu (2017) showed that the use of asynchronous mobile learning in distance learning allows the students easily share their own learning experiences with others, providing assistance to each other to develop students' understanding on a particular learning topic, and can provide feedback among students directly. In short the use of mobile learning in distance learning process. The existence of this advantage makes students easily to solve problems in learning that he has not mastered. On the other hand, one study conducted by Chen (2014) show that a person with high self-efficacy is cooperative, helpful and willing to share in social situations. It means the web-based learning management system can improve the students' self-efficacy.

Furthermore, the use of an online asynchronous learning medium with mobile learning uses two important types of technology: mobile technology and social networking technologies in the learning process (Kaypak, Canbek, Bozna, and Tu, 2017). The advantage of both these technologies on distance learning is that students are accustomed to using this technology in daily life so that students are familiar with the structure of learning media used. The students also can also access learning materials anywhere and anytime. This reason which makes the self-efficacy of students who implement hybrid learning in this study increasing.

On the other hand, the optimization of ICT can be done by integrating android-based-game in the teaching learning. Educational games can influence the students' behavior, such as giving pleasure in teaching learning, providing a positive learning experience, and positively influencing students' learning outcomes (Jabbour, 2014). Games can provide many opportunities for students to learn more interesting and can facilitate the student to learning. Android-based-game is one of the android-based learning games that can be utilized as an innovative learning chemistry that can affect the



academic performance of students. The Android-based-games applied in this study contain core competencies and basic competencies of hydrocarbon material that students must master, a summary of hydrocarbon learning materials, and exercise on hydrocarbon matter packaged in game form. The use of android-based-game gives a positive influence in the learning process because it makes students motivated by the presence of games in hydrocarbon learning. In fact, the results of this study indicate that in the CG-1 class that only apply android-based games have the lowest self-efficacy students compared to the other two classes. This is because students do not feel confident of her/his ability if only use the game in the learning process. The game paradigm just for fun is still firmly attached in this case.

The Profile of Students' Self-Efficacy Based on Task Orientation Aspect

Compared to the students who have low self-efficacy, students who have high self-efficacy will choose to perform difficult and challenging tasks to be mastered (Eggen & Kauchak, 2010; Kurbanoglu & Akin, 2010; Ormrod, 2003; Bandura, 1994; Zimmerman, 2000; Uzuntiryaki, 2008; Santrock, 2011; Schunk *et al.*, 2010). In general, students' self-efficacy plays a positive role in their attitude towards and their processes and outcomes derived from ICT based learning. Therefore, before attempting to interpret the conceivable relations between self-efficacy and ICT based learning, it is meaningful to discuss the relevant findings concerning Computer Self-Efficacy (CSE). CSE defined as an individual's perception of efficacy in performing specific computer related tasks within the general computing domain. Thus, CSE can be considered a domain specific measure of self-efficacy that reflects a person's belief in his/her ability to perform specific tasks based ICT. The results of Tsai, Chuang, Liang, and Tsai (2011) CSE has been shown to influence an individual's choice to engage in a technology task and the effort expended to accomplish it. In addition, Chen (2014) discovered that those who are more confident about their computer skills are motivated more to learn, and having more experience would lead to higher self-efficacy.

Based on the results of this study, students in class E feel the task given by the teacher through the hybrid learning phase is very challenging. Students are challenged to master the technology used in hydrocarbon learning. Students can easily access the learning materials when needed. This is what makes the self-efficacy of students in class E sharper. Compared with E and CG-2 classes that apply hybrid learning, the students' self-efficacy in CG-1 class is only dominant in fair criterion. Students in the CG-1 class are only given traditional tasks so that students are less motivated in completing the task that makes students' self-efficacy in this class tend to be low.

The results of this study were similar to those of previous studies. One study conducted by Chen (2014) shows that the students who used technology in the teaching learning, ranked their selfefficacy quite moderately and they accepted those technology as a good teaching learning media. These results are quite promising, since self-efficacy is one of the important factors in effective learning. The sense of technological self-efficacy, including ICT, affects the students' decision to use ICT in the teaching learning and is not dependent on their beliefs on the value of using that technology. Abulibdeh and Hassan (2011) proposed that all communication and interactions become mediated by the interface with which students must interact each time they wish to perform some task in the ICT-mediated environment.

The Profile of Students' Self-Efficacy Based on Effort and Persistence Aspect

Self-efficacy level influences the amount of effort exerted and the persistence in performing certain actions, the emotional responses of the person attempting the behavior, and the actual action of the person. The students with high self-efficacy are more likely to strive to complete the task. The students also tend to survive by continuing to try when faced with challenging tasks. Conversely, the students with low self-efficacy will soon give up when faced with challenging tasks (Ormrod, 2003; Eggen & Kauchak, 2010; Bandura, 1994; Schunk *et al*, 2010). The students endure to accomplish challenging tasks by taking longer to complete the task (Santrock, 2011). In this study, students in E and CG-2 class spent considerable effort when assigned to model hydrocarbon isomers and presented the task via video conferencing. Based on observations, the students try hard to master the use of



video conferencing. The students are motivated to complete the task given by the teacher and then present it through video conferencing. After the students completes the presentation task through video conferencing, the students feel satisfied in the learning process. Teaching learning by video conferencing gives new experiences to the students in hydrocarbon learning. This is what causes the students have the dominant self-efficacy in the good category.

The results of this study supported the previous study. A study conduct by Chen (2014) shows that perceived usefulness is said to be the degree in which an individual believes that using a particular technology would enhance their performance; whereas, perceived ease of use is the degree in which a person believes that using a particular technology would be free of effort. In addition, Abulibdeh and Hassan (2011) argued that the complex interaction deals with simulations and actual data that can promote student interest to persist in learning, and real time relates to interaction of students and lecturers online.

The Profile of Students' Self-Efficacy Based on Beliefs Aspect

Students with high self-efficacy can control themselves when the goal is not achieved, assume the failure occurs because the effort is not sufficient or lack of knowledge and skills that can be obtained, have confidence to succeed in teaching learning, and have a desire to continue to learn despite the external nor internal conditions does not support (Bandura, 1994; Eggen & Kauchak, 2010; Santrock, 2011; Zimmerman, 2000). Based on the results of this study, the students in E and CG-1 class who does not have facilities to apply hybrid learning still tryng to learn well. The students are trying to borrow school facilities or friends who have facilities that support hybrid learning. Students are able to carry out the learning well, despite the external conditions does not support. Although under limited conditions, students continue to strive to be able to carry out the learning activities very well. After the online phase of hybrid learning was done, the students feel be able to learn the teaching material delivered by the teacher.

In this case, the sense of technological self-efficacy, including computers, affects the students' decision to use computers and is not dependent on their beliefs on the value of using that technology. Research conducted by Uzuntiryaki (2008) shows the results that if students believe have the ability to complete certain tasks then the students have high self-efficacy. In addition, Pintrich and Schunk (2001) stated that if someone attributes the success of internal factors such as ability, then self-efficacy is improved, which might be reasonably useful for students with high self-efficacy.

The Profile of Students' Self-Efficacy Based on Performance Aspect

Teacher may increase students' self-efficacy beliefs in terms of performance through modelling. Successful students or scientists can be examples for students to accomplish tasks and develop efficacy beliefs (Uzuntiryaki, 2008). Social persuasion, within realistic limits, can lead to successful performance: individuals put extra effort into accomplishing tasks and their self-efficacy is enhanced. These students believed in their ability to use metacognitive strategies to accomplish a task, which may have shaped their self-efficacy beliefs. Abulibdeh and Hassan (2011) revealed that noting social interaction is among the skills needed to increase both performance and productivity of students.

Students with high self-efficacy tend to learn and achieve better than students who have low selfefficacy even though the students have the same ability. Among students with the same ability, students who believe they can do the task then he/she will be more successful than students who feel themselves unable to do the task. In short, there is a difference in academic performance between students with high self-efficacy compared with low self-efficacy although the ability of these students is similar (Ormrod, 2003; Eggen & Kauchak, 2010; Uzuntiryaki, 2008). Self-efficacy based on dominant performance aspects with good category in class E still relate to task orientation aspect. In the aspect of task orientation, students in class E believe that they can accomplish the task that teachers are given successfully than students in CG-1 class even though the ability of students in class E and CG-1 alike.



In this case, a person's self-efficacy and technological acceptance are also related to their online learning performances. Although the performance of two groups of students, those who were taught in the traditional classroom setting versus those who learned through a ICT based learning, showed no remarkable differences, the latter group reported higher computer self-efficacy and a greater sense of satisfaction with their learning process. The sense of control over the learning process influences a students' sense of self-efficacy in which people with a higher self-efficacy are more willing to tackle a difficult task rather than avoid it. Chen (2014) study result revealed that perceived usefulness is said to be the degree in which an individual believes that using a particular technology would enhance their performance.

Considering the role of self-efficacy beliefs in students' attitude towards their processes and outcomes, it is worth examining ways of increasing students' self-efficacy at all levels of education. Therefore, special attention should be given to the sources that shape self-efficacy beliefs. Further research on students' self-efficacy analysis about the application of technology in teaching learning still needed. The growing ICT can be utilized in technology-based learning process to create a new and interactive learning atmosphere. Application of technology as an interactive learning media needs to be developed and seen the impact on the students' self-efficacy. In addition to improving the students' self-efficacy, the use of technology in the learning process can improve teachers' selfefficacy. Therefore, the teachers' self-efficacy profile analysis in the learning process should also be further explored. One study conducted by Calik (2013) indicate that the use of technology can improve self-efficacy of teachers. ICT-based learning can improve the teachers' self-efficacy because it uses an asynchronous e-learning which make the teacher communicated with their peers, scholars and lecturer; and uploaded all related documents, such as animations, simulations, videos, cartoons. This reason make the teacher always tends to create a discussion board for topics/issues in the course. Such a unique learning environment, which differs from the other pre-service courses, may have engendered an increase in the chemistry teachers' self-efficacy. In addition, teachers' selfefficacy in this case needs to be assessed, because the teacher is someone who plays an important role in the learning process. Teachers with good self-efficacy will make the learning process well organized so that the self-efficacy of students increasing.

Acknowledgement: This work received financial support from the Kemenristek Dikti (Indonesian Directorate General of Higher Education) through "Tim Pascasarjana" Research Grant 2017.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



Fitriyana is a student of Chemistry Department, Graduate School, Yogyakarta State University, Indonesia. Her interest is a quantitative research in education including the implementation of various chemistry teaching method, teaching-learning media such as instructional technology in the chemistry classroom, and assessment in chemistry education.

Nur Fitriyana, S.Pd. Graduate School, Yogyakarta State University Yogyakarta – INDONESIA E. Mmail: <u>nur.fitriyana2016@student.uny.ac.id</u>



International Journal on New Trends in Education and Their Implications April 2018 Volume: 9 Issue: 2 ISSN 1309-6249



Wiyarsi is a lecturer and researcher in Chemistry Department, Faculty of Mathematics and Natural Science, Yogyakarta State University, Indonesia. Her interest of researcher are students' and teachers' self-efficacy, context-based learning in chemistry, Pedagogical Content Knowledge (PCK) of pre-service chemistry teacher, development of chemistry teaching material integrated vocational context.

Dr. Antuni WiyarsI, M.Sc. Faculty of Mathematics and Natural Science, Yogyakarta State University Yoogyakarta – INDONESIA E. Mail: <u>antuni w@uny.ac.id</u>



Sugiyarto is a lecturer and researcher in Chemistry Department, Faculty of Mathematics and Natural Science, Yogyakarta State University, Indonesia. Her interest of researcher are educational media development in chemistry teaching learning and has been uploaded in the playstore in the tittle of chemondro, misconception observed in chemistry textbooks and the users, students, and teachers.

Prof. Dr. K.H. Sugiyarto, M.Sc. Ph.D. Faculty of Mathematics and Natural Science, Yogyakarta State University Yoogyakarta – INDONESIA E. Mail: <u>sugiyarto@uny.ac.id</u>

REFERENCES

Abulibdeh, E. S., & Hassan, S. S. (2011). E-learning interactions, information technology self efficacy and student achievement at the University of Sharjah, UAE. *Australasian Journal of Educational Technology*, 27(6), 1014–1025.

Aiken, L. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and Psychological Measurement*, *45*, 131-142.

Azwar, S. (2016). *Reliabilitas dan validitas.* Yogyakarta: Pustaka Pelajar.

Bandura, A. (1994). Self-efficacy. In V.S. Ramachaudran (Ed),. *Encyclopedia of human behavior*, (vol.4, pp. 71-81). New York: Academic Press.

Calik, M. (2013). Effect of technology-embedded scientific inquiry on senior science student teachers' self-efficacy. *Eurasia Journal of Mathematics, Science & Technology Education, 9*(3), 223-232.

Chen, Y-L. (2014). A study on student self-efficacy and technology acceptance model within an online task-based learning environment. *Journal of Computers, 9*(1), 34-43.

Eggen, P., & Kauchak, D. (2010). Educational psychology. USA: Pearson Merril Prentice Hall.



Jabbour, K. K. (2014). An analysis of the effect of mobile learning on Lebanese higher education. *Informatics in Education, 13*(1), 1-15.

Jeng, Y. L., Wu, T. T., Huang, Y. M., Tan, Q., & Yang, S. (2010). The add-on impact of mobile applications in learning strategies: A review study. *Educational Technology & Society, 13*(3), 3-11.

Kaypak, E., Canbek, N. G., Bozna, H., & Tu, C. (2017). Mobile learning and MOOCs. *International Journal of Trends in Education and Their Implication, 8*(3), 1-8.

Kim, W. (2007). Towards a definition and methodology for blended learning. *Workshop on Blended Learning*, (pp. 1-8). Edinburgh.

Kurbanoglu , N. İ., & Akin, A. (2010). The relationships between university students' chemistry laboratory anxiety, attitudes, and self-efficacy beliefs. *Australian Journal of Teacher Education, 35*, 48-59.

Lawshe, C. (1975). A quantitative approach to content validity. *Personnel Psychology, 28*, 563-575. Mataka, L., & Kowalske, M. (2015). The influence of PBL on students' self-efficacy beliefs in chemistry. *Chemistry Education Research and Practice, 16*, 929-938.

Ormrod, J. E. (2003). *Educational psychology developing learners.* New Jersey: Pearson Merrill Prentice Hall.

Pandey, H., & Pande, P. (2014). Video conferencing: An efficient e-learning tool for distance education. *International Journal of Innovation and Scientific Research*, *10(2)*, 308-311.

Partridge, H., Ponting, D., & McCay, M. (2011). Good practice report: Blended learning. *Australian Teaching and Learning Council*, 81-85.

Pintrich, P. R., & Schunk, D. H. (2001). Motivation in education: theory, research, and applications. Englewood Cliffs, NJ: Merrill Prentice-Hall.

Santrock, J. W. (2011). *Educational psychology*. New York: The MC Graw-Hill Companies, Inc.

Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2010). *Motivation in education.* New Jersey: Pearson Merril Prentice Hall.

Tayebinik, M., & Puteh, M. (2012). Blended learning or e-learning? *International Magazine on Advances in Computer Science and Telecommunications, 3*(1), 103-110.

Tsai, C.-C., Chuang, S.-C., Liang, J.-C., & Tsai, M.-J. (2011). Self-efficacy in Internet-based learning environments: A literature review. Educational Technology & Society, *14*(4), 222–240.

Uzuntiryaki, E. (2008). Exploring the sources of Turkish pre-service chemistry teachers' chemistry self-efficacy beliefs. *Australian Journal of Teacher Education, 33*(6), 12-28.

Villafane, S. M., Xu, X., & Raker, J. R. (2016). Self-efficacy and academic performance in firstsemester organic chemistry: Testing a model of reciprocal causation. *Chemistry Education Research and Practice, 17*, 973-989.

Widoyoko, E. P. (2009). *Evaluasi program pembelajaran .* Yogyakarta: Pustaka Pelajar.



Woldeamanuel, M., Atagana, H., & Engida, T. (2014). What makes chemistry difficult? *AJCE, 4*, 31-43.

Woolfolk, A. (2007). Educational psychology. United States of America: Pearson Merril Prentice Hall.

Zhao, Y., & Breslow, L. (2013). Literature review on hybrid/blended learning. *Teaching and Learning Laboratories*, 1-22

Zimmerman, B. J. (2000). Self efficacy: An essential motive to learn. *Contemporary Educational Psychology*, 25, 82-91.



THE INFLUENCE OF 4MAT MODEL ON ACADEMIC ACHIEVEMENT AND RETENTION OF LEARNING IN TRANSFORMATION GEOMETRY

Resrch. Assist. Feyza Aliustaoğlu Kastamonu University, Educational Faculty Kastamonu- TURKEY

Assoc. Prof. Dr. Abdulkadir Tuna Kastamonu University, Educational Faculty Kastamonu- TURKEY

Abstract

This study investigates the influence of 4MAT model in the teaching of "Transformation Geometry" – a subject included in secondary school seventh grade mathematics curriculum - on students' academic achievement and retention of learning. 4MAT model, which is one of the contemporary educational approaches, is based on perceiving and processing knowledge. 4MAT model was designed by considering all of four learning styles in such a way that all learners could find a timeframe suitable for them. It defends developing student-centered learning environments based on the learning styles of students and making students discover knowledge by themselves. It enables students to use both hemispheres of their brains effectively (McCarthy, 1990). The pretest-posttest control group guasi-experimental design was used in the study. The study took 3 weeks. This teaching period was determined by considering the time recommended in the textbook and the time allocated for activities in other studies on 4MAT model. In this period, experimental group students were taught by lesson plans and activities based on 4MAT model. Control group students were taught by the 7th grade textbook of the Ministry of National Education in the same period. The research sample consisted of 61 seventh grade students living in a northern province of Turkey. The Transformation Geometry Knowledge Test developed by the researcher was used as data collection tool. This test was used in this study as a pre-test at the beginning of the teaching process, as a posttest at the end of the teaching process and as a retention test one month after the teaching process. The present study concluded that there was a significant difference in favor of the experimental group between the experimental group students and the control group students in terms of academic achievement and retention of learning in the learning of transformation geometry subject. It was seen that 4MAT model was more effective in the teaching of transformation geometry in comparison to textbook-based teaching.

Keywords: Mathematics education, 4MAT model, brain hemisphere, learning style, transformation geometry.

INTRODUCTION

As modern educational mentality has emerged, innovations have been introduced to teaching, and many models have started to be used in order to be more productive in education. One of these models is 4MAT model (McCarthy, 1982). McCarthy created 4MAT model through experimental studies carried out in a high school for 6 years (McCarthy, 1987). The 4MAT model has many similarities to Kolb's learning style model in terms of perception and processing of information. In both models, individual's perception of the information ranges from concrete experience to abstract conceptualization and processing of the information ranges from reflective observation to active experimentation, see Figure 1 (McCarthy, 1982, 1990, 2000).



Figure 1: Learning cycle (McCarthy, 1990)

Through experimental studies, McCarthy determined the learning styles as a combination of an individual's perception and processing of the information as follows (see Figure 2):

- type 1 learners (imaginative learners);
- type 2 learners (analytic learners);
- type 3 learners (common-sense learners); and
- type 4 learners (dynamic learners) (McCarthy, 1987, 1990, 1997; Morris & McCarthy, 1999).



Figure 2: McCarthy's 4MAT model (McCarthy, 1990)

Concrete Experience



The priorities of the imaginative learners are personal meaning. Teachers need to create a reason for their students and answer "Why?" question. The priorities of the analytic learners are phenomena that will provide conceptual meaning. Teachers should give cases to students to deepen their understanding and answer "What?" question. The priorities of the common-sense learners are to know how things work. Teachers should give their students an opportunity to do this and answer "How?" question. And lastly, the priorities of the dynamic learners are personal exploration and adapt their learning to them. Teachers should give their students an opportunity to provide personal exploration and answer "If?" question (McCarthy, 1997).

Since mathematics is an abstract course, non-use of appropriate methods and techniques may cause students to wrongly feel that mathematics is not used in the daily life, and mathematics is limited to textbooks alone. To prevent that, it must be made clear that mathematics is an enjoyable course that both contributes to the development of individuals and provides them with such skills as questioning and establishing cause and effect relations. That can be achieved by visualizing and concretizing subjects as much as possible, including all students in lessons actively, and implicating the link of mathematics with real life in lessons (Altun, 2006). Besides, one of the main reasons for low mathematics (Ersoy, 1997). 4MAT model, which is one of the contemporary educational approaches, is based on perceiving and processing knowledge. It defends developing student-centered learning environments based on the learning styles of students and making students discover knowledge by themselves. It enables students to use both hemispheres of their brains effectively (McCarthy, 1990). Thus, it is recommended to be used in mathematics lessons.

4MAT model does not only consist of a cycle that is based on Kolb's experimental learning model. In consideration of neurological studies, McCarthy also stated that the dominant hemisphere used by individuals in the information processing process (i.e. right or left hemisphere) had to be considered (McCarthy, 1990). To achieve meaningful learning, the integrity of new information must be seen and such information must be associated and constructed with the existing information in the mind that has been learned before. That is possible only if brain functions are used as a whole. The research on the functions of right and left hemispheres of brain generally describes left hemisphere as serial, logical, rational, verbal, analytic, and systematic. Analysis and planning strategies are adopted. The result is important and problems are solved by looking at the parts (McCarthy, 1990). The right hemisphere, on the other hand, is visual, universal, and holistic. It can see the connections between pieces. It solves the problem by looking at the big picture (i.e. the whole) and considers the whole more important than all parts (McCarthy, 1990).

4MAT model was designed by considering all of four learning styles in such a way that all learners could find a timeframe suitable for them. Training should be conducted to address all four regions of the learning cycle so that all students can be successful and not only limited to one region but also to improve all learning abilities. Thus, students do not only succeed in their own learning style regions but also learn a lot from each other in other regions of the cycle. To this end, McCarthy developed an eight-step lesson plan (McCarthy, 2000). Each step of this eight-step model addresses a different hemisphere of the brain. Such steps are as indicated in Figure 3 (McCarthy, 1990; Morris & McCarthy, 1999).



Figure 3: 4MAT model and eight steps (McCarthy, 1990; Morris & McCarthy, 1999)

Transformation geometry is an abstract subject included in the mathematics curriculum with an amendment introduced by the Ministry of National Education in 2005 (MoNE, 2006). Therefore, studies on transformation geometry in Turkey are limited and studies to be done are important. Research on transformation geometry has mostly focused on the computer-supported teaching of this subject and compared traditional teaching with computer-supported teaching. (Dixon, 1995; Glass, 2001; Altın, 2012; Sarı, 2012; Özyaşar, 2013). However, it is thought that attention should also be focused on the teaching of transformation geometry through other contemporary learning approaches, and 4MAT model is one of these approaches. Additionally, when reviewing the "4 MAT 4 geometry teacher book" (McCarthy, 2010), it appears that the 4MAT model is suitable for teaching the subject of transformation geometry. However, there isn't any study about the application of 4MAT model to transformation geometry subject.

In this research, reflection symmetry topic will be investigated from the topics of transformation geometry. The concept of symmetry is an important concept that individuals need to organize things and events in their environment and to develop qualitative perceptions about the outside world (Knuchel, 2004). NCTM (1991) notes that the concept of symmetry is a necessary mental tool for analyzing mathematical situations. There are many reasons why symmetry is important. The first of these is the need for symmetry to recognize the environment we have experienced. The second reason is that the concept of symmetry is included in mathematics curricula at every level from primary education to university. In addition, the information about symmetry has great importance for the teaching of many subjects in the context of analytic geometry, plane and space geometry (Aksoy & Bayazit, 2014). The concept of symmetry also has an interdisciplinary function. Many professions, such as biologists, chemists and physicists use the concept of symmetry et al., 2002; Whiteley, 2004).

The literature review about 4MAT model shows that most studies compare the effects of traditional teaching methods and those of 4MAT model on student achievement in different lessons. There are studies that examine the impact of 4MAT model on academic success in science lesson (Aktaş, 2011;



Delaney, 2002; Mutlu, 2004), in middle school mathematics lesson (Ardıç, 2013; Dikkartın, 2006, Uysal, 2009), in high school mathematics lesson (Peker, 2003), in geography lesson (Demirkaya, 2003; Kofoğlu, 2014), in physics lesson (Ergin, 2011), in history lesson (Öztürk, 2007), in microbiology lesson (Jackson, 2001). Some researchers, on the other hand, deal with the influence of 4MAT model on the retention of what is learned in addition to academic achievement (Ardıç, 2013; Jackson, 2001; Uysal, 2009).

When looking at the researches done it is seen that fewer studies have been conducted on 4MAT model in Turkey in comparison to those conducted abroad. Moreover, while research on 4MAT model has been conducted abroad for a long time, research on this subject has just started in Turkey. In addition, studies on the 4MAT model in mathematics are few and also there are very few studies examining the impact of the 4MAT model on academic achievement and retention of learning together in mathematics subjects. Therefore, it is thought that the research to be done on this model has great importance.

Research Problem

This study was carried out in order to determine the influence of 4MAT model on the learning of transformation geometry. The problem of the present study is as follows: "Does the use of 4MAT model in teaching 'Transformation Geometry' in the middle school 7th-grade mathematics course have any influence on student achievement and the retention of what is learned?" In this regard, an attempt was made to answer the below-mentioned questions;

- 1. Is there any significant difference between the influence of teaching by 4MAT model and teaching based on the textbook on students' academic achievement on transformation geometry subject?
- 2. Is there any significant difference between the <u>influence</u> of teaching by 4MAT model and teaching based on the textbook on the retention of knowledge on transformation geometry subject?

METHOD

Research Model

The pretest-posttest control group quasi-experimental model was employed in the study. The subjects were subjected to measurement both before and after the experimentation. The subjects were divided into two groups: experimental and control group. Because the classes were formed by the school management, it was not possible for the students to be placed on the experimental and control groups randomly. One of the previously formed classes was assigned to the experimental group and the other to the control group.

Sample

The sample of the research consisted of 61 seventh grade students living in a northern province of Turkey. The distribution of the study group is provided in Table 1 given below.

Group	Female	Male	Total	
Experimental group	21	11	32	
Control group	16	13	29	
Total	37	24	61	

Table 1: The Number of Students in the Experimental and Control Groups

As is seen in Table 1, the study group consisted of 61 students in total. It was decided that the groups were equal to each other by looking at the mathematics lesson success scores in previous years and the mathematics averages in examinations made by the Ministry of National Education. Additionally, pre-test mean scores obtained by the achievement test were analyzed and it was seen that groups are equivalent.



Application

The lessons were completed in the total of 8-course hours, each of 40 minutes. The duration was determined by considering the recommended duration for this achievement in the secondary school mathematics curriculum and the durations suggested in the lesson plans developed based on the 4MAT model. The teaching experience in both groups was done by two teachers who graduated from Primary Mathematics Education Department. They had the same experience in mathematics teaching and were of the same age. The teacher who is teaching in the experiment group had the knowledge and expertise about the 4MAT model.

Experimental group teaching: Experimental group students were taught by lesson plans and activities based on 4MAT model. Lesson plans based on 4MAT model were prepared by examining the books entitled "4 MAT 4 Algebra" (McCarthy, 2007) and "4 MAT 4 Geometry Activity Book" (McCarthy, 2010) and receiving expert opinions. A sample lesson plan is presented in Appendix 1.

Control group teaching: Control group students were taught by the 7th grade textbook of the Ministry of National Education in the same period. This teaching period was determined by considering the time recommended in the textbook and the time allocated for activities in other studies on 4MAT model. Generally, question-answer, display techniques were used and the teacher was more active than students. First of all, the teacher explained the subject on the board. After doing the teaching, the teacher asked the students various questions about the subject. Some students were able to answer the questions, and some could not answer correctly. The activities in the textbook were done by the students with the guidance of the teacher. Some of the questions in the book were given to students as homework. The next lesson teacher solved the questions students could not solve. Then the teacher taught the new subject similarly.

Data Collection Tools and Data Analysis

The research data were obtained through The Transformation Geometry Knowledge Test. This test was used in this study as a pre-test at the beginning of the teaching process, as a post-test at the end of the teaching process and as a retention test one month after the teaching process. 35 questions were prepared based on previous years' central exam questions and the questions from various sources. To determine its validity and reliability, the test was administered to 118 eighth grade students as a pilot study. Cronbach's Alpha coefficient was used a criterion of reliability. It is considered that a Cronbach's Alpha reliability coefficient which is not less than 0.70 is generally enough for accepting that test scores are reliable (Büyüköztürk, 2008). The Cronbach's Alpha reliability coefficient of The Transformation Geometry Knowledge Test was found to be 0.754.

The validity of the knowledge test and the difficulty of the questions were examined by SPSS (Statistical Package for the Social Sciences). The test was finalized to consist of 30 questions based on reliability, validity, and difficulty criteria as well as expert opinions. Thus, it was ready for administration to both groups as the pre-test, post-test and retention test.

RESULTS

Results Related To First Sub-Problem

An ANCOVA test was used for determine is there any significant difference between the influence of teaching by 4MAT model and teaching based on the textbook on students' academic achievement on transformation geometry subject. ANCOVA hypotheses were examined for achievement test in the first place. Since all ANCOVA hypotheses were confirmed, whether or not there was any significant difference between the posttest scores of the groups adjusted based on the pretest scores was analyzed through the ANCOVA test. The analysis results are given in Table 2.



Group	Original Mean	Adjusted Mean
Experimental	14.16	14.90
	Pretest	
Control	15.72	14.90
Experimental	21.22	21.70
	Posttest	
Control	18.55	18.02

T A T A		C			<u> </u>	~
Table 2: The Ad	justed Scores d	of the Exi	perimental	and	Control	Groups

As is seen in Table 2, while the original pretest score of the experimental group was 14.16, that of the control group was 15.72. On the other hand, while the original posttest score of the experimental group was 21.22, that of the control group was 18.55. The adjusted means indicated that the pretest scores became equal at 14.90, and the posttest scores were recalculated to be 21.70 for the experimental group and 18.02 for the control group. Figure 4 presents the pretest and the posttest scores of the experimental and control groups.



Figure 4: The pretest and the posttest scores of the experimental and control groups

Table 3 shows the ANCOVA results of the posttest scores adjusted based on the pretest scores by groups.

Group	Sum of Squares		sd	Mean Square	ean Square			Р
					F			
Pretest	512.213	1		512.213		37.302		.000
Group	199.496	1		199.496		14.528		.000
Error	796.428	58		13.732				
Total	25697.000	61						

Table 3: The Ancova Results of the Posttest Scores Adjusted based on the Pretest Scores by Groups

As is seen in Table 3, the ANCOVA results showed that there was a significant difference in favor of the experimental group between the posttest average scores of the experimental and control groups students adjusted based on the pretest scores [F(1.58)=14.528, p<.05]. The results demonstrated that the experimental group students have a higher-level academic achievement in



comparison to the control-group students. Based on these results, it can be said that teaching involving 4MAT model is more effective than teaching based on the textbook.

Results Related To Second Sub-Problem

An ANCOVA test was used for determine is there any significant difference between the influence of teaching by 4MAT model and teaching based on the textbook on the retention of knowledge on transformation geometry subject. ANCOVA hypotheses were examined for achievement test in the first place. Since all ANCOVA hypotheses were confirmed, whether or not there was any significant difference between the posttest scores of the groups adjusted based on the pretest scores was analyzed through the ANCOVA test. The analysis results are given in Table 4.

Table 4: The Adjusted Scores of the Experimental and Control Groups

Group	Original Mean	Adjusted Mean
Experimental		14.16
14.90		
	Pretest	
Control		15.72
14.90		
Experimental		21.66
22.07		
	Retention test	
Control		18.52
18.06		

As is seen in Table 4, while the original pretest score of the experimental group was 14.16, that of the control group was 15.72. On the other hand, while the original retention test score of the experimental group was 21.66, that of the control group was 18.52. The adjusted means indicated that the pretest scores became equal at 14.90, and the retention test scores were recalculated to be 22.07 for the experimental group and 18.06 for the control group. Figure 5 presents the pretest and the retention test scores of the experimental and control groups.



Figure 5: The pretest and the retention test scores of the experimental and control groups

Table 5 shows the ANCOVA results of the posttest scores adjusted based on the pretest scores by groups.



Table 5:The	e Ancova Results of th	ne Posttes	t Scores Adjusted based	d on th	ne Pretest Scores by Groups
Group	Sum of Squares	sd	Mean Square	F	Р

Group	Sum of Squares	30	Fican Square			1
Pretest	385.524	1	385.524		23.714	
				.000		
Group	237.923	1	237.923		14.635	
				.000	1	
Error	942.936	58	16.258			
Total	26280.000	61				

As is seen in Table 5, the ANCOVA results showed that there was a significant difference in favor of the experimental group between the retention test average scores of the experimental and control groups students adjusted based on the pretest scores [F(1.58)=14.635, p<.05].

When two groups starting to learn in equal conditions are compared at the end of a certain period, the group with a higher average is deemed to have achieved more permanent learning. The results demonstrated that in transformation geometry subject, the experimental-group students taught through 4MAT model have more permanent learning in comparison to the control-group students taught based on the textbook. Based on these results, it can be said that teaching involving 4MAT model is more effective than teaching based on the textbook.

DISCUSSION AND CONCLUSION

The present study concluded that there was a significant difference in favor of the experimental group between the experimental group students and the control group students in terms of academic achievement in the learning of transformation geometry subject. The research result is similar to those of many studies in the literature. As in this study, in many of the researches, subjects taught experimental groups by 4MAT model and control groups by use of textbooks based on traditional lecture and question-answer teaching. In most of the studies, similar to this study, it was seen that experimental groups were significantly more successful than control groups. When we examined according to the lessons, 4MAT model has a significant impact on science achievement (Aktaş, 2011; Mutlu, 2004), on mathematics achievement (Ardıç, 2013; Dikkartın, 2006; Peker, 2003; Uysal, 2009), on geography achievement (Demirkaya, 2003; Kofoğlu, 2014), on physics achievement (Ergin, 2011), on history achievement (Öztürk, 2007) and on microbiology achievement (Jackson, 2001). Contrary to these studies, in the work of Delaney (2002) and Lee (2008) there was no significant difference in academic achievement between the experimental and control group students.

When we look at the research that examines the effect of the 4MAT model on the retention of learned topics, as in this study, it has been seen that teaching based on 4MAT model is more effective than traditional teaching at achieving permanent learning (Ardıç, 2013; Jackson, 2001; Uysal, 2009). Looking at these results, it can be concluded that 4MAT model is effective in practice. Based on these research results, the following suggestions have been made.

- Failure in addressing all students and teaching based on just one method cause us to fail to reach intended success in the mathematics course. Since 4MAT model takes into consideration individual differences and provides the diversity of methods and activities, it may be used in the classroom environment effectively.
- Mathematics teachers may teach transformation geometry subject based on 4MAT model rather than sticking to textbooks alone.
- Prospective teachers should be informed of 4MAT model and other methods based on learning styles in the faculties of education so that they can employ such models in their future professional lives.



• The effect of 4MAT model on academic achievement may be investigated in subjects other than transformation geometry and in grades different from the 7th grade as well as at different levels and in different sub-learning fields.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



Feyza Aliustaoğlu is a Research Assistant at Kastamonu Univesity, Educational Faculty Mathematics Education, Turkey. She is a PhD student at Kastamonu University Mathematics Education. Her study areas are Mathematics Education, 4MAT Learning Model and Pedagogical Content Knowledge.

Resrch. Assist. Feyza Aliustaoğlu Kastamonu University, Educational Faculty Kastamonu- TURKEY E. Mail: <u>fdemirci@kastamonu.edu.tr</u>



Abdulkadir Tuna is an Assoc Professor Dr. at Kastamonu Univesity, Educational Faculty Mathematics Education, Turkey. He received Ph.D in Mathematics Education from Gazi University. His study areas are Mathematical Thinking and Learning, Mathematics Education and 5E Learning Model.

Assoc. Prof. Dr. Abdulkadir Tuna Kastamonu University, Educational Faculty Kastamonu- TURKEY E. mail: atuna@kastamonu.edu.tr

REFERENCES

Aksoy, Y., & Bayazit, İ. (2014). An analytical approach to the difficulties encountered in the teaching and learning of the concept of symmetry. E. Bingölbali & M. F. Özmantar (Ed.) *Mathematical difficulties encountered in primary education and solution proposal.* (pp. 187- 215). Ankara: Pegem Akademi Yayınevi.

Aktaş, İ. (2011). *The effect of the 4MAT system on the 7th grade students' the success in structure and properties of matter unit, motivaton toward science and technology course and learning styles* (Unpublished master dissertation). Mustafa Kemal University Institute of Social Sciences, Hatay.

Altın, S. (2012). *The effect of computer aided transformation geometry instruction on 8th grade students' mathematics success and attitude* (Unpublished master dissertation). Eskişehir Osmangazi University Institute of Education Sciences, Eskişehir.

Altun, M. (2006). Developments in mathematics education. *Uludağ University* Faculty of Education Journal, *19*(2), 3.

Ardıç, E. Ö. (2013). *The effect of 4MAT instruction model on teaching geometrical objects topic of the 8th grade* (Unpublished master dissertation). Karadeniz Teknik University Institute of Education Sciences, Trabzon.



Barry, A. M., Berry, D., Cunningham, S., Newton, J., Schweepe, M., Spalter, A., ... & Williams, R. (2002). Visual learning for science and engineering. In *Visual Learning Campfire Symposia Program, ACM SIGGRAPH and Eurographics co-sponsored*. Snowbird, Utah.

Büyüköztürk, Ş. (2008). *Scientific research methods.* Ankara: Pegem Academy.

Delaney, A. (2002). *Better teaching model? Middle school science classroom using the 4MAT instructional strategy vs. lessons created without this model* (Unpublished master dissertation). University of North Texas, USA.

Demirkaya, H. (2003). *In geography teaching, the effect of 4MAT teaching system on the success and attitudes in high school geography lessons* (Unpublished doctoral dissertation). Gazi University Institute of Education Sciences, Ankara.

Dikkartın, F. T. (2006). *The effects of the 4MAT educaiion model on the student success and attitude at the geometry education* (Unpublished master dissertation). Balıkesir University Institute of Sciences, Balıkesir.

Dixon, J. K. (1995). Limited English proficiency and spatial visualization in middle school students' construction of the concepts of reflection and rotation. *The Bilingual Research Journal*, *19*(2), 221-247.

Ergin, S. (2011). Effects of the 4MAT instruction method on the achievement of high school students with different learning styles on the subjects of work, power and energy in physics education (Unbuplished doctoral dissertation). Gazi University Department of Physics Education, Ankara.

Ersoy, Y. (1997). Trends in mathematics education, *Contemporary Education*, 230(22), 11-13.

Glass, B. J. (2001). Implication *of* geometric transformations in the multiple dynamically linked representations. *Dissertation Abstract International, 62*(3), 951.

Jackson, P.R. (2001). *The effects of teaching methods and 4MAT learning styles on community college students' achievement, attitudes and retention in introductory microbiology* (Unpublished doctoral dissertation). The Lynn University, ABD.

Kofoğlu, T. R. (2014). *The effect using 4MAT training system in success of 11th grade stuudents in Geography class* (Unpublished master dissertation). Gazi University Institute of Educational Sciences, Ankara.

Knuchel, C. (2004). Teaching symmetry in the elementary curriculum. *The Montana Mathematics Enthusiast, 1*(1), 3-8.

Lee, A. D. (2008). *Teaching and learning the cycle: an experiential model for intercultural training for cross-cultural kids* (Unpublished doctoral dissertation). Biola University, USA.

McCarthy, B. (1982). Improving staff development through CBAM and 4MAT. *Educational Leadership*, *40*(1), 20-25.

McCarthy, B. (1985). What 4MAT training teaches us about staff development. *Educational Leadership*, *42*(7), 61-68.

McCarthy, B. (1987). *The 4MAT system, teaching to learning styles with right/left mode techniques.* Barrington: Excel.

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org



McCarthy, B. (1990). Using the 4MAT System to bring learning styles to schools. *Educational Leadership, 48*(2), 31–37.

McCarthy, B. (1997). A tale of four learners: 4MAT's learning styles. *Educational Leadership, 54*(6), 46–51.

McCarthy, B. (2000). About Teaching 4MAT in the classroom. Wauconda, IL: About Learning, Inc. Access Date: 15 June 2017, <u>http://www.amazon.com/About-Teaching-Classroom-Bernice-McCarthy-ebook/dp/B003X4KY24</u>

McCarthy, B., & McCarthy, D. (2003). *About teaching companion: The 4MAT implementation workbook*. Wauconda, Illinois: About Learning.

McCarthy, B. (Ed.). (2007). *4 MAT 4 algebra: The system of mathematics.* Wauconda, Illinois: About Learning.

McCarthy, B. (Ed.). (2010). 4 MAT 4 geometry teacher book. Wauconda, Illinois: About Learning.

Ministry of National Education. (MoNE, 2006). *Elementary mathematics (6-8. classes) curriculum.* Ankara, Turkey: Author.

Morris, S., & McCarthy, B. (1999). *4MAT in action*. Barrington: Excel Inc.

Mutlu, M. (2004). The effect of the 4MAT teaching model on students' attitudes and success in *science lesson during teaching photosynthesis–cellular respiration subject of a 8th grade science lesson* (Unpublished doctoral dissertation). Gazi University Institute of Education Sciences, Ankara.

National Council of Teachers of Mathematics. (NCTM, 1991). *Professional standarts for teaching mathematics.* Reston: VA.: NCTM.

Öztürk, Z. (2007). *Learning styles and the effect of teaching based on 4MAT model on the student success for high school history lesson* (Unpublished doctoral dissertation). Gazi University Institute of Education Sciences, Ankara.

Özyaşar, A. (2013). *Investigation of some variables effect on transformational geometry abilities of seventh grade students* (Unpublished master dissertation). Adıyaman University Institute of Sciences, Adıyaman.

Peker, M. (2003). *The effects of learning styles and 4MAT method on students' attitudes and achievement in mathematics* (Unpublished doctoral dissertation). *Gazi University* Institute of Education Sciences, Ankara.

Sarı, H. (2012). *Primary 7th grade mathematics courses teaching the learning area of the lower of dynamic geometry using the software of the rotation geometry with geometer's sketchpad and geogebra to compare the effects on students' success and permanency of learning* (Unpublished master dissertation). Gazi University Institute of Education Sciences, Ankara.

Uysal, F. (2009). *To the students' success the effect of the 4MAT learning styles model at teaching of "fractions" in maths in 6th grade of elemantary* (Unpublished master dissertation). Gazi University Institute of Education Sciences, Ankara.



Whiteley, W. (2004). Visualization in mathematics: Claims and questions towards a research program. *Unpublished Manuscript Presented at the 10th International Congress on Mathematics Education.* Copenhagen, Denmark.

Appendix 1. Sample Lesson Plan based on 4MAT Model

Acquisition: Explains reflection

1st Quarter (Connecting the Concept with the Self) 1st Step (Connect)

Studenst are provided with an opportunity to have personal experience so that they can establish a bond with the subject.

Objective: To enable students to establish a bond with the subject by giving examples from daily life.

Activity: Students sit in groups. They are asked to write their opinions on paper together with group members. Then they are told that the opinions noted by them will be discussed in the class.

Photos about reflection are brought to the classroom. Students are requested to examine photos in Figure 6.



Figure 6: Photos about reflection

The following questions are asked: "What sorts of similarities and differences are there between ourselves and our images in the mirror?" and "What change and what remain unchanged in the reflection?". In addition, the question, "Why is the word 'ambulance' written backwards on ambulances?" is asked. Students write their opinions in groups of 4.

Photos about symmetry in Figure 7 are showed. Students are asked to give examples. The relationship between symmetry and reflection is questioned.



Figure 7: Photos about symmetry

Do you think there is symmetry in daily life?

Students are made to play the mirror game. They are made pairs. One student plays the role of a person looking in the mirror, and the other student plays the role of the image of this person in the mirror. The student looking in the mirror acts in some ways, and the student playing the role of the image tries to act in the same ways by considering the images of such acts in the mirror. For example, when the student looking in the mirror raises his right hand, left hand must be raised by the student playing the role of the image.

Students' attention is attracted by showing games about reflection.

2nd Step (Attend)

The experience created in the previous step is analyzed.



Objective: To enable students to analyze the experience in the first step by discussing.

Activity: Classroom discussion organized by teacher is made.

Students examine photos about reflection and discover that a reflection is the image of a figure with respect to a specific reference point.

It is discovered that our image in the mirror is the same as us, and the difference is that our image in the mirror is our reflection. Mirrors show written things backwards. So, when the driver of a car followed by an ambulance looks at the ambulance by using the rear-view mirror, reads the word "ambulance", which is written on the ambulance backwards, normally. That is, s/he reads it as "ambulance" and gives way to the ambulance depending on his/her humanity. Students are made to find out why the word "ambulance" is written backwards and understand that reflection is employed on this occasion.

Based on the symmetry photos examined, students are made to find out that reflection is the symmetry of an object with respect to a line. Students are requested to find the lines of symmetry of butterfly and human face.

It is concluded that the student playing the role of image in the mirror does the opposite of the person looking in the mirror as our image in the mirror is the opposite of us.

Students' opinions in regard to the symmetry game in the internet are received.

2nd Quarter (Concept Formulation) 3rd Step (Imagine)

Ideas are conceptualized in this step.

Objective: To enable students to see the relationship between the concepts "symmetry" and "reflection" and visualize the concept "symmetry of figure with respect to a line".

Activity: Students are made to find the symmetries of letters and figures by using the symmetry mirror. Symmetrical and nonsymmetrical letters are drawn. By using the symmetry mirror, it is discussed which letters are symmetrical and which ones are asymmetrical (see Figure 8).



Figure 8: Photos about symmetry mirror

Isometric dot paper is covered with gelatin. The symmetry mirror is put in the middle of it. Figures are made out of multi-squares, and the symmetries of these figures are found by use of the symmetry mirror. In this way, reflection is acquired by regarding the symmetry mirror as the line of symmetry. Triangle, quadrangle, and circle models are drawn, and the concepts "symmetry" and "reflection" are understood by using the symmetry mirror. It is concluded that the image turns down when the symmetry is being taken in the models used and the drawings made. The mirror symmetry is reflection with respect to a line.


The images of the figures, letters, and words in the mirror are examined by putting a symmetry mirror next to and over them. In this way, symmetry is found.

Regular polygons are made by cutting paper, and students are asked to find the number of symmetry axes through folding (see Figure 9).



Figure 9: Students' studies about symmetry axes

Every group folds the paper in two. They draw a model and cut it. They open the figure, put a pencil between two sides, and regard it as line of symmetry. In this way, symmetry is understood. The same model is used when explaining how to find the symmetry of a symmetry. In this case, the paper is folded in three (see Figure 10).



Figure 10: Students' studies about reflection over a pair of parallel lines

4th Step (Inform)

Teacher gives information about the subject.

Objective: To define the concept reflection; to find the symmetries of figures and their reflections with respect to a line.

Activity: Teacher conducts the lesson where information about the subject area is to be given.

It is explained that the concepts "mirror symmetry", "reflection", and "symmetry with respect to a line" have the same meaning, that a figure and its reflection are equivalent, and that the form and the size of a figure do not change in reflection, and only the figure becomes reverse and changes place. The concepts "horizontal symmetry" and "vertical symmetry" are explained. Examples can be given from the symmetry axes of letters. The symmetry axes of regular polygons are focused on. It is demonstrated that symmetry with respect to a line is found by determining points on the figure and drawing perpendicular lines from such points to the symmetry axis.

3rd Quarter (Practice and Personalization) 5th Step (Practice)

The defined concepts are practiced.

Objective: To practice upon reflection under the guidance of teacher.

Activity: Isometric paper is reflected on the board by a projector; figures are drawn on it; and students are made to find the symmetries of these figures. Students find such symmetries by drawing the figures on their notebooks. Students are made to solve problems for practice.

Figures are created on the geometry board by use of rubbers. Students are made to find their reflections on the axes. The figures are created on a geometry board. Their symmetric images are obtained on other geometry boards. (see Figure 11).





Figure 11: Reflection examples in geometry board

Students are asked to create symmetrical figures on the paper by using colored pencils and to find symmetry lines. Evaluations are made in regard to which ones are symmetrical and which ones are non-symmetrical (see Figure 12).





Simple reflection practices are made by Geogebra program in the computer.

6th Step (Extend)

By using their current knowledge, students add to what have they learned in the previous step. **Objective:** To enable students to internalize what they have learned about reflection.

Activity: Students are made to solve higher-level problems for practice.

High-level practices are made in regard to reflection by Geogebra. Billiards games and problems such as those involving shortest distance between cities that require the use of reflection are assigned to 4-person groups as a project (see Figure 13).



Figure 13: Students' activities on reflection in the geogebra program

4th Quarter (Integrating Application and Experience) 7th Step (Refine)

Practices are analyzed by students.



Objective: To enable students to analyze the practices about reflection.

Activity: Practices in the steps 5 and 6 are analyzed in terms of relevance and usefulness. Every group evaluates the works of other groups. In regard to their projects, they ask questions to one another and receive the opinions of one another.

8th Step (Perform)

Students share what they have learned with their classmates.

Objective: To provide students with an opportunity to explain what they have learned to one another.

Activity: Based on the criticisms, group works are made the best. Teacher evaluates projects according to a rubric. Projects are hung in the classroom. Students present their projects to the classroom. In this way, every student can see all projects. If possible, projects are exhibited in the website.

Students are requested to create a mathematics journal where they will write their opinions about this mathematics lesson.



WHY ARE THEIR MATHEMATICAL LEARNING ACHIEVEMENTS DIFFERENT? RE- ANALYSIS TIMSS 2015 DATA IN INDONESIA, JAPAN AND TURKEY

K. Kartianom Universitas Negeri Yogyakarta Graduate School Yogyakarta- INDONESIA

Dr. Heri Retnawati Universitas Negeri Yogyakarta Mathematics and Science Faculty Yogyakarta- INDONESIA

Abstract

This study aims to describe students' mathematics achievement influencing factors in Indonesia, Japan, and Turkey at the student level and by school level with the use of TIMSS data 2015. The sample used in this study is the fourth grade of elementary school students from 3 countries participating in TIMSS 2015, namely Indonesia (N=3967), Japan (N=4307), and Turkey (N=5974). The findings indicated that there is no dissimilarity in mathematics learning achievement among students in Indonesia, Japan, and Turkey. The students' self-concept of mathematics proved itself a significant factor influencing their learning achievement across Indonesia, Japan and Turkey, while school climate factors only significantly affects the students' mathematics learning achievement in Indonesia and Turkey. The results also show the benefit of students mathematics self-concept to be formed or inculcated early (before elementary school) through positive school climate, because both have a positive contribution on student learning achievement in mathematics. In general, it can be concluded that the affective characteristics (student mathematics self-concept) and independent factors by the level of school (school climate) can only explain a small variance of achievement of student in learning mathematics.

Keywords: Mathematics, TIMSS, Multilevel Linear Model (MLM).

INTRODUCTION

TIMSS is a mathematics and science-based international assessment targeting elementary school fourth graders and of junior high school 8th graders. TIMSS has entered its sixth session after it was held in 1995, 1999, 2003, 2007 and 2011. TIMSS is a project organized by an international teamwork which is independent but work together with a national educational research institute devoted to improving the successfulness of education. TIMSS 2015 was followed by 70 countries, whereas in 2011, TIMSS was followed by only 63 countries. Countries around the world are participating in TIMSS activities because they are aware of the benefits of information from TIMSS results aimed at improving the education quality. For example, the 2011 TIMSS report provided important information that there were many factors that might affect student achievement, including student background, attitudes of student towards scientific subjects, teaching staff and educational workshop, and class characteristics (Mullis, 2013). It can be made clear that the utilization of TIMSS result is very helpful to the government in determining education policy which should be put forward to education quality.

The 2015 TIMSS results provided information that students in countries located in East Asian (Singapore, South Korea, Hong Kong, Taiwan, and Japan) had high learning scores of performance (Mullis et al., 2012). However, interesting information was obtained when achievement in mathematics along East Asia so that students affective factors, such as students' attitudes in



Japanese toward low mathematical achievement. In contrast, students from both grades in Indonesia and Turkey had shown a very high attitude toward mathematics. In grades 4 and 8, the achievement of students' mathematics learning achievement in both countries in TIMSS 2015 is inversely proportional, both of which are in 10 categories that are considered very low, either (Mullis et al., 2012). Meanwhile, some previous research results that also utilize TIMSS data precisely proved that student background and their affective factors, like self-concept, confidence, etc. have an effect on their mathematics learning performance. Moreover, it churns out that the students' mathematics learning achievement differences are also influenced by school factors, such as economic status, social and school culture, school climate, etc. (Lamb & Fullarton, 2002; Lüdtke et al., 2009). Therefore, students' mathematics differences in learning achievement across the three countries is indicated by the influence of factors linked to student and school.

Mathematics a obligatory subject in every school curriculum and has a very strong correlation with self-concept of mathematics (M-SC) (Antunes & Fontaine, 2007). M-SC is one's view of himself (Shavelson, Hubner, & Stanton, 1976). If associated with mathematics, M-SC can be meant as a person's view of his competence in mathematics. Self-concept becomes very important, because of its relationship with various academic results, one of which is achievement of students (Huang, 2011). High student mathematics achievement cannot be separated from the influence of students' attitudes toward positive mathematics (Caputo, 2015). Male students show self-concept that is higher in mathematics learning than female students, but the difference is not very significant (Antunes & Fontaine, 2007). Moreover, the students' self-concept in mathematics also knows a significant correlation with students' attitudes about mathematics (M-ATT) (Alkharusi, 2010). Hence, students' attitude, whether negative or positive attitudes, has relationship with students' M-SC.

Attitude is a person's intention to choose or dislike something, a person's tendency to engage or avoid an activity, a belief assumes a person's good or bad, and one's belief assumes something useful or useless (Neale, 1969). It can be understood that 3 components related to attitude, namely affective, cognitive, and behaviour (Can et al., 2017). In relation to mathematics, attitudes are more focused on student behaviour to accept or reject mathematics. Based on the relationship between students' attitudes toward student achievement is also positively significant (Alkharusi, 2009). Student attitudes are also part of contributing factors in explaining students' mathematics learning achievement is associated with positive-negative students' attitudes, and high-low index of positive-negative attitude of students becomes the cause of high-low student mathematics' learning achievement.

There is no certain definition climate in school (SCM) (Boulifa & Kaaouachi, 2015). SCM can be interpreted as school effect, and also can be understood as class effect and teacher effect (Brault, 2004). SCM, however, can be illustrated through strict curriculum objectives, effective teachers, competent students, parents support, sense of security, and well- organized school (IEA, 2012). Climate of school is part of academic success. In addition, students who study in schools with a fair and friendly climate have a higher average achievement than students who study science in schools that have a negative climate (Mohammadpour, Shekarchizadeh, & Kalantarrashidi, 2015; Lubienski, Lubienski, & Crane, 2008). Relating to mathematics, students that obtain high mathematics learning achievement usually attend schools that emphasize academic success, whereas students who attend school with irregular and unsafe surrounding social atmosphere such as bullying have low mathematics learning achievement (IEA, 2012).

Research on self-concept and attitudes of student on mathematics has been done by previous researchers, but more specifically in 8th grade (TIMSS) and 15-year-old students (PISA). Previous research that tried to tie students' mathematics learning achievement with school factor also focused only on school socioeconomic status. In other words, research relating to affective factors and school factors that have impacts on mathematics learning achievement in 4th grade using multilevel analysis model is still rare, especially in Indonesia, Japan, and Turkey. Previous studies using multilevel



models only used students' final scores provided by the TIMSS in the TIMSS database, whereas the research used the students' responses from non-test instruments (self-concept, student attitudes, and school factors) and tests (student learning achievement) and then re-analysed by the Generalized Partial Credit Mode (GPCM)I is also rarely done. The utilization of TIMSS data by most people is only used as a descriptive introduction in a conducted research,for example, to see the students' achievement position in mathematics, the average of achievement learning mathematics, student self-concept index, student attitude index, student confidence index, etc. However, there is one thing that needs to be studied which is the question of why students' mathematics learning achievement in every country of the three can be different.

Based on the research literature discussed above, there are obviously many factors indicated to have contributed in influencing student learning achievement in mathematics subjects, such as students' M-SC, students' M-ATT, and SCM. The aim of this research is to know the factors influencing student's achievement in learning mathematics in Indonesia, Japan, and Turkey, both at student level and at school level with the use of TIMSS data 2015. To answer the purpose, researcher makes some research question which will be answered in the discussion section, 1) "how much is inexplicable variance in students' learning achievement on mathematics subject in terms of differences within and between schools?", 2) "what are statistically predicting factors students' learning attainment in mathematics?", 3) "what is the strongest predictor of mathematical learning achievement relying on the final multilevel model?", and 4) "to which extent do the variables in the final multilevel model in 3 countries explain the overall variance in learning achievement of students in learning mathematics?".

METHODS

Sample

The research sample was the 4th graders of primary school from 3 countries which are members of TIMSS 2015, Indonesia, Japan, and Turkey. The three countries were chosen based on two reasons. First, these countries stood for a variety of education systems across the entire world. Second, the average mathematical score and student attitude index in these countries varies. The average mathematical score in Japan was above the equalized score set in the TIMSS International Benchmark Scores, but had a low index of mathematical attitudes. The two other countries, Indonesia and Turkey, had an average mathematics score below the levelled out score set in the TIMSS International Benchmark Scores, but both countries had a high index of mathematical attitudes. This sampling process can be dug out in TIMSS 2015 technical report (see TIMSS, IEA website).

Variable

Dependent Variable

The achievement of student mathematics learning in TIMSS 2015 involved three topics: numerics, geometry and measures, and display data (IEA, 2013). In the number topic, the tested material linked entire numbers, fractions and decimals, and expressions, simple equations, and relationships (IEA, 2013). Number of items used in the TIMSS to measure the mathematics learning performance of students' in 4th grade consisted of 179 items. The questionnaire code used were M04, M05, and M06 (see the information table item, the IEA website).

Independent Variable by the Student level

Independent variables by the student level consisted of M-SC and M-ATT. The instrument used in TIMSS to measure students' M-SC consisted of four items with the following codes ASBM03A, ASBM03B, ASBM03C, and ASBM03D. The items about students' M-ATT consisted of nine items with codes ASBM01A, ASBM01C, ASBM01D, ASBM01F, ASBM01G, ASBM01H, and ASBM01I. The complete data can be checked in Student Questionnaires TIMSS 2015.



Independent School Level Variable

The school level independent variable was the SCM. The SCM in TIMSS 2015 was illustrated by academic success. Instruments of academic success were filled by the principal which consist of eighteen items with the following codes ACBG14BA, ACBG14BB, ACBG14BD, ACBG14BE, ACBG14BF, ACBG14BH, ACBG14BI, ACBG14BJ, ACBG14BH, ACBG14BK, ACBG14BL, and ACBG14BM. The complete data can be checked on the School Questionnaires (see TIMSS 2015 Context Questionnaires, IEA).

Data Analysis Techniques

This work concerned with an analysis of TIMSS 2015 secondary data from Indonesia, Japan, and Turkey. Data on students' mathematics learning achievement, students' M-SC, M-ATT, and SCM were re-analysed using IRT approach, called Generalized Partial Credit Model (GPCM) for polythomus data (2-PL). The 2-PL model consists of the difficulty level and the differentiated items. The data of the three countries were analysed simultaneously to produce an estimation of the ability or index on the same scale. The finding on students' mathematical ability, the students' M-SC, students' M-ATT, and SCM found were in theta (logit) formation ranged from -4 to +4. To be more easily understood, the estimation results were converted on a scale from 0 to 100 using the "Ability/Index_100= (12.5*Ability/Index/Theta) +50" equation. Furthermore, an analysis of multilevel models was begun assessing the value of ICC. ICC is used to see how much variance percentage is explained by other factors (school factor, teacher factor, family factor, etc.) that cannot get completely explained by student factors. Basically, multilevel modelling considers individual groupings, estimates the variation of dependent variables associated with within and between groups differences and identification of factors by every level in association with the reliant variable, regardless of SE of coefficient from regression (OECD, 2009; Steele, 2008; Woltman, Feldstain, & Mackay, 2012).

This study used two-level model or Two-Level Multilevel Model. At level-1 (student level), students' M-SC and students' M-ATT were included in model-1 determine how much variance was explained in within school and between schools, whereas at level-2, the differentiation within and between schools were identified through independent variables (predictors) in the environment found in the school (school level) by including variables which were significant at level-1 (student level) into model-2 (final model). The software program used was R.3.4.1 with the editor R-Studio.0.99.891.

FINDING

Descriptive Statistic

Before the foremost analysis, the researchers primordially used descriptive statistics for the comprehension of sample overview. Within Table 1 total number of schools, students, and average student achievement score of mathematics based on TIMSS 2015 data in Indonesia, Japan, and Turkey.

Countries	N-School	N-Student	Mathematics Score	Average SD
Indonesia	230	3967	46,96	11,23
Japan	148	4307	53,29	12,86
Turkey	228	5974	49,79	12,50

Tabel 1: The Mathematics Average Score

Table 1 depicts that based on TIMSS 2015 data, the mathematics average score of Indonesian students was lower than that of Turkish students. The mathematics average score of Japanese outweighs Indonesian and Turkish students.

Multilevel Model

This study used samples of different sizes as shown in Table 1. To avoid biased results, the samples within this research were clustered by school. If clusters are considered in estimating the proportion



of variance within dependent variable by independent variables, the findings can be more valid (Woltman, Feldstain, MacKay, & Rocchi, 2012). Therefore, this study used multilevel model with twolevel in order that effect of variable by both school and student level is know when one wants to clarify the variance of students' learning performance in learning mathematics. Analyzing data began with the model without independent variables, (the null model, Step 1). Furthermore, it systematically moved toward a more complex model (step 2-3), which included the dependent variable by the level of both school and student, as argued by Hox (2010). The mathematical equations model of multilevel analysis model is included in the equation (1).

$$Y_{ij} = \beta 0_j + \beta_{1j} (SE) X_1 + \beta_{2j} (SE) X_2 + \beta_{3j} (SE) X_3 + \varepsilon_{ij}$$
(1)

Y is the dependent variable. X_{1r} X_{2r} and X_3 are independent variable (predictor). *i* is individual or student and *j* is group or school. β_0 is the average intercept, while β_{1r} β_{2r} and β_3 are coefficient of each predictor (*X*). *SE* is standard error and ε_{ij} is error or residual errors in the individual or student level. $\beta_{0j} = \beta_0 + U_{0j}$, where U_{0j} is students' errors in school level.

Step 1: null model

Intraclass Correlation Coefficient (ICC) is a comparison between the number of variation by the level of school with the amount of variance of student and school level. Table 2 indicates that 0.3% of the entire total variance (126.23) of students' mathematics learning achievement in Indonesia was related to differences in school level, 0% (165,489) for Japan, and 0% (156) for Turkey. The findings expound that the variability of achievement in mathematics learning between schools in those three countries was very small (see Figure 1). The variability in students' mathematics learning achievement due to the difference at the student level (within-schools) had a very large percentage, 99.7% of total variance for Indonesia, 100% for Japan, and 100% for turkey is concerned with differences in levels students. Therefore, it is necessary to conduct further analysis to determine the linkage between variables; variables connected to students, variables connected to school, and students' achievement in mathematics learning for every country using the multilevel approach.

Negara	Effect	Variable	Parameter Estimation	SE	ICC	
Indonesia	Fixed	Mathematics Score	46.941	0.185	0.003	
	Pandom	Between School Variance	0.441	2.895		
	Kanuom	Within School Variance	125.789	0.686		
Japan	Fixed	Mathematics Score	53.295	3.566	2.2358E-23	
	Dandom	Between School Variance	3.70E-21	3.7E-21		
	Kanuom	Within School Variance	165.489	3.566		
Turkey	Fixed	Mathematic Score	49.792	0.161	1.35E-10	
	Dandom	Between School Variance	156.466	2.862		
	RanuOIII	Within School Variance	2.12E-08	7E-08		

Table 2: TheOutcomes of MLM for Fixed and Random Effect from Null Model



Figure 1: Students' Mathemathics Learning Achivement in Indonesia, Japan, and Turkey



Step 2: Add the Predictor Variables at the Student Level (Model 1) Indonesia

Equation (2) is an equation constructed from the analysis results in model 1 displayed in Table 3. Equation (2) shows that of the both variables design in model 1, there was one insignificant variable which was variables connected to students' attitudes about learning mathematics. Hence, the attitudes of student on mathematical variables did not get used in the equation and also in the advanced analysis of model 2. Meanwhile, self-concept variables become statistically significant predictors and had a positive correlation with mathematics learning achievement. It can also be seen from the value of estimated coefficient value that is two times the SE (Gelman & Hill, 2007).

 $\theta_{\text{Mathematics}} = \beta_{0j} + 0,071(0,02) \theta_{\text{M-SC}} + e_{ij}$

(2)

In other words, students who had high self-concept of mathematics had better achievement than students who had low M-SC. In addition, it was found that after adding the student-level variables (M-SC and M-ATT) into model (1), By student level, unexplained variance dipped from 125.789 to 125.3 and 0.441 to 0.410 by the level school. The decrease can be understood that most of the variance of mathematics learning achievement at student and school level was explained by M-SC variable of student in model (1), while students' M-ATT explanation was significant because it did not significantly affect student learning achievement of mathematics. In general, model (1) could explain the overall variance with 0.4%, (126.23) in learning achievement of students. With much specification, the variables with significance in model (1) succeeded in explaining 6.8% of the overall variance (0.441) by the level of school and 0.38% (125,789) by the level of student. Of the two predictors included within the model (1), only the students' M-SC is the strongest and significant predictor of students' mathematics learning achievement in Indonesia.

Japan

In Japan, not all variables at student-level included in model (1) were significant predictors of students' mathematics learning achievement, as shown in (3) below:

$$\theta_{\text{Mathematics}} = \beta_{0j} + 0.131(0.022) \theta_{\text{M-SC}} + e_{ij}$$

(3)

Simillar to Indonesia, students that have an advanced mathematics self-concept in Japan also have better achievement than students do not have advanced M-SC. Moreover, relying on the information obtained after adding the student-level variables (M-SC and M-ATT) into model (1), by the level of student, the unexplained variance dropped from 165.489 to 163.839 and 3.70E-21 (0.000) to 1.36 E-21 (0,000) at the school level. It means that most of the variance achievement in learning mathematics at by both level was explicated by students' M-SC in model (1), while students' M-ATT did not take part in the meaningful explanation, because it did not significantly affect students' achievement in learning mathematics. In general, the overall variance could be explained by model (1) at 1%, (2,235) in achievement of students in learning mathematics. More explicitly, the significant variables in model (1) successfully explained 63.2% of the overall variance (3.7E-21) by the level of school and 1% (165,489) at the student level. Of the two predictors included in model (1), only the students' M-SC was the strongest and most significant predictor of students' mathematics learning achievement in Japan.

Turkey

While in Turkey, the same results are also shown in model (1) as produced in model (1) in Indonesia and Japan. Equation (4) shows that not all variable by the level of student in model (1) was significant as a predictor of student's mathematics learning achievement. Students' M-SC was the only variable which is statistically significant, while student M-ATT had an estimated coefficient value which not twice greater than the standard error value (SE), so that it is not significant (Gelman & Hill, 2007; Steele, 2008b).

 $\theta_{\text{Mathematics}} = \beta_{0j} + 0.118(0.016) \theta_{\text{M-SC}} + e_{jj}$

(4)



Similar in Indonesia and Japan, Turkish student who had good mathematics learning achievement also had high mathematics self-concept, and vice versa. Furthermore, after adding the student-level variables (M-SC and M-ATT) into model (1), by student level, unexplained variance diminished from 156.466 to 154.540 and 2.12E-08 (0.000) to 3.12E-14 (0,000) by the level of school.

It means that M-SC of students in model (1) explained most of the mathematics learning variance achievement by student and school level, while student's M-ATT did not have impact on the meaningful explanation, because it did not significantly affect students' mathematics learning achievement. In general, model (1) could explain 1.8% of the overall variance (156) in the student's mathematics learning achievement. More specifically, the significant variables in model (1) succeeded in explaining 100% of the overall variance (2, 21E-08) by the school level and 1.2% (156,466) at the student level. Of the two predictors included in model (1), only the students' M-SC was the strongest and most significant predictor of students' mathematics learning achievement in Turkey.

Step 2: Add the Predictor Variables Connected to the level of school (Final Model)

Variables connected to the level of student involved in model (1) had not yet widely explained in the variance of students' mathematics learning achievement in Indonesia, Japan, and Turkey. Therefore, the new model should be created which consist of significant variables in model (1) and also add new variables connected to school level, namely school climate.

Indonesia

Equation (5) indicated that the most dominating variable within the model was the M-SC variable, as much as its estimated coefficient is the largest (b = 0.066). The latter was approximately four times the (SE = 0.017). It could be interpreted that the coefficient with positive value shows any students that has a high M-SC had high learning achievement of mathematics. In addition, the inclusion of SCM led to a decrease in baffling variance by the level of school from 0.411 to 0.027, indicating that about 93.9% of students' achievement differences in learning mathematics were explicated by school climate attended by students. After adding the M-SC and SCM variables included in the model (2) the results stayed constantly significant. This demonstrates that the variables designed in this model (2), M-SC and SCM explained the difference of students' mathematics learning achievement in Indonesia.



 $\theta_{\text{Mathematics}} = \beta_{0j} + 0.066(0.017) \theta_{\text{M-SC}} + 0.047(0.015) \theta_{\text{SCM}} + e_{ij}$ (5)



Figure 2 (a) is an overview of the self-concept index of 4th grade students in Indonesia attributed to their mathematics learning achievement. Figure 2 (a) shows that students with low self-concept math index also has low mathematics achievement scores. However, there are some students seen in Figure 2 (a) having a high self-concept mathematical index but having a low mathematics learning achievement score. Figure 2 (b) is a school climate index that is also connected with students' achievement in learning mathematics. Figure 2 (b) shows that students who frequent school with strict curriculum objectives, effective teachers, competent students, parents support, sense of



security, and well- organized school have better performance scores than those who frequent school that do not reflect that.

Japan

In Japan, equation (6) indicates that the M-SC variable was a variable that remains significant with the coefficient of estimation(b = 0.104) with approximately seven times the SE of 0.016. This means that the coefficient with positive value shows that any student with high M-SC also had high mathematics learning achievement. In other word, the involvement of SCM variables did not contribute significantly. This can proven from the coefficient of estimation value (b = 0.022) which was approximately one standard error (SE = 0.019). In addition, the involvement of SCM variables also did not greatly reduce the unexplained variance by the level of school, from 1.36E-21 to 1.10E-21. This shows that the M-SC variable completely explained the variance that could not be explained by the level of student and that of school. Therefore, significant variables in model (2), namely M-SC explained the learning achievement difference among students' in mathematics in Japan.



(6)



Figure 3 (a) and (b): Math Self-Concept and School Climate Students Japan

Figure 3 (a) is an overview of the self-concept index of 4th grade Japanese elementary school students from Japan that is related to their mathematics learning achievement score. Figure 3 (a) shows that students that have a high self-esteem index of mathematics also have high achievement scores of mathematics. Nevertheless, there are some students seen in Figure 3 (a) having a high self-concept mathematical index but having a low mathematics learning achievement score. Figure 3 (b) is a school climate index that is also connected with students' mathematics learning achievement. Figure 3 (b) shows that there is no difference in mathematics learning achievement among students in certain school that applying strict curriculum objectives, effective teachers, competent students, parents support, sense of security, and well- organized school with students attending school that do not reflect this.

Turkey

In Turkey, equation (7) demonstrates that the M-SC variable was a variable that remains significant as its coefficient of estimation (b = 0.115) with around nine times comparing to the SE whose value was 0.014. This means that the coefficient with positive value shows that whoever student with high M-SC also has high learning achievement of mathematics. Additionally, the involvement of SCM led to an unexplained decrease in variance by the level of school from 3.21E-14 to 1.31E-14, indicating that about 100% of the difference in mathematics learning achievement among the students was explicated by the school-based climate attended by students. After adding the M-SC and SCM variables within the model (2) the results remains significant. It proved that the variables involved in model (2), ie M-SC and SCM explained the dissimilarity in student's achievement in mathematics learning across Turkey is explained by.





Figure 4 (a) and (b): Math Self-Concept and School Climate Students Turkey

Figure 4 (a) is an overview of the self-concept index of 4th grade of primary school students across Turkey attributed to their mathematics learning achievement. Figure 4 (a) shows that students that have a high level of self-concept math index also have high achievement scores of mathematics. Nevertheless, there are some students seen in Figure 4 (a) having a high self-concept mathematical index but having a low mathematics learning achievement score. Figure 4 (b) is a school climate index that is also related to with students' mathematics learning achievement. Figure 4 (b) shows that students that frequent school with strict curriculum objectives, effective teachers, competent students, parents support, sense of security, and well-organized school have better performance scores than students who regularly attend school that do not reflect that.

Final Model Interpretation

Table 3 is a summary of two stages of multilevel analysis which are model (1) and model (2) of three countries.

Indonesia

Considering the self-conceptual variables of mathematics student and school-related variables, the final multilevel model (model 2) only explains a small (0.6%) of the overall unexplained variance in mathematics learning achievement of student, as the entire variance decreases from 126.230 to 125.417. More specifically, this model only explains 0.3% and 93.9% of variance at student level (125,789) and school (0.441). The dimension of the variance that is too small by the level of school causes the variables present in model (2) to explain nearly 100% of the unexplicated variance by the level of school. In general, the researchers can conclude that this model with multilevel has an average match, since most of the significant variables in model (2) do not contribute in a significant way to explaining unexplained variance on differences in achievement of student in mathematics in Indonesia. Holding account on the formed coefficients within the last model, by making other variables constant, students that get a high M-SC also achieve better in mathematics than those with low M-SC with an increase of 0.066 in score. Furthermore, the score of students' mathematics learning achievement will increase by 0.047 for each additional SCM unit.

Japan

In other world, in Japan, of the two variables that exist within the model (2) there is only one variable that significantly affect the student's mathematics learning achievement. The variable is the students' M-SC which in the last model of multilevel (model 2) can only explain a small part (1%) of the total unexplained variance in achievement of students' mathematics learning, as far as there was a decrease in total variance, from 165,489 to 163,900. In specific way, the final model only explains 1% and 70.3% of variance at student level (165,489) and schools (3.7E-21). The size of the variance



that is too small at the school level causes significant variables in model (2) to account for almost more than 50% of the variance not explicated at the level of school. In general, the researcher can conclude that this model with multilevel has an average match, since most of the significant variables in model (2) do not contribute in a significant manner to the unexplained variance of student differences in learning achievement in Japanese, especially at the student level. Considering the coefficients formed in the final model, students that get a high M-SC also perform better in learning mathematics than students with low M-SC, its score increases of 0.104.

Turkey

In Turkey, the result is not far much different from Indonesia. The final multilevel model (model 2) consisting of the students' M-SC and school-related variables explained only a small part (1.8%) of the total variation that is unexplained in students' achievement in learning mathematics, as the overall variance diminished from 156 to 154. More explicitly, the final model in Turkey only described 1.8% and 100% of variance at both students' performance and school level, (156,466) and (2.12E-08) respectively. The small size by school level variance caused variables presented in model (2) explained 100% of the variance of the school level which was unexplained before. In general, it is undoubtedly concluded that this model with multilevel technique has an average match, since most of the significant variables in model (2) did not significantly contribute to explain unexplained variance on dissimilarity in student achievement in mathematics across Turkey. Furthermore, relying coefficients created in the last model and if there was a holding constant of other variables, students who had high M-SC also achieve better in mathematics learning than those with low M-SC with score increased by 0.115. Moreover, the score of student mathematics learning achievement would increase by 0.073 for every added unit of SCM.

	Indonesia		Japan		Turkey			
Variable	Model I : Student	Model II : +School	Model I : Student	Model II :+School	Model I : Student	Model II : +School		
Student-Level Variable								
Math-Self Concept	0.071(0.02)*	0.066(0.017) *	0.131(0.022) *	0.104(0.09)*	0.118(0.016) *	0.115(0.014)*		
Math-Attitude School-Level Variable	-0.005(0.02)	-	-0.038(0.022)	-	0.008(0.018)	-		
School Climate		0.047(0.015) *		0.022(0.019)		0.073(0.012)*		
Variance Explained								
Student	0.0038	0.0030	0.010	0.010	0.012	0.018		
School	0.068	0.939	0.632	0.703	1.000	1.000		
Total	0.004	0.006	0.01	0.01	0.012	0.018		

Table 3: The Result of Multi Level Modelling

* Significant level: *p-value* < 0,05

DISCUSION

The research indicated that 99.7% of total variance on achievement of student in learning mathematics in Indonesia was associated with within-school differences, while 0.3% was associated with among schools located in the similar country. In other word, 100% from student mathematics achievement total variance in Japan was related with the students' difference within-school and 0% of the total variance of students' mathematics learning achievement was connected with the differences among schools. This means that the education in 12 schools from the three countries were indicated more impartial. These findings are on the same side with previously conducted research, which suggests that school education systems in developing and developed countries more emphasis on policy with equality (Gustafsson, Nilsen, & Hansen, 2015). It means that there is no dismilarity in the teaching quality among schools, where all students are exposed to a high quality



education system, no more special treatment that high quality education system is only for high achieving students.

The findings out of this study demonstrated that M-SC is a very significant predictor in influencing students' mathematics learning achievement for all involved countries in TIMSS. The findings reinforce the outcomes previously studied the that students M-SC (preschool students) is very influencial component on student mathematics learning achievement (Arens et al., 2016). The findings of research also show that M-ATT do not have significant influence students' mathematics learning achievement in the three countries. It indicates that some female students still vulnerable to the harmful effects of mathematics, that mathematics does not really pose the contribution to the future of a woman in general (Charles, Harr, Cech, & Hendley, 2014). It means that some students are not so affected by the harmful effects of mathematics, but their mathematics learning achievement is varied, some are low and some are still high. In conclusion the three countries, Indonesia, Japan, and Turkey still have students with a negative mind-set towards learning mathematics which have a negative effect on the low mathematics learning achievement, but there are also students whose learning achievement remains high.

By the other side, SCM is the significant in predicting student mathematics learning achievement in Indonesia and Turkey, but not for students in Japan. This is supporting previous findings which suggest that perceptions of SCM may affect learning environments and student learning achievements (Boulifa & Kaaouachi, 2015). More specifically, the findings of previous studies using sample students from Turkey show that students that frequently go to school with an optimistic climate have better performance than students who frequent school which badly rated by the school headteacher (Erberber, 2010). While in Japan, SCM is insignificant due to the high Human Development Index (HDI). This support the results out of previous studies in developed countries that the SCM effect on achievement of students tend to vary, this is an illustration of the function of the level of human development level (Gustafsson et al., 2015).

Based on the finding of multilevel analysis on the final model, M-SC is the dominating predictor of student mathematics learning achievement in three countries. Further review, however, the coefficient of M-SC in learning achievement is very small. This outcome is sided with recent research that students' self-concept is generally able to influence students' learning achievement in mathematics and reading ability even though in low level, where male students are higher in mathematics than female based on self-concept. The latter are higher at reading concept (Caputo, 2015). If it is related to the coefficient on M-SC detected from students' toward their achievement in learning mathematics across three countries, which is very small but remain significant. In all three countries, the dismilarity between male and female students on self-concept could be a factor that needs to be acted upon. Nevertheless, the coefficient of M-SC remains greater than the SCM coefficient.

Findings coming out of the analysis with Multilevel technique indicate that the last model is able explicate 0.6% of the overall unexplained variance in student mathematics learning achievement in Indonesia, 1% for students in Japan, and 1.8% for students in Turkey. More specifically, 0.3% and 93.9% of all variables in the final model succeeded in explaining the differences in mathematics achievement in Indonesian from within-school (125,789) and among schools (0.441). The same case in Japan, 1% and 70.3% of the significant variables in the final model succeeded in explaining the differences in students' achievement in within-school (165,489) and among schools (3.70E-21), while in Turkey, 1.8% and 100% of the variables within the model succeeded in explaining differences in achievement of student in mathematics in Turkey from within-school (156,466) and among schools (2.12E-08). Contrary, there are still variance that still unexplained in the final model (99.4%, 99%, and 98.2%) in Indonesia, Japan, and Turkey. The final model this research has not been very good, because it only can explain the unexplicated variance associated with the students' learning achievement difference in mathematics among the three countries, especially at the student level. It



suggests that the further research take into consideration other explanatory variables that may explicate the remaining variance.

CONCLUSSION

This study resulted in a "unique" insight into the mathematics learning achievement of grade-4 of primary school students identified through the indicated factors contributing in explaining the student achievement dissimilarity in mathematics across Indonesian, Japanese and Turkish. Analysis with multilevel resulted in showing that students' achievement learning mathematics proved no difference for all three countries, by the school of level, (inter-school). However, the difference is purely derived from the student factor itself (in-school). In addition, the final multilevel model also provides information that M-SC and SCM is defined as a predictor of student's mathematics learning achievement, although it cannot be said to be a good model because it can only clarify the variance of student's achievement in learning mathematics for all three countries. It is important that students' positive M-SC should be embedded or established early (before elementary school) through a friendly SCM, as both have a contribution in predicting student mathematics level of learning achievement.

In general, the findings of this research comes up with the indicate that policymakers, educators and parents should consider student M-SC early (before entering primary school) and SCM in making educational policies and designing related curricula as well. This study highlights the factors that can predict students' achievement in mathematics learning in Indonesia, Japan, and Turkey by applying multilevel analyses that significantly contribute to knowledge procuration and fill gaps in existing research literature.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



K. Kartianom is an alumnae of magister degree of educational research and evaluation program, Graduate School of Yogyakarta State University, Indonesia. She is interested in research about education, measurement in education, and assessment in mathematics education.

K. Kartianom Universitas Negeri Yogyakarta Graduate School Yogyakarta- INDONESIA E. Mail: <u>kartianom.2018@student.uny.ac.id</u>



Heri Retnawati is one of lecturer and researcher in Mathematics Department, Mathematics and Science Faculty, Universitas Negeri Yogyakarta, Indonesia. Her interest of researches are teaching methods and assessment in mathematics education, measurement in education, and psychometric.

Dr. Heri Retnawati Universitas Negeri Yogyakarta Mathematics and Science Faculty Yogyakarta- INDONESIA E. Mail: <u>heri retnawati@uny.ac.id</u>



REFERENCES

Alkharusi, H.A. (2010). Factors associated with preservice teachers' attitude towards educational measurement. *International Journal of Learning*, 17 (1), pp. 95-108.

Alkharusi, H.A. (2009). Correlates of teacher education students' academic performance in an educational measurement course. *International Journal of Learning*, 16 (2), pp. 1-16. doi:10.18848/1447-9494/CGP/v16i02/46111.

Antunes, C., & Fontaine, A. M. (2007). Gender differences in the causal relation between adolescents' maths self-concept and scholastic performance. *Psychologica Belgica*, *47*(1–2), 71–94. doi:10.5334/pb-47-1-71.

Arens, A. K., Marsh, H. W., Craven, R. G., Yeung, A. S., Randhawa, E., & Hasselhorn, M. (2016). Math self-concept in preschool children: Structure, achievement relations, and generalizability across gender. *Early Childhood Research Quarterly*, *36*, 391–403. doi:10.1016/j.ecresq.2015.12.024.

Boulifa, K., & Kaaouachi, A. (2015). The relationship between students' perception of being safe in school, principals' perception of school climate and science achievement in TIMSS 2007: A comparison between Urban and rural public school. *International Education Studies, 8*(1), 100–112. doi:10.5539/ies.v8n1p100.

Brault, M.-C. (2004). *L'influence du climat scolaire sur les résultats des élèves: Effet-établissement ou perception individuelle?* Université de Montréal.

Can, I., Koydemir, S., Durhan, S., Ogan, S., Gozukara, C., & Cokluk, G. (2017). Changing High School Students' Attitudes Towards Mathematics in a Summer Camp: Happiness Matters. *Educational Sciences: Theory & Practice*, *17*(5), 1625–1648. doi:10.12738/estp.2017.5.0373.

Caputo, A. (2015). The motivational patterns of school learning: A correlational study on self-concept and attributions. *Journal of Educational, Cultural and Psychological Studies, 2015*(12), 143–167. doi:10.7358/ecps-2015-012-capu.

Charles, M., Harr, B., Cech, E., & Hendley, A. (2014). International Studies in Sociology of Education Who likes math where? Gender differences in eighth-graders ' attitudes around the world. *International Studies in Sociology of Education*, *24*(1), 85–112. doi:10.1080/09620214.2014.895140.

Erberber, E. (2010). The Impact of International Achievement Studies on National Education Policymaking Article information : *International Perspectives on Education and Society*, *13*, 119–142.

Gustafsson, J. E., Nilsen, T., & Hansen, K. Y. (2015). School characteristics moderating the relation between student socio-economic status and mathematics achievement in grade 8. Evidence from 50 countries in TIMSS 2011. *Studies in Educational Evaluation*. doi:10.1016/j.stueduc.2016.09.004.

Hox, J. J. (2010). *Multilevel Analysis: Techniques and Applications*. doi:10.1002/1521-3773(20010316)40:6<9823::AID-ANIE9823>3.3.CO;2-C.

Huang, C. (2011). Self-concept and academic achievement: A meta-analysis of longitudinal relations. *Journal of School Psychology*, *49*(5), 505–528. doi:10.1016/j.jsp.2011.07.001.

IEA. (2012). *Timss 2011 International Results in Science. New directions for youth development* (Vol. 2012). doi:10.1002/yd.20038.



IEA. (2013). *TIMSS 2015 Context Questionnaire Framework Martin. TIMSS 2015 Assessment Frameworks.* Retrieved from

http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED545250&site=ehost-live

Lamb, S., & Fullarton, S. (2002). Classroom and School Factors Affecting Mathematics Achievement: A Comparative Study of Australia and the United States Using TIMSS. *Australian Journal of Education*, *46*(2), 54–71. doi:10.1177/000494410204600205.

Lubienski, S. T., Lubienski, C., & Crane, C. C. (2008). Achievement Differences and School Type: The Role of School Climate, Teacher Certification, and Instruction. *American Journal of Education*, *115*(1), 97–138. doi:10.1086/590677.

Lüdtke, O., Robitzsch, A., Trautwein, U., & Kunter, M. (2009). Assessing the impact of learning environments: How to use student ratings of classroom or school characteristics in multilevel modeling. *Contemporary Educational Psychology*, *34*(2), 120–131. doi:10.1016/j.cedpsych.2008.12.001.

Mohamed, A., Mustafa, M., Lazim, A., & Hamdan, A. M. (2012). The factors influence students ' achievement in mathematics: A case for Libyan $\hat{a} \in \mathbb{T}^M$ s students. *World Applied Sciences Journal*, 17(9), 1224–1230.

Mohammadpour, E., Shekarchizadeh, A., & Kalantarrashidi, S. A. (2015). Multilevel modeling of science achievement in the TIMSS participating countries. *Journal of Educational Research*, *108*(6), 449–464. doi:10.1080/00220671.2014.917254.

Mullis, I. V. S. (2013). Introduction. TIMSS 2015 Assessment Framework.

Mullis, I. V. S., Martin, M. O., Foy, P., & Arora, A. (2012). *The TIMSS 2011 International Results in Mathematics*, 17–183. doi:10.1002/yd.20038.

Neale, D. (1969). The role of attitudes in learning mathematics. *The Arithmetic Teacher*, *16*(8), 631–640.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-Concept: Validation of Construct Interpretations. *Review of Educational Research*, *46*(3), 407–441. doi:10.3102/00346543046003407.

Woltman, H., Feldstain, A., MacKay, C., & Rocchi, M. (2012). An introduction to hierarchical linear modeling. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 52–69. doi:10.2307/2095731.



INVESTIGATING 12th GRADE STUDENTS' PRIOR KNOWLEDGE OF STATIC ELECTRICITY CONCEPTS

Prof. Dr. Ketut Suma Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- INDONESIA

Prof. Dr. I Wayan Sadia Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- INDONESIA

Dr. Ni Made Pujani Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- INDONESIA

Abstract

This study was aimed at describing the types of prior knowledge of the 12th-grade students on static electricity concepts. This study was done at public senior high schools in Singaraja Bali. There were 117 students who participated in the study, they were between 16-17 years old. The data of students' prior knowledge of static electrisity were collected by using Three Tier Diagnostic Static Electricity Test (TTDSET) with the index of reliability r= 0.61. The data analysis was done by descriptive technique. The result showed that the students' prior knowledge of static electricity concepts is very varied which can be categorized into four categories namely: Scientific Knowledge, Misconception, Lack Knowledge, and Error. The implication of the result in the teaching of physic is that the teacher needs to identify the student prior knowledge of static electricity concepts and design appropriate strategy of concept change.

Keywords: Prior knowledge, scientific knowledge, misconception, lack knowledge, error.

INTRODUCTION

It has been long since teachers received a teaching model that was based on a hidden assumption that knowledge could be transferred directly from the teacher's mind to the student's mind (Bodner, 1986). Hence, education focused on the effort to transfer knowledge from the teacher's mind to the students' mind. According to constructivism, knowledge is constructed in the mid of learner. The scientific theory is an understanding that is constructed by an individual interaction in the culture that defines a discipline, in this case, physical sciences (Chambers & Andre, 1997). Studies such as Orborne & Wittrock (1983); Driver et al (1994); Osborne et al. (1985); Maloney et al. (2001); Tekkaya (2002); Thompson & Logue (2006); Baser (2006); Küçüközer and Kocakülah (2007); and O'Dwyer (2009), show that the students enter the classroom not with empty minds, but they bring with them prior knowledge about science which is developed from daily experiences.

Prior knowledge is given various labels such as preconception (Turgut, Gürbüz & Turgut, 2011); children science (Bell, 1993; Osborn et al., 1985); alternative conception (Peterson, 2002) and misconception (Brown & Clement, 1989). Ausubel (1968) states that prior knowledge is a single factor which is the most important in influencing learning. Similarly, Ausubel, Hewson & Hewson (1983) show that one of the factors that influence student learning in science is students' prior knowledge, which can be in the form of alternative conception or also scientific conception. Prior knowledge is a



knowledge that the student has before learning starts (Edinyang, 2006). Spesifically, Dochy and Alexander (1995) state that prior knowledge is all knowledge which is (1) dynamic, (2) available before learning,(3) structured, (4) can exist in various forms (i.e., declarative, procedural, and conditional knowledge), (5) explicit and implicit, and (6) contain component and metacognitive knowledge components.

According to constructivism, prior knowledge of the student plays an important role in developing student scientific knowledge. Prior knowledge can be viewed as naive theories that were difficult to change, as knowledge was developed base on everyday students' experiences, and as system account (Esanu & Hatu, 2015). Constructivism views learning as the construction and acceptance of new ideas or the reconstruction of existing ideas (Bell, 1993). During the learning, the students develop meaning based on background, attitude, and experiences (Pinarbasi, 2006). Many findings show that learning outcome especially comes from prior knowledge (Roschelle, 1997). A correct prior knowledge which is consistent with new knowledge has a positive effect on the development of scientific knowledge, on the contrary, the prior knowledge which is contradicting with new information has a negative effect (Svinicki,1993-1994). Dochy & Alexander (1995) differentiate the effect of prior knowledge into three categories 1) directly influence in facilitating learning, 2) the effect of the quality of prior knowledge (for example, incompleteness, misunderstanding, accessibility, number, availability and previous knowledge structure and 3) the interaction effect between quality and the effect facilitation.

The student prior knowledge can fit with scientific knowledge and there is also a prior knowledge that does not fit with scientific knowledge (Clement, Brown, & Zeitsman (1989). The prior knowledge which contradicts with the scientific concept is called misconception. The misconception that is brought by the student that contradicts with the scientific explanation (Broughton, Sinatra, and Reynolds, 2010), is resistant to changed, is very strong and difficult to changed by traditional teaching (Sungur, Tekaya & Geban, 2001). Misconception influences students to learn about new scientific knowledge and plays an important role in learning (Ozmen, 2007). The fact shows that misconception is the most important factor that gives a negative contribution to the students' academic success (Ozkan & Selcuk, 2012). Based on the description above, identification of the students' prior knowledge is important.

Studies on preconception (prior knowledge) of students about dynamic electricity have been done by many researchers such as Engelhardt & Beichner (2004), Turgut, Gürbüz, & Turgut (2011), Ismail et al. (2015), Sencar & Eryilmaz (2004), and O'Dwyer (2009). On the other hand, studies on the preconception about static electricity are still very limited such as Maloney et al. (2001) ; Bilal & Erol (2009); and Koudelkova & Dvorak (2015). Like dynamic electricity concept, static electricity concept is very important and is used frequently in daily life. Therefore, a correct understanding of static electricity concepts at school should be developed. In an effort to enhance meaningful learning about static electricity needs to be done. The question that is answered in this study is "what does student prior knowledge look like concerning the concepts of static electricity?"

METHOD

Research Subject

This study was a descriptive study carried out at four public senior high schools in Singaraja Bali. The number of the students involved as the sample was 117, consisting of 40 males and 77 females. They were between 16-17 years old.

Data Collecting and Instrument

The data collected in this research were the types of students prior knowledge concerning static electricity concepts. The data were collected with a test technique. The instrument used was Three



Tier Diagnostic Static Electricity Test that is modified from Maloney et al. (2001) and Bilal & Erol (2009). This test consisted of three levels. The first level was a multiple choice that that asked the student to choose a correct answer from the alternative options answers. The second level was a multiple choice test that asked the students to choose an alternative reason that fitted with their choice at the first level. In this part, the students were also given the opportunity to write their reason if it was not found in the alternative option. The third part was the choice of the degrees of their certainty that the student has toward the answer and the reason that they have chosen. This part consisted of two alternatives, i.e., sure and not sure. This test had a reliability index of r=0.61. There were 25 items developed to identify the student prior knowledge of static electricity concepts. Table 1 shows the distribution of test items in static electricity subtopic.

Table 1: Distribution of Test items in static electricity subtopic

able if bloadballon of reschemb in static electricity subtopic								
Static Electricity Sub concepts	No item							
Electric charge	1, 2, 3, 4, and 5							
Electrostatic Force	6, 7, 8, 9, 10, 11							
Electric Field	12, 13, 14, 15, 16, 17							
Electric Potential and Electric Potential Energy	18, 19, 20, 21, 22							
Capacitor	23, 24, 25							

Data Analysis

The data about the students' prior knowledge of static electricity concepts were analyzed descriptively. Qualitative analysis was used to describe the student conception categories into categories based on the result of TTDSET. Based on the result of TTDSET the students' prior knowledge was categorized into four categories: Scientific Knowledge; Misconception, Lack knowledge, and Error. The categorization was based on the combination of the student's responses in TTDSET in first, second and third levels as in Table 2. The student misconception types in each subconcept of electricity were described qualitatively and compared with what can be found in the literature of misconceptions.

Aswer level 1	Answer level 2	Answer level 3	Prior knowledge category		
True	True	Sure	Scientific Knolwledge (SK)		
True	True	Not sure	Lack Knowledge (LK)		
True	Wrong	Not sure	Lack Knowledge (LK)		
Wrong	True	Not sure	Lack Knowledge (LK)		
Wrong	Wrong	Note sure	Lack Knowledge (LK)		
Wrong	True	sure	Error (E)		
True	Wrong	Sure	Misconception (M)		
Wrong	Wrong	Sure	Misconception (M))		

Addapted from Kaltakci and Didis (2007)

FINDING

Categories of Students' Prior Knowledge

Before learning about static electricity at senior high school, the students had got a prior knowledge of static electricity concepts. Based on TTDSET the students' prior knowledge about static electrical concept could be classified into four categories: Scientific Knowledge (SK), Misconception (M), Lack Knowledge (LK), and Error (E). Table 3 shows the percentage of the students whose prior knowledge can be categories into the four categories.



N			Μ			LK			E		
la i 26) (Fem (%)	Tot (%)	Ма (%)	Fem (%)	Tot (%)	Ма (%)	Fem	Tot (%)	Ma (%)	Fem	Tot (%)
5.7 5	54.6	55.0	32.3	28,0	30,1	14.1	13.7	13.5	0.9	1.7	1.4
0.3 9	9.3	9.7	52.5	46.9	49.2	33.3	35.0	34.3	6.0	7.4	6.9
7.7 1	18.1	18.0	27.3	30.7	29.4	51.1	54.7	47.9	5.3	4.5	4.8
7 1	1.4	1.6	30.2	31.4	30.9	55.7	48.9	51.6	18.3	14.3	15.9
5 7	7.6	6.0	45.4	36.7	40.2	46.8	51.4	49.6	7.8	1.9	4.3
7.8 1	18.2	18.1	37.5	34.4	35.9	40.2	39.0	39.4	7.7	6.0	6.6
		a Fem (6) (%) 5.7 54.6 0.3 9.3 7.7 18.1 7 1.4 5 7.6 7.8 18.2	Fem Tot (%) (%) (%) 5.7 54.6 55.0 0.3 9.3 9.7 7.7 18.1 18.0 7 1.4 1.6 5 7.6 6.0 7.8 18.2 18.1	a Fem Tot Ma (%) (%) (%) (%) 5.7 54.6 55.0 32.3 0.3 9.3 9.7 52.5 7.7 18.1 18.0 27.3 7 1.4 1.6 30.2 5 7.6 6.0 45.4 7.8 18.2 18.1 37.5	Fem Tot Ma Fem (%)	Fem Tot Ma Fem Tot (%) (%) (%) (%) (%) (%) (%) 5.7 54.6 55.0 32.3 28,0 30,1 0.3 9.3 9.7 52.5 46.9 49.2 7.7 18.1 18.0 27.3 30.7 29.4 7 1.4 1.6 30.2 31.4 30.9 5 7.6 6.0 45.4 36.7 40.2 7.8 18.2 18.1 37.5 34.4 35.9	Fem Tot Ma Fem Tot Ma (%) (%) (%) (%) (%) (%) (%) 5.7 54.6 55.0 32.3 28,0 30,1 14.1 0.3 9.3 9.7 52.5 46.9 49.2 33.3 7.7 18.1 18.0 27.3 30.7 29.4 51.1 7 1.4 1.6 30.2 31.4 30.9 55.7 5 7.6 6.0 45.4 36.7 40.2 46.8 7.8 18.2 18.1 37.5 34.4 35.9 40.2	Fem Tot Ma Fem Tot Ma Fem (%) 5.7 54.6 55.0 32.3 28.0 30.1 14.1 13.7 13.7 0.3 9.3 9.7 52.5 46.9 49.2 33.3 35.0 7.7 18.1 18.0 27.3 30.7 29.4 51.1 54.7 7 1.4 1.6 30.2 31.4 30.9 55.7 48.9 5 7.6 6.0 45.4 36.7 40.2 46.8 51.4 7.8	Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem Tot (%) </td <td>Fem Tot Ma Fem Tot Ma Fem Tot Ma (%)</td> <td>Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem (%)</td>	Fem Tot Ma Fem Tot Ma Fem Tot Ma (%)	Fem Tot Ma Fem Tot Ma Fem Tot Ma Fem (%)

Table 3: The average of percentage of Student categorized into SK, M, LK, and E for each static electricity subtopic

Note: Ma = Male; Fe= Female.

Table above shows that in general: (1) on average, 18.1% students who consisted of 17.8% male and 18.2 % female had prior knowledge which was categorized as Scientific Knowledge; (2) 35.9 % students which consisted of 37.5% male and 34.4 % female had prior knowledge which was categorized as misconception; (3) 39.4% students which consisted of 40.2% male and 39.0% female lacked knowledge; and (4) 6.6% students who consisted of 7.7% male and 6.0% female had errors. The average of the percentage of the students with scientific knowledge mostly came from the students with scientific knowledge concerning electric charge, i.e., 55.0% consisting of 55.7% male and 54.6 % female. While the percentage of the students had prior knowledge of scientific knowledge type in other concepts such as electrostatic force, electric field, electric potential, and capacitor was in the range between 6.0% - 18.0%. On the other hand, the average of the percentage of the students who had the misconception about electrostatic force was 49.2% and capacitors 40.2%. The percentage of students who lacked knowledge was consecutively contributed by those who lacked knowledge in electrical potential, 51.6%, capacitor 49.6% and electric field 47.9%. The average of the percentage of students who had errors was mostly contributed by the students who had errors in electric potential, i.e., 15.7%.

Types of students' misconception in static electricity concepts

The qualitative analysis of the students' responses in TTDSET item shows the types of the students' misconceptions about static electricity concept as follows.

- 1. A balloon rubbed by silk will have the static electrical charge that it can attract paper torn pieces. The term static electricity is identical to a static charge.
- Plastic rubbed by cloth will get additional electrons from the cloth, that the plastic charge becomes positive; the cloth will have the negative charge so that the cloth and the plastic will attract each other.
- 3. A neutral object has more neutrons then electrons and protons.
- 4. An object is called neutral if it has the same number of protons neutrons and electrons.
- 5. In an interaction between two objects with different charges, the object with more charge obtains a greater force than with the force proportional to its charge.
- 6. In an interaction between two objects with different charges, the object with a greater charge obtains a smaller force.
- 7. In an interaction between two charged particles, the particle with a greater charge exerts a greater force. This is similar to the finding of Bilal & Erol (2009).
- 8. In an interaction between two charges in which one has -2 units and +1 unit, and attractive force occur in which the +1 unit charge gets an attractive force by the -2 units charge with the charge twice the force obtained by the -2 units charge. The students drew the attractive force vector in the +1 charge twice as long as in the -2 unites charge.
- 9. In an interaction between two charges in which one has -2 units and +1 unit, repulsive force occurs in which the -2 unit charge obtains force twice as much as the +1 unit charge. The



students drew the vector of repulsive force in the -2 unit charge twice as long as the +1 unit charge.

- 10. In two objects with the same names but with different charges (for example +Q and +4Q), the objects with the smaller charge obtains a greater acceleration. In which the students equate charge with mass in Newton's second law.
- 11. In two objects with the same names but with different charges (for example +Q and 4Q), the object with greater charge obtains a greater acceleration.
- 12. The students do not do vector addition to obtain total force in the interaction between two charges or more.
- 13. A charge in a uniform electric field does not have acceleration. A similar misconception is also found in Bilal & Erol (2009), i.e., the particle charged in a uniform electric field moves at a constant speed.
- 14. A charged object that lies in a more densely electric filed lines obtains as smaller acceleration than if it is placed in less densely electric field line because of the denser the electric field line, the smaller its field strength.
- 15. In the parallel plate capacitor the wider the surface of the plate the greater its capacity to store charge because the parallel plate capacitor capacity meets the equation $C = \epsilon d/A$, with C = capacitor capacity, d=distance between parallel plates, and A=the area of the surface of the parallel plate.
- 16. In the parallel plate capacitor the greater the distance between the surfaces of plates the greater its capacity to store charge because the parallel plate capacitor capacity meets the equation $C = \epsilon d/A$, with C= capacitor capacity, d=distance between parallel plates, and A=the area of the surface of the parallel plate.
- 17. Some capacitors in series circuit, the capacity of the equivalent capacitor is greater than the capacity of each component.
- 18. In some capacitor with different capacities connected in series, the potential difference of each capacitor is the same.
- 19. Some capacitors with the same capacity that connected in series, the capacity of the substitutes are greater when they connected in parallel.
- 20. Energy stored by some capacitors with the same capacity connected in series is greater than the energy stored by some capacitors with the same capacity connected in parallel because the capacity of the substitutes connected in series is greater than the parallel circuit. Energy stored in capacitor $E = \frac{1}{2}CV2$.
- 21. The electric field strength in the center of a ball cell whose inner part radius r and outer part radius R charged +Q distributed evenly in the ball cell is because the electric field strength in a point inversely proportional with the square of the distance of the point to the source charge. Here the students apply electric field formula of the point charge in the continuous charge distribution.
- 22. A positive charge if placed in an electric field, its potential energy increases because it moves in the opposite direction to the electric field.
- 23. Electron will move from high potential to low potential.
- 24. If a positive charge that is released from rest in the uniform electric field, its potential energy will decrease because the charge moves in an opposite direction to the electric field.
- 25. A positive charge in uniform electric field moves toward low potential, the work done by the negative electrostatic force changes in negative potential energy which means its potential energy becomes lower.
- 26. The greater the distance between two equipotential surfaces with the same potential difference, the work exerted by the electrostatic force to move the charge from one surface to another becomes greater.
- 27. The greater the distance between two equipotential surfaces with the same potential, the work exerted by electric field becomes greater, because E =V.d, with E = electric field, V =potential different between two equipotential surfaces and d =distances between equipotential surfaces.
- 28. The wider the surface of the plate of parallel plate capacitor, the greater is the capability to store a charge because $C = \epsilon Ad$, where C = capacitor capacity, A = area of the surface of the parallel



plate and the d= distance between two parallel plates.

- 29. If some capacitor is connected in series, the capacity of the equivalent capacitor equals the sum of the capacity of each capacitor. The student regards capacitor series circuit with is the same as electric resistance series circuit.
- 30. The capacity of the equivalent capacitor of some capacitors that are connected in parallel is smaller than the capacity of the capacitor of each component. The students regard capacitor of the parallel circuit that is the same as are resistance in the parallel circuit.

DISCUSSION AND CONCLUSSION

The high percentage of scientific knowledge about electric current can be assumed to be caused by the fact that before studying at senior high school the students have got a lesson about electric current in their previous education. At junior high school, the students learned the basics of electric charge which included how to make an object become charged, types of charge, and the characteristics of electric charge. However, the percentage of the students who had misconceptions and lake knowledge was still high enough. Meanwhile, the contribution of the percentage of students experiencing misconception on electrostatic force and capacitor was caused by several factors. First, the students did not know that in the interaction between two charges; the students did not know that the electrostatic interaction between two objects with different charges, the two charges experienced the same electrostatic force. On the contrary, the students understood that a greater charge obtains a greater force, even there were also students who understood that a greater charge exerts a greater work toward other objects. This agrees with the finding in Maloney (2001) and Bilal & Erol (2009). It seems that the failure of the students in understanding Newton's third law affects the concepts of the electrostatic force (Meloney, 2001). The students' misconceptions in electrostatic force were also seen from their ignorance of the relation between the distance between two charges, the students did not understand qualitatively that electrostatic force is inversely proportional to the square of the distance between the two charges that interact. A similar misconception is also found by Koudelkova & Dvorak (2015), that the students did not know qualitatively about electrostatic force (Coulomb force). In representing attractive force or repulsive force between two charges in a vector diagram, many students could not differentiate vector length for different attractive force or repulsive force. Similarly, when they were asked to determine the acceleration experienced as the result of an interaction of two objects with the same masses but with different charges, many students said that an object with a smaller charge had a greater acceleration.

The students tried to use Newton's second law in electrostatic force but they thought that an object charge was the same as its mass. For the concept of the capacitor, the students had not learned it at junior high school. The students' misconception about the concept of the capacitor was largely coming from the misinterpretation of series or parallel circuits of some capacitors. At junior high school, the students had learned electric resistance series and parallel circuits. When they were asked about capacitor series and parallel circuits they interpreted them similar to their interpretation of electric resistance series or parallel circuits.

For the concepts that have not been taught at junior high schools such as electric field, electric potential, and the capacitor, many students did not have any knowledge about them (lack knowledge). Electrostatic concepts in general, and electric field, electric potential, and the capacitor, in particular, were less familiar to them in their daily life. Concepts such as electric field, electric line force, the motion of charge in the electric field, an electric field of continuous charge, potential difference, electric potential energy, equipotential surface, the motion of charge in the equipotential surface, the motion of charge in the equipotential surface are abstract concepts that are remote from the students daily life. The students acquire prior knowledge through interactions with their environment. The students' less familiarity with static electricity concepts caused their very low level of interaction with these concepts, this caused a relatively high percentage of the students with lake knowledge about the electric field, electric potential, and capacitor.



Before entering formal lessons students have had prior knowledge of static electricity concepts. Their prior knowledge can be categorized into four categories: scientific knowledge, misconceptions, lack of concepts, and errors. There are thirty types of misconceptions identified in this study, some of which are alike to those found in misconception literature. Students' prior knowledge of static electricity concepts is very useful in designing appropriate conceptual change strategies. Therefore it is very important for the teacher to identify the variety of student's prior knowledge about static electricity before starting the lesson.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



Prof. Dr. Ketut Suma, M.S. is a Professor in the Department of Physics Education, Faculty of Mathematics and Natural Sciences, Ganesha University of Education. He completed his master degree at Bandung Institute of Technology- Indonesia and got a doctorate degree at Universitas Pendidikan Indonesia. The interest of the author are physics teaching, assessment, and character education.

Prof. Dr. Ketut Suma Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- Indonesia E. Mail: ketut.suma@Undiksha.ac.id



Prof. Dr. I Wayan Sadia, M.Pd, completed his doctoral degree at Universitas Pendidikan Indonesia in Bandung-Indonesia. He is a Professor in the Physics Education Departement, Faculty of Mathematics and Natural Sciences, Ganesha University of Education. His interests are science and character education research.

Prof. Dr. I Wayan Sadia Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- Indonesia E. Mail: <u>iwayan.sadia@undiksha.ac.id</u>



Dr. Ni Made Pujani, M.Si, is a lecturer at Science Education Department, Faculty of Mathematics and Natural Sciences, Ganesha University of Education. Her master's degree obtained at Bandung Institute of Technology -Bandung Indonesia, while his doctorate degree was obtained at Universitas Pendidikan Indonesia. Her research interest is science teaching and assessment.

Dr. Ni Made Pujani, M.Si Ganesha University of Education Faculty of Mathematics and Natural Sciences Singaraja- Indonesia E. Mail: nimade.pujani@undiksha.ac.id



REFERENCES

Ausubel D. P. (1968). *Educational psychology*: A cognitive view. New York: Holt, Rinehart, and Winston

Baser, M. (2006). Effect of conceptual change-oriented instruction on students' understanding of heat and temperature concepts. *Journal of Maltese Education Research, 4*(1), 64-79.

Bell, B.F. (1993). *Children's science, constructivism, and learning in science*. Victoria: Deakin University.

Bilal, E., & Erol, M. (2009) Investigating students' conceptions of some electricity concepts. *Lat. Am. J. Phys. Educ. 3,(),* 193-2001.

Bodner, G.M. (1986). Constructivism: A Theory of knowledge. *Journal of Chemical Education*, *63*, 873-878.

Brown, D. E., and Clement, J. 1989. Overcoming misconceptions via analogical reasoning: Abstract versus explanatory model construction. *Instructional Science*, *18*, 237-261.

Broughton, S.H., Sinatra, G.M., Reynold, R.E. (2010). *The Nature of the refutation text effect:* An investigation of attention allocation. UtahState University: Merril Lcazier Library.

Clement, J., Brown, D.E., and Zietsman, A. (1989). Not all preconceptions are misconceptions: Finding "Anchoring for Misconceptions" for grounding instruction on students, intuition. *International Journal of Science*, *11*(5), 554-565.

Chambers, S.K., & Andre, T. (1997). Gender, prior knowledge, interest, and experience in electricity and conceptual change text manipulations in learning about direct current. *Journal of Research in Science Teaching*, *24* (2), 107-123.

Driver, R., Squires, A., Rushworth, P. Valerie, & Robinson,W.(1994). *Making sense of secondary science. research into children's ideas.* London & New York: Routledge.

Dochy, F. J. R. C., Alexander, P. A. (1995). Mapping prior knowledge: A framework for discussion among researchers. *European Journal of Psychology of Education*, *X*(3), 225-242.

Ediyang, S. O. (2006). Prior knowledge of general objectives and specific behavioral objectives on students' achievement and retention in social studies in Akwa Ibom State of Nigeria. An Unpublished Ph.D. Thesis, University of Calabar, Calabar.

Engelhardt, P.V., & Beichner, R.J. (2004). Students' understanding of direct current resistive electrical circuits. *Am. J. Phys.* 72 (1), 98-115.

Esanu, A., & Hatu, C.(2015). The significance of prior knowledge in physics Learning. *The 11th International Scientific Conference eLearning and software for Education Bucharest,* April 25-26, 2015.

Hewson, M.G., and Hewson, P.W. (1983). Effect of instruction using students' prior knowledge and conceptual change strategies on science learning. *JRST*, *20*, Issue (8), 1983, 731–743.

Ismail, I. I., Samsudin, A., Suhensi, E., & Kadiawati, I. 2015. Diagnostik Miskonsepsi Melalui Listrik Dinamis Four Tier Test. *Prosiding Simposium Nasional Inovasi dan Pembelajaran Sains 2015*: tgl 8 dan 9 Juni 2015, Bandung, Indonesia.



Kaltakçi, D., & Nilüfer, D. (2007). Identification of pre-service physics teachers' misconceptions on gravity concept: A study with a 3-tier misconception test. *Sixth International Conference of the Balkan Physical Union*, 499-500, American Institute of Physics.

Koudelkova, V., Dvorak, L.(2015). High school students' misconceptions in electricity and magnetism and some experiments that can help students to reduce them. *IL NUOVO CIMENTO 38*, (C), 1-7.

Küçüközer, H. and Kocakülah, S. (2007). Secondary school students' misconceptions about simple electric circuits. *Journal of Turkish Science Education 4*, 101-115.

Maloney, D.P., O'Kuma, T.I., Hieggelke, C.J., & Heuvelen, A. V. (2001). Surveying students' conceptual knowledge of electricity and magnetism. *Am. J. Phys.* Suppl. 69 ~71, July 2001.

O'Dwyer, A. (2009). Prior understanding of basic electrical circuit concepts by first-year engineering students. *All-Ireland Society for Higher Education (AISHE) Conference*, NUI Maynooth.

Osborne, R., & Freyberg, P., Bell, B., Tasker, R., Cosgrove, M., and Schollum, B. (1985). *Learning in science*: The implication of children's science. London: Heinemann.

Osborne, R.J. & Wittrock, M.C. (1983). Learning science: A generative process. *Science Education*, 67, 489-508.

Ozkan, G., Selcuk, G.S. (2013). The use of conceptual change text as class material in the teaching of sound in physics. *Asia Pacific Forum on Science Learning and Teaching, 14*, Issue 1, article 11 (June 2013).

Ozmen, H. 2007. The effectiveness of conceptual change texts in remediating school students' alternative conception concerning chemical equilibrium. *Asia Pacific Education Review*, 8(3), 413-425.

Petersson, G. (2002). Description of cognitive development from a constructivist perspective. Paper presented at *the third European Symposium on Conceptual Change, June* 26-28. 2002, Turku, Finland.

Pinarbasi, T., Canpolat, N., Bayrak Ceken, C., S. & Goban, Geban, O. (2006): An investigation of the effectiveness of conceptual change text-oriented instruction on students' understanding of solution concepts. *Research in Science Education, 36*.

Roschelle, J. (1997). Learning in Interactive Environments: Prior Knowledge and New Experience. Retrieved October 16, 2017, from <u>http://astc.org/resource/education/priorknw.htm</u>.

Sencar, S., & Eryilmaz, A. (2004). Factors mediating the effect of gender on ninth-grade Turkish students' misconceptions concerning electric circuits. *Journal of Research in Science Teaching*, *41*(6), 603-616.

Sungur, S., Tekkaya, C., & Geban, O. (2001). The contribution of conceptual change texts accompanied by concept mapping to students' understanding of the human circulatory system. *School Science and Mathematics*, *101*, 91–101.

Svinicki, M. (1993-94). *What they don't know can hurt them*: The role of prior knowledge in learning. Essays on Teaching Excellence. Toward the Best in the Academy, 5, (4).

Tekaya, C. (2002). Misconception as a barrier to understanding biology. *Hacettepe Universitesi Egitim Fakultesi Dergisi, 23*,259-266 (2002).



Thompson, F., & Logue, S. (2006). An Exploration of common student misconceptions in science. *International Education Journal*, 7(4), 553-559.

Turgut, U., Gürbüz, F., & Turgut, G. (2011). An investigation 10th grade students' misconceptions about electric. Current. *Procedia Social and Behavioral Sciences, 15* (2011), 1965–197.



SOCIAL PARADIGMS IN GUIDING SOCIAL RESEARCH DESIGN: THE FUNCTIONAL, INTERPRETIVE, RADICAL HUMANIST AND RADICAL STRUCTURAL PARADIGMS

Prof. Dr. Ilhan Gunbayi Akdeniz University, Faculty of Education TURKEY

Sath Sorm Akdeniz University, Faculty of Education TURKEY

Abstract

The four paradigms are influential philosophical stances applied to advocate social research designs since they have been supported by eight different analytical lenses and had various functions for analysing the research nature as well as social phenomena based on two main analytical approaches, objective and subjective viewpoints. After clarifying their application in social research methods, we have concluded that the functionalist paradigm is very compatible with most of quantitative research methods whereas the interpretive paradigm is very fit for the majority of qualitative research designs. In terms of the radical humanist paradigm, it is extremely applicable with participatory action research, emancipatory action research and transformative design while the radical structuralist paradigm is very appropriate with technical action research, experimental research, quasi-experimental research and embedded design. However, some research designs intertwine between two paradigms; for example, mixed convergent parallel, mixed multiphase design, and mixed embedded design. Therefore, they make the researcher confusing.

Keywords: Paradigm, approach, method, research, design.

INTRODUCTION

Our activities are determined by our creed or philosophies. Before conducting a social research, we always reckon to our philosophy or research nature behind our study. Here is a social paradigm which is a set of belief that is used to view the social world, and to guide us how to do our actions as well as social scientific study. We refer to those terms as the system of beliefs, philosophies, or the nature of study as paradigm. The notion in this context are basics in sense that they must accept simply on faith; there is no way to create their own ultimate truthfulness (Guba & Lincoln, 1994). Recently, social paradigm has been gaining wide popularity through applying to guide researches. Killam (2013) argues different types of research are based on different sets of beliefs; to understand research, one must examine philosophy behind it. Analogously, she further uses metaphor of paradigm as the lens of coloured glasses. Once we think about paradigm, think about looking through coloured glasses. If you put on red glasses, everything looks red. If we put on green, the world looks green. If we put on yellow, everything around us looks yellow.

Why is social paradigm important for research? There are many advantages that the researcher should focus upon it. Firstly, it helps us to formulate research problems or questions systematically. It explains the reality or the truth, lying behind our research problem. In this sense, it implies the nature of the study that affects the succeeding procedure. Secondly, upon undertaking the actual research, it prompts the possible answer so that we are able to logically predict the future results or implication of our work. Thirdly, it enables us to see the relation among the variables so that we are able to control them. Thus, it prevents researchers from being blurred in their study. Furthermore, once we understand paradigm, we are able to employ the compatible research design which informs the research strategies that lead us to use correct techniques of data collection and data analysis so



that our research would be reliable and creditable. Moreover, according to Kraft (1979), there are six major functions of worldview or paradigm that enable us to see or to study the object of the research more scientifically:

• "It explains how and why things became the way they are, and how and why they continue or change.

- It is used to order, judge and validate.
- It provides psychological reinforcement for the group.
- The worldview of a culture or subculture integrates various elements of the culture.

• It enables a people to sort out, arrange and make different commitments, allegiances or loyalties to things that are assumed, valued and done".

METHODOLOGY

The objective of the article is to claim the importance of functional, interpretive, radical humanist and radical structural paradigm in guiding scientific social research so that they guide us to do our researches more scientifically, relying on their particular approaches, philosophical background and diversely to the study topics than present research paradigms do. They are the seminal achievement of Burrell and Morgan, written in 1979. The purposes of their model are to create the way to analyse organizations and social theories. Seeing their paradigms are useful for research, beyond the extent of their implication, we aim to exhibit the benefits of these paradigms in leading researchers to apply them in their study. The following arguments are the reasons why the four paradigms are appropriate for research.

The authors deployed two main tools to understand why research designs are being supported by one of these four paradigms. For the first tool, we deployed scheme for analysing assumptions about the nature of social science, developed by Burrell and Morgan (1979) as major strategy to classify the application of the four paradigms in social research.



The Subjective-Objective Dimension

Figure 1: A scheme for analysing assumptions about the nature of social science (Burrell& Morgan, 1979)

Nominalism versus Realism

Nominalism is from the Latin "nomen" means "name". This philosophy significantly originated from Arabic philosophy in "Tahafut al-Falasifah" around A.D. 1059-1111, simultaneously in the European Middle Age era. The term represents a belief concerning universal by arguing that universal does not exist except in name (Iannone, 2001). Its position revolves around the assumption that the social



world external to individual cognition is made up of nothing more than names, concepts and labels which are used to structure reality. The nominalist does not admit to any 'real' structure to the world which these concepts are used to describe. The 'names' used are regarded as artificial creations whose utility is based upon their convenience as tools for describing, making sense of and negotiating the external world. Nominalism is often equated with conventionalism, and we will make no distinction between them (Burrell & Morgan, 1979).

Standing in stark contrast to nominalism, realists holds a view that the social world external to individual cognition is a real world made up of hard, tangible and relatively immutable structures. Whether or not we label and perceive these structures, the realists maintain, they still exist as empirical entities. We may not even be aware of the existence of certain crucial structures and therefore have no 'names' or concepts to articulate them. For the realist, the social world exists independently of an individual's appreciation of it. The individual is seen as being born into and living within a social world which has a reality of its own. It is not something which the individual creates- it exists 'out there'; ontologically it is prior to the existence and consciousness of any single human being. For the realist, the social world has an existence which is as hard and concrete as the natural world (Burrell & Morgan, 1979).

Positivism versus Anti-positivism

Positivism was created in the mid-19th Century by Auguste Comte, who established the posivist approach to social science. Positivists argues that the explanation on sociology is the same as that of natural science. Thus, we are able to use, logic, methods, and procedures of natural science to interpret the social phenomena (Lawson, Jones, & Moore, 2000). According to Mastin (2008), "the only authentic knowledge is scientific knowledge, and that such knowledge can only come from positive affirmation of theories through strict scientific method (techniques for investigating phenomena based on gathering observable, empirical and measurable evidence, subject to specific principles of reasoning)". He, moreover, argues there are five main principles behind Positivism:

- 1. "The logic of inquiry is the same across all sciences (both social and natural).
- 2. The goal of inquiry is to explain and predict, and thereby to discover necessary and sufficient conditions for any phenomenon.
- 3. Research should be empirically observable with human senses, and should use inductive logic to develop statements that can be tested.
- 4. Science is not the same as common sense, and researchers must be careful not to let common sense bias their research.
- 5. Science should be judged by logic, and should be as value-free as possible. The ultimate goal of science is to produce knowledge, regardless of politics, morals, values, etc. "

Some sociologists from anti-positivism have noted that, since they lack the goal of understanding, positivism's three goals- description, control, and prediction-are incomplete (Trueman, 2018). Being opposite to positivism, anti-positivism, based on Lawson et al. (2000), was developed by Weber (1953) in "Verstenhen" sociology which stressed on the meaning of social action as understood by the social actors involved, and by the contribution of early Chicago school scholars: Mead (1934) focused on the concept of self in understanding social action, and other sociologists such as Dewey (1953), Cooley (1902), Thomas (1909). Anti-positivists hold position that the intersubjective world is essentially relativistic and can only be understood from the point of view of the individuals who are directly involved in the activities which are to be studied. They reject the standpoint of the 'observer', which characterises positivist epistemology, as a valid vantage point for understanding human activities. They maintain that one can only 'understand' by occupying the frame of reference of the participant in action. One has to understand from the inside rather than the outside. From this point of view social science is seen as being essentially a subjective rather than an objective enterprise. Anti-positivists tend to reject the notion that science can generate objective knowledge of any kind (Burrell & Morgan, 1979). Similarly, Lawson et al. (2000) assumes that the subject matter of sociology is basically different from that of natural sciences. Subjective consciousness of individuals



cannot be quantified. On the other hand, we cannot understand social action through scientific methods, and there are no causal laws governing social behaviour.

Voluntarism vs Determinism

The assumption of human activities were discussed in two dimensions, voluntarism and determinism. Voluntarists believe that the human action is autonomous and free-willed while determinists adhere to the position that the man is completely determined by the situation or environment around him (Burrell & Morgan, 1979). Voluntarism forms intentions, and makes decisions and choices taking precedence over intellect; on the other hand, the will is the faculty that enables agents to be motivated to act on the basis of their rational deliberations about which actions would be best to perform (NWE, 2016). So, based on voluntarism, human being is independent and has altruistic character, and determinists are dependent. Both assumptions are the main nature of human being, and they are very important for the social researchers to study about the social phenomena.

Ideographic versus Nomothetic

Wilhelm Windelband proposed the distinction between nomothetic and ideographic research strategies or methodologies in 1894; eventually, it has become customary to classify modern social research into categories (Mouton & Marais, 1988). Theoretically, ideographic view holds that, in order to understand the world, we should obtain the first and knowledge of the subject under investigation (Burrell & Morgan, 1979). Its approach is the observation. We should get inside the situations and involve ourselves in the real life of the subject of investigation. We are not able to make generalization as a whole or law, but we are able to make a generalization in particular case, case study for example. According to this method, individual is unique so the study should be individualistic or small group-oriented and naturalistic. Therefore, ideographic method is qualitative research in nature and the common techniques of data collection are unstructured interviews, self-reports, autobiographies etc.

Not the same to ideographic theory, nomothetic approach focuses on using natural science method such as testing hypotheses and doing experiment by following systematic protocol and techniques as tools (Burrell & Morgan, 1979). The study from this approach is big group-oriented towards establishing general law as well as generalization. Therefore, the nomothetic approach is quantitative research in nature. Surveys, questionnaires, test etc. are the common techniques of this kind of method.

Totally, the four assumptions above are powerful tools for scientifically analysing the social theory accurately, and are widely accepted. Moreover, they are useful for classifying particular social paradigm usage in underpinning research design because they have eight distinct analytical lenses of four social-scientific debates. Nominalism and realism assist us to answer the ontological inquiries "what is the nature of reality? Socially constructed or factual reality? ". Epistemologically, positivism and anti-positivism help us to seek solution of "how do we know what we know? What are the sources of knowledge? How reliable are these sources? What can one know? How does one know if something is true? Is a belief true knowledge? Or is knowledge only that which can be proven using concrete data? What methods can you use to find out about their existence? (Wagner, Kawulich & Garner, 2012). On the other hand, voluntarism and determinism are the effective tools for analysing the human actions by asking, whether his activities are determined by the situation or environment or not? or are they done autonomously and willingly? Finally, it is helpful for us to look deeply at ideographic and nomothetic approach of methodological assumption. They lay emphasis upon "what techniques can we apply to find the answer of object of the investigation.



For the second one, we used Habermas's knowledge-constitutive (cognitive) interests.



Figure 2: Hbermas's Knowledge Constitutive (Cognitive) Ineterests (Hbermas, 1987)

Habermas's theory of knowledge-constitutive interest has been reflected on epistemology of the social scientific research as well as utilized in social analysis. For him, technical interest is the scientific, positivist method, with focusing on laws, rules, prediction and control of behaviour, with passive research objects and instrumental knowledge (Cooper, 2016). Most of all, technical interest employs objective approach and systematic line of inquiry in functioning its work (Taylor, 2006). Thus, this interest is fit for leading the quantitative scientific research in nature.

In respect of the practical interest, it is exemplified in the hermeneutic, interpretive methodologies outlined in qualitative approach to understanding and seeking to clarify, understand and interpret the communications of speaking and acting subjects. Hermeneutics put emphasis on interaction and language; it tries to understand situations through the eyes of participants, focusing on social facts in their cultural locations. Hermeneutics explicit the meaning in a social context of interacting subjects, recovering and reconstruction the intentions of actors in a condition.

Emancipatory interest is characterized the intentions of transforming to oppose the operation of power and to bring about changing by believing that domination and oppression have prevented full existential realization of individual and social freedom (Cooper, 2016). Emancipation referred to the ability to free oneself from environmental constrain and power of others over self and awareness that are important for releasing oneself from such situation (Bali, Wickramasinghe & Lehaney, 2009).

THE FUNCTIONALIST PARADIGM IN GUIDING QUANTITATIVE RESEARCH

Functionalist paradigm is rooted in the sociology of regulation which provides the rational explanation on the status quo, the social order, the social integration, solidarity, equilibrium, the need of satisfaction and actuality by using objectivist approach as a tool. Based on its assumption, one tends to be realist, positivist, determinist and nomothetic (Burrell & Morgan, 1979). Originally, functionalist paradigm mainly came from the root of tradition of sociological positivist. Thus, it is depending on the natural science's method to study its subject. It emphasises that "human behaviour is governed by relatively stable social structures. It underlines how social structures maintain or undermine social stability. It emphasizes that social structures are based mainly on shared values or preferences and suggests that re-establishing equilibrium can best solve most social problems" (Brym & Lie, 2007). The dominant usage of this paradigm is for studying about social affair, organization or social system. It is absolutely pragmatic oriented paradigm that concerns to find practical solution to practical problems.

The assumption of functionalist paradigm are: firstly, the social world is composed of relatively concrete empirical artefacts and relationship which can be identified, studies and measured via natural science approach. Secondly, society has real, concrete existence, and systematic character and is directed towards the production of regulation, order equilibrium, stability in society, and the



way in which these can be maintained. Thirdly, social facts exist outside of men's consciousness and restrain men in their everyday activities. The aim was to understand the relationships between these 'objective' social facts and to articulate the sociology which explained the types of 'solidarity' providing the 'social cement' which holds society together. The stability and ordered nature of the natural world was viewed as characterising the world of human affairs (Burrell & Morgan, 1979).

To which research design are applicable to functionalist paradigm? As seeing above, the functionalist paradigm is quantitative research in nature because, ontologically, it is realist. Epistemologically, it is positivist. It tends to be determinist in human nature, and to be nomothetic in methodological assumption. Therefore, what we will emphasize is on quantitative research design.

First, the researcher should use this paradigm to guide descriptive study of quantitative research because this design's role is to seek the description of the current status of a variable or phenomenon (Shirish, 2013). It utilizes objectivist approach as a tool, questionnaires, statistical analysis, to investigate the subject study. It is consistent with functionalist paradigm's subject concern which rests upon status quo, current state of affair. Furthermore, to conduct descriptive research more broadly and diversely, the researchers should consider more about the social order, the social integration, solidarity, equilibrium, the need of satisfaction and actuality in the level of objective view. Shortly, this paradigm is very suit to descriptive research since the functionalist paradigm reveals in detail answer on "how is the social system maintain? They can choose some of these concerns relevant to their topics as supportive idea in their research so that they are able to find proper and sufficient variables that scientifically correspond to their research questions. Specifically, using this paradigm to underpin the descriptive design is very fit for administration or organizational study.

On the other hand, survey research both longitudinal and cross sectional design are also oriented by the functionalist paradigm because, based on Converse (2009), survey is relevant to the notions of 'scientific', objective, and 'standardized' gathering of the 'fact' through 'probability' sampling; originally, its assumption is that the form of knowledge is construct of hard, objective measurements rather than opinion, emotion, intuition or exaggerated political tendency.

Furthermore, correlational research is also applicable for this paradigm because this paradigm provide the explanation on systematic relation in nature and its basic assumption is every element in the fabric of social scheme is related. It is consistent with correlational research's function which is used to look and look for the functional relationship among the variables (McBurney & White, 2010). Totally, this paradigm helps correlational researchers to understand how and why variables in the system have correlation.

The mixed explanatory sequential research design is a sequential design which the first strand of quantitative research is prioritized while the qualitative method is applied to supplement the first phase (quantitative data collection and analysed and then followed by qualitative data collection and analysed, lastly interpreted). The design attempts to find the "Why" question through generally developing causal explanation or testing theory (Baran & Jones, 2016). The researcher deploys the mixed explanatory sequential research when:

- "The researcher and the research problem are more quantitatively oriented.
- The researcher knows the important variables and has access to quantitative instruments for measuring the constructs of primary interest.
- The researcher has the ability to return to participants for a second round of qualitative data collection.
- The researcher has the time to conduct the research in two phases.
- The researcher has limited resources and needs a design where only one type of data is being collected and analysed at a time.
- The researcher develops new questions based on quantitative results, and they cannot be answered with quantitative data (Creswell & Plano Clark, 2011)".



Therefore, the mixed explanatory sequential design is oriented by the functionalist paradigm because it focuses dominantly on quantitative method and findings which yields statistical significance, confident intervals, and affect size, and provide the overall results of a study (Creswell, 2015).

THE INTERPRETIVE PARADIGM IN GUIDING QUALITATIVE RESEARCH

The interpretive paradigm is polarized in the dimension of sociology of regulation by using subjective approach as analytical tool. The subjective areas of analysis are stressed on the same to those of functionalist paradigm: the status quo, social order, consensus, social integration and cohesion, solidarity and actuality. However, its approach is different from that of functionalist view. Its ontological position tends to be nominalist. Epistemologically, it is anti-positivist, and voluntarist in human nature. More particularly, it is located in ideographic division in methodology.

The interpretivist holds the premise that, to understand the world, we should be aware of the fundamental nature of social world at the level of subjective experience. It explains the realm of individual consciousness and subjectivity. In terms of the world outlook, interpretive theorists see the world as emergent social process, created by the individuals concerned, and the world of human affair is cohesive, ordered, and integrated. To find social reality, implicitly rather than explicitly, we should scrutinize in depth of human consciousness and subjectivity in order to seek for the fundamental meanings that underscore in social life (Burrell & Morgan, 1979). It is in line with Holloway and Wheeler (2010) who argue the qualitative approach believes that the human experiences as well as other social phenomena is context-bound, so they are not able to be free from time and location or the mind of the human actor. Moreover, they claim that complete objectivity and neutrality are impossible to gain; the values of all participants become a part of the research. Thus, one is very suit for directing qualitative research design.

The interpretive paradigm has been applied popularly in guiding qualitative research such as case study, grounded theory, ethnography, phenomenology, narrative study, systematic review, discourse analysis etc. Case study is directed by interpretive paradigm because of some reasons. Initially, case study, the same to other qualitative designs, is used to answer humanistic "why? and how?" questions instead of to answer more mechanistic "what?" question (Marshall, 1996). So does the interpretive paradigm, it is deployed to widely undertake psychological researches for finding the humanistic answers by using humanistic approach (Mills, Durepos, & Wiebe, 2010). More specifically, Yin (2008) argues that case study is applied to investigate a contemporary phenomenon within its real-life context, most of all when the boundaries between phenomenon and context are not clearly evident. According to him, there are four different applications:

- "To explain the presumed causal relation in real-life interventions that are too complex (from holistic to embedded level, from single to multiple design) for positivist methodology (survey or experimental research).
- To describe the real-life context in which an intervention has occurred
- To illustrate certain topic within an evaluation, again in a descriptive mode.
- To enlighten these situations in which the intervention has no clear, single set outcome." (Yin, 2009; Brym, & Lie, 2007).

Similarly, based on Wang (2015), case study has been used to explore in-depth explanation or knowledge about particular group or individual (case) such as an individual, a classroom, a school, a company or a group of organizations etc. in purpose of responding the in-depth inquiries; to achieve so, case researchers have utilized various strategies to collect data from different sources. Beneficially, the results gaining from case study is fruitfully useful for constructing hypothesises for further empirical research.

Grounded theory is conducted to generate a theory by using inductive approach. It investigates many individuals who share in the same process, action, or interaction, and the research participants are not apparently to be situated in the same location or interacting on so frequent a basis that they



develop shared patterns of behaviour, beliefs, and language (Creswell, 2007). Since its background has had the same ontological, epistemological, human nature and methodological foundation to the interpretive paradigm's. Therefore, grounded theory also follows the interpretive guidance. Strategically, Grounded theory is developed from a corpus of data, which all forms of observation and all kinds of interview techniques serve as main tools for collecting data; however, other strategies may also applicable (Glaser & Strauss, 1967). Data is produced through interpreting meaning of the interaction between the researcher and participants. In his seminal accomplishment "symbolic interactionism", Blumer (1969) proposes three premises in which the meaning is created from:

- 1. "Human beings act towards things on the basic of meaning the things have for them. They views this world; for instance, this physical objects as tree, building, box..., human beings as mother, father, friends..., animals as cow, horse, dog..., institution as school, company, hospital..etc. When the faces in his everyday lives.
- 2. The meaning of such things is derived from the social interaction that one has with one's fellows
- 3. These meaning are handled or modified via an interpretive process used by the person in dealing with the things he encounters".

Since data constructing from the meaning of interpretation of interaction, the focus group method is the most influential tool for substantive grounded theory design (Martin & Gynild, 2011). On the other hand, the grounded theory investigator should focus on the quality of interaction between the researcher and informants.

In terms of ethnographic research, it is used to study about the social or cultural life of communities, institutions, or other setting. As naturalist, ethnographer holds the premise that human behaviour and the ways in which they construct and make meaning of their worlds and their lives are highly variable and locally specific, and researcher's eyes and ears play primary roles in gathering data (LeCompte & Schensul, 1999). Ethnographic research is in the group of research design which is guided by the interpretive paradigm because it seeks an explanation for social or cultural events based on the perspectives and experiences of the people being studied; moreover, it is relying on the daily lives of the people (Noblit & Hare, 1988). According Creswell (2007), ethnography is a way of studying a culture-sharing group (to explore the beliefs, language, behaviours, and issues such as power, resistance, and dominance) as well as the final, written product of the research. It studies on the whole cultural group, which are sometimes small (a few students, a few nurses), but it is large because ethnography gets involved many people, interacting each other over time, for example students in entire school, nurses in entire hospital. Based on him, in order to conduct ethnography successfully, ethnographers should employ long-term observations.

"As a process, ethnography involves extended observations of the group, most often through participant observation, in which the researcher is immersed in the day-to-day lives of the people and observes and interviews the group participants" (Creswell, 2007).

The interpretive paradigm has been very fit to direct ethnographers to do their research about culture-sharing group since such a study is used idiographic approach that subjective view, namely observation, acts as main mean to look for the subject of investigation. However, other types of data collection methods such as tests and measures, surveys, content analysis, elicitation techniques, audio-visual methods, spatial mapping, network research, collection of cultural artefacts and interviews (individual or group) are applicable as well (LeCompte & Schensul, 1999).

Phenomenological research is another design which is oriented by the interpretive paradigm. It is the study of human experience and the way in which things are perceived as they appear to consciousness. The focus is on people's perceptions of the world-their perception of the 'things in their appearing'. We are interested in describing the world as it appears to people, and we need to engage in a variety of processes in order to achieve this (Langdridge, 2007). It puts emphasis on descriptions of what people experience and how it is that they experience what they experience



(Patton, 1990). Additionally, phenomenologists try to seek the answer on "how the everyday, intersubjective world is constituted" from the participants' perspective (Schwandt, 2000).

Husserl (1970) argues that "we can only know what we experience". Thus, based on this statement, any inquiry cannot engage in 'sciences of facts' because there are not absolutely facts; we only can establish 'knowledge of essences' because only the essence is the central underlying meaning of the experience shared within the different lived experiences. Technically, the researcher should first look into the individual point of view, i.e. the realization of subject consciousness perceived in the objects, to get to understand human phenomena as lived and experienced, which pointed out as the major characteristics of a phenomenological psychological method (Giorgio, 1985). The major data source for this kind of study is interviewing. Patton (1990) stated the purpose of interviewing specifically as "to find out what is in and on someone else's mind", and that is exactly what the target of the phenomenological study focuses on, i.e. the perception of lived experience.

Remarkably, there are two perspectives of phenomenological analysis of the perception of lived experience: from the people who are living through the phenomenon, and from the researcher, whose has great interest in the phenomenon. In order to 'return to the things themselves, according to Husserl (1970), the researcher cannot impose the meanings for the learners, for example, because they are the absolute sources of their own existence living through the learning environment. However, it seems to be impossible to detach personal interpretations from the things that are personally interesting. Therefore, the researcher has to be aware of his or her own experience being infused into both his/her and engagement in the interviews and the analysis of data. All we explicate above are reasons which claim that phenomenological research is directed by the interpretive paradigm because its objective of inquiry is delving into experiences. It draws parallel with the paradigm's assumption. For data collection, phenomenologist only attempt to understand and then describe on what the participants respond. There is no intervention from the researcher.

Narrative study is a story-based approach, used to investigate into the life story of human centre topic that reflects the fact of experiences (Webster & Mertova, 2007). Narrative inquiry uses field texts, such as stories, autobiography, journals, field notes, letters, conversations, interviews, family stories, photos (and other artefacts), and life experience, as the units of analysis to research and understand the way people create meaning in their lives as narratives to respond the "why" subjective behind their statement (Clandinin & Connelly, 2000). It is consistent with the interpretive position, which affirms that it was not attempted to predefine independent variables and dependent variables, but only try to understand phenomena through the meanings that people assign to them (Klein & Myers, 1999). To sum up, the interpretive paradigm also works well as a guide in showing the direction of narrative researcher.

Systematic review is other qualitative design, backed by the interpretive paradigm. One is a type of literature review that collects and critically analyses multiple research studies or papers. Basically, its assumption is that a review of existing studies is often quicker and cheaper than getting on a new study. The systematic review researchers believe that every primary qualitative report is the conductors' interpretation of the study participants' interpretation of the phenomenon being researched. So, they are able to reveal the multiple opinions of different stakeholders with sensitive understanding. They look for evident that contest, reinforces and augments their emerging understanding of phenomena (Suri, 2017).

Systematic review is one form of research synthesis which contributes to evidence based policy and practice by identifying the accumulated research evidence on a topic or question, critically appraising it for its methodological quality and findings, and determining the consistent and variable messages that are generated by this body of work. They differ from other types of research synthesis by virtue of the way they formulate a research question, their comprehensive approach to searching, their critical appraisal strategy, and the transparency of criteria for including and excluding primary studies for review (Davies, 2004).


There are eight phases of conducting systematic review according to Torrance (2004):

- 1. "Specify a single 'answerable' research question
- 2. Identify search terms
- 3. Conduct a 'systematic' search of electronic databases, plus hand-searching journals, 'grey' literature, etc
- 4. Define and report explicit inclusion/exclusion criteria, including in relation to research methodology and quality
- 5. Take initial inclusion/exclusion filtering decisions on the basis of an abstract if it is available or the title if it is not
- 6. Decisions taken by more than one reviewer to increase reliability.
- 7. Identification of a 'map' of the field comprising articles to be read and indexed, with further exclusion of articles deemed of less relevance and/or low methodological quality after reading.
- 8. Final review of only those texts directly relevant to the research question and of high methodological quality "

Relying heavily on argument above, it is strongly consistent with the interpretive paradigm which holds premise that the world is socially constructed in terms of the meanings we attribute to events. The questions typically ask in this method are: How different stakeholders in different contexts experience a phenomenon? How do the contextual particularities interact with the perceptions of different groups and individuals? How do individual primary research reports on a topic reinforce, contradict or augment each other (Suri, 2017).

Similarly meta-synthesis, backed by the interpretive paradigm, attempts to integrate results from a number of different but inter-related qualitative studies. Meta-synthesis is used to compare, interpret, translate, and synthesize different research frameworks. The technique has an interpretive, rather than aggregating, intent, in contrast to meta-analysis of quantitative studies. Meta-synthesis of qualitative research is a parallel technique to meta-analysis of quantitative research but has important differences; for, meta-synthesis of qualitative research is based on structuralism paradigm. Thus the goal of meta-synthesis is interpretive rather than deductive. While quantitative meta-analysis aims to increase certainty in cause and effect conclusions, qualitative meta-synthesis seeks to understand and explain phenomena. (Walsh & Downe, 2004).

Discourse or metaphor analysis is a research guided by the interpretive paradigm as well. It is utilized to analyse the language that is structured according to different patterns that people's utterances follow when they take part in different domains of social life (Jorgensen & Phillips, 2002). 'Discourse' refers to any utterance which is meaningful. These texts can be: written, oral and mixed written/oral. Discourses are ways of being in the world, or forms of life which integrate words, acts, values, beliefs, attitudes, social identities, as well as gestures, glances, body position, and clothes." (Gee, 1999) Literally, metaphor, a form of oral discourse is the figure of speech in which a word or phrase literally denoting one kind of object or idea is used in place of another to suggest a likeness or analogy between them whereas discourses are ways of being in the world, or forms of life which integrate, body position, and clothes" (Gee, 1999). Thus, discourse or metaphor analysis is the study about the language by using metaphor or other forms of a language as a tool to understand the social world of communication. For data collection technique, the naturalistic tools have been deployed widely this method such as interview, speeches, focus group discussion and various texts (Amin, 2017).

The mixed exploratory sequential design is the iterative design in which qualitative method is employed to create theory or specific theoretical constructs while the quantitative method is applied to help with testing out the idea generated from qualitative findings (Hesse-Biber, 2010). It is generally recognized that, to generalize the qualitative results more acceptably and convincingly, quantitative phase play role as auxiliary method. Likewise, Creswell and Plano Clark (2011) raise the



importance of this design as follows: it is necessary for researcher to use this design when they want to make a generalization, assess, or test qualitative the mixed exploratory sequential design findings to check whether they are able to be generalized to a sample and a population or not. Additionally, the mixed exploratory sequential design research is employed when the researcher and the research problem are more qualitatively oriented.

- "The researcher does not know what constructs are important to study, and relevant quantitative instruments are not available.
- When the researcher doesn't know what constructs are important to study and relevant to quantitative instruments are not available
- The researcher has the time to conduct the research in two phases.
- The researcher has limited resources and needs a design where only one type of data is being collected and analysed at a time.
- The researcher identifies new emergent research questions based on qualitative results that cannot be answered with qualitative data".

Moreover, based on them, sequential exploratory mixed methods researchers hold the assumption that an exploration is needed for one of several reasons: (1) measures or instruments are not available, (2) the variables are unknown, or (3) there is no guiding framework or theory. Since this kind of design has been placed qualitative method first and is qualitatively oriented, it is put more emphasises on qualitative research problems. Therefore, the interpretive paradigm is the priority whereas the functionalist paradigm in quantitative method that focuses on measuring variables and statistical trend is just auxiliary. However, the multiple worldviews are used in this design, and the paradigms underpinning this design shift from one phase to other (Creswell & Plano Clark, 2011).

Multiphase design, according to Creswell & Plano Clark (2011), is used when the researcher cannot fulfil the long-term program objective of the study with a single mixed methods study, so this design is applicable for long-term project which proceeds multiyear plan and changing in turn (qualitative followed by quantitative and then qualitative again), and when the researcher has experiences in large-scale research (e.g., an evaluation background, a background in complex health science projects), and he or she has sufficient resources and funding to implement the study over multiple years, or whenever he or she is part of a team that includes practitioners in addition to individuals with research expertise in both qualitative and quantitative research, and he or she is conducting a mixed method project that is emerging, and new questions arise during different stages of the research project. In this condition, multiphase design is contextually fit.

Philosophically, the design incorporates flexibly. If it is started by qualitative research, and ended by the same design as the beginning. Thus, the interpretive paradigm is dominant, and prioritized In this case, the multiphase design is led by the interpretive paradigm. In contrast, if the study is begun by quantitative and ended by quantitative research. It means that the multiphase design is directed by the functionalist paradigm. Shortly, one can be guided by the interpretive paradigm or the functionalist paradigm if sequential, or pragmatism if concurrent.

The mixed convergent parallel design occurs when the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritizes the methods equally, and keeps the strands independent during analysis and then mixes the results during the overall interpretation (Creswell & Plano Clark, 2011). Thus, it can be used both the interpretive paradigm and the functionalist paradigm.

THE RADICAL HUMANIST PARADIGM IN DIRECTING QUALITATIVE RESEARCH

The radical humanist paradigm provides an explanation of radical change, modes of domination, emancipation, deprivation and potentiality by using subjective approach. So, the radical humanist researchers tend to be nominalist, anti-positivist, voluntarist and ideographic. The crucial notion of the paradigm is that the consciousness of man is dominated by the ideological superstructures with



which he interacts, and that these drive a cognitive wedge (the wedge of alienation or false consciousness which blocks true human fulfilment) between himself and his true consciousness (Burrell & Morgan, 1979).

By criticising the status quo, the humanist paradigm's frame of reference beholds the society to be transformed the limitation of existing social arrangement concerning with release from the constraints which existing social arrangements place upon human development. It is based on the principle that there will be revolution or transformation through consciousness that is the means through which society will change with people throwing off the chains of psychic impressions which tie them into alienating modes of life. It is a belief in the ability to change society through changing consciousness, by changing the way people think, see, and understand of the world. It tries to bring about a new worldview, a new paradigm which allows people individually and in conjunction with others to reorganize their experiences.

There are some research designs under the umbrella of the radical humanist paradigms in which is applied to conduct research that is change oriented and seeks to advance social justice causes by identifying power imbalances and empowering individuals and/or communities, that is, the purpose of mixing methods in the transformative design is used for value-based and ideological reasons more than for reasons related to methods and procedures (Greene, 2007; Creswell & Plano Clark, 2011). According to Mertens (2009), in transformative standpoint, the reality is socially constructed; thus, to carry out the transformative research successfully, the researcher should build interactive connection between the researcher and the participants so that we are able to find the knowledge that socially and historically situated in a complex cultural context. Furthermore, she scientifically advises that definitions of the problem, and method should be adjusted to accommodate cultural complexity; power issues should be addressed explicitly; and issues of discrimination and oppression should be recognized. Based on this assumption, the transformative research design is directed by the radical humanist paradigm because the priority is given to be qualitatively oriented even though quantitative research is used. Therefore, the design is guided by the radical humanist paradigm.

Action research is a disciplined process of inquiry conducted *by* and *for* those taking the action. The primary reason for engaging in action research is to assist the "actor" in improving and/or refining his or her actions. Fundamentally, the design is grounded in qualitative research paradigm, putting emphasis on localized studies that focus on the need to understand *how* things are happening, rather than merely on *what* is happening, and to understand the ways that stakeholders-the different people concerned with the issue-perceive, interpret, and respond to events related to the issue investigated (Stringer, 2014). Action research depends on some characteristics:

- "Involvement with practical issues in real world (often in organizations) because practising and applying are based on premise that research that produces nothing but books is not good enough.
- A concern with change. It looks for new strategies to solve the problem and develop more.
- Cycle: the research feedback loop. Typically, after reflection, a change of some kind is introduced – an intervention – and its effects assessed, and the process is repeated indefinitely. It can be the way the changing group proceeds, with no gap between 'research' and organizational decision-making.
- Involving those affected in design and implementation (not as objects of research but participants) because action research involves practitioner integrally and rejects notion of two stages whereby researchers produce knowledge which is then generated to practitioners. Instead, research, practice and action are integrated".

It is categorised into three types of action research; namely, technical, participatory and emancipatory action research. Philosophically, two of which are oriented by the radical humanist paradigm. First, participatory action research that comprised of four features according to Din Babar (2015):



- 1. "Participation, associating with the participative nature to the democratic process. Participating between the researcher and participants occurs in all stages of the study, from setting agenda, clarifying the research focus, undertaking fieldwork and analysing findings and using data.
- 2. Cyclical spiral process- spiral of continuous and overlapping cycles: cyclical process where cycles of activities form a spiral of continuous and overlapping cycles of action and reflection. Each cycle consists of a small scale intervention or changes in understanding.
- 3. Emergence: Emergence signifies that during the research, there may be changes in the questions, relationships and purposes of the research. This evolutionary research process emerging out of a period of collaborative engagement is suited to complex situations and environments in transition or where there is a desire for change.
- 4. Reflection and reflexivity: Reflection and reflexivity (self-reflection) are integral parts of participatory action research. Reflexivity or self-reflection is the recognition of the researcher's presence in the research study and the interplay between the researcher, the research context and the data".

The second type of action research, supported by the radical humanist paradigm is emancipatory action research. Theoretically in this research's assumption, people will change by throwing off the chains of psychic impressions which tie them into alienating modes of life. It is a belief in the ability to change people through changing consciousness, by changing the way people think, see, and understand of the world. It allows someone individually and in conjunction with others to reorganize their experiences. Thus, consciousness is the driving force; it is the essence of radical humanism (e.g. motivational interview with a patient). It is agreed with Skerritt (1996) who argues that the participants' transformed consciousness, and change within their organisation's existing boundaries and conditions, but when it also aims at changing the system itself or those conditions which impede desired improvement in the organisation.

In addition to the paradigm, critical discourse analysis is also underpinned by the radical humanist paradigm. It is used to systematically explore often opaque relationships of causality and determination between (a) discursive practices, events and texts, and (b) wider social and cultural structures, relations and processes; to investigate how such practices, events and texts arise out of and are ideologically shaped by relations of power and struggles over power; and to explore how the opacity of these relationships between discourse and society is itself a factor securing power and hegemony (Fairclough, 1995). Its assumption is that social reality is constructed through and within language, and that every language use designed to represent reality necessarily entails decisions as to which aspects of that reality to include, and decision as to how to arrange them (Richardson et al, 2014).

Rogers (2011) states critical discourse analysis is ideological effects-the effects of texts in inculcating and sustaining ideologies. Based on him, ideologies is primarily representations of aspects of the world that can be shown to contribute to establishing and maintaining relations of power, domination, and exploitation-primarily because such presentations can be enacted in ways of interacting socially inculcated in ways of being in people's identities. Moreover, critical discourse analysis contribute to more broadly conceived social research into processes of social and cultural change affecting contemporary organizations (Fairclough, 1995).

THE RADICAL STRUCTURALIST PARADIGM GUIDING QUANTITATIVE RESEARCH

Advocating the sociology of radical change from an objective view, the radical structuralist paradigm holds the notion that conflict is inherently occurred in society, so this conflict brought to create social change. This view is a much more realist position that grounds social change in the antagonisms between structural relations, not consciousness as the radical humanist is. More specifically, the reality, according to the paradigm, is not changed by the consciousness of people, but is changed by the binding together of these contradictions that will transform existing societies into new forms. The radical structuralists are interested in explicating radical change, emancipation, and potentiality, in an



analysis which emphasises structural conflict, modes of domination, contradiction and deprivation. It approaches these general concerns from a standpoint which tends to be realist, positivist, determinist and nomothetic.

Thus, goal of radical structuralist paradigm is to analyse the structural conflict, the existing modes of domination, contradictions and deprivations which cause the society to radically change, and to provide critique in social affair or status quo. Moreover, it emphasizes the need for destruction or transcendence of the limitations imposed on the social and organizational arrangements.

Operating in social research methods, this paradigm serves a lots of advantages for leading scientific study. The research designs, guided by this paradigm, are technical action, experimental, quasi-experimental and mixed-embedded research. Technical action research is utilised to find technical solutions to improve or to change the outcome of a practice and an intervention (Coghlan & Brydon-Miller, 2014). Willis & Edwards (2014) raise their point of view that this research method researchers expect the research to contribute to both basic and applied goal, tending to start with a particular theory as an a priori beginning point and to work toward solving problems with solutions based on that guiding theory; it tends to separate researcher roles from practitioner roles and to treat the researcher as the expert who leads and directs the research project. On the other hand, due to emphasising on using the scientific method places considerable emphasis on technical aspects of "good" research, such as establishing validity and reliability of instruments used in the research and obtaining objective data on outcomes.

Experimental design is the structure by which variables are positioned, arranged, or built into experiment (Wiersma & Jurs, 2004). The main function of experiment design is to develop the strategy to control variance towards fulfilling the objective of research (Broota, 1989). In terms of philosophical stance, one is considered to be under the coverage of the radical structuralist paradigm because there is a change in experimental structure from the top to the bottom (from experimenter or the researcher to the participants). An experiment aims at predicting the outcome by introducing a change of the preconditions which is represented by one or more independent variables, also referred to as "input variables" or "predictor variables." The change in one or more independent variables, also referred to as "output variables" or "response variables" (Wikipedia, 2018).

The characteristics of quasi-experimental design are in common with those of experimental research such as reproducing the techniques of the laboratory experiment with highly structured methods; generating initial hypotheses; controlling variables and being accurate (quantitative) measurement of outcomes; most of all, generalizing from samples to similar populations (Gray, 2004). The difference is that quasi-experiment research involves the use of intact groups of subjects in an experiment, rather than assigning subjects at random to experimental treatments (Wiersma & Jurs, 2004). It is very appropriate to use quasi-experimental design when randomization is too expensive, unfeasible to attempt or impossible to monitor closely; there are difficulties, including ethical considerations, in withholding the treatment, and the study is retrospective and the programme being studied is already underway (Gray, 2004).

Besides those designs, the embedded design is supported by the radical structuralist paradigm as well. It is utilized purposively to address multiple questions, calling for different methods or to improve experiment (Watkins & Gioia, 2015). In application, the design method is combined by two approaches, the primary (quantitative/qualitative) and the secondarv approach (quantitative/qualitative), and the priority is put on primary one. Because the most common type of embedded design found in the literature occurs when researchers embed qualitative data within an experimental design. The general steps include (1) designing the overall experiment and deciding the reason why qualitative data need to be included, (2) collecting and analysing qualitative data to enhance the experimental design, (3) collecting and analysing quantitative outcome data for the



experimental groups, and (4) interpreting how the qualitative results enhanced the experimental procedures and/or understanding of the experimental outcomes (Creswell & Plano Clark, 2011).

Therefore, the embedded design is depending on the priority approach. One is employed the radical structuralist paradigm or the functionalist paradigm if the primary design is experimental, correlational, longitudinal, or focuses on instrument validation. In contrast, it is employed the interpretive paradigm if the primary design is phenomenological, grounded theory, ethnography, case study, or narrative.

CONCLUSION

Social Paradigm Guiding Social Research	Types of Research Design
The functionalist paradigm	Descriptive study
	Correlational research
	Survey research
	Mixed explanatory sequential design
	Mixed convergent parallel design
	Mixed multiphase design
The interpretive paradigm	Case study
	Ethnographical research
	Phenomenological research
	Grounded theory
	Discourse/metaphor analysis
	Narrative analysis
	Systematic review
	Meta-synthesis
	Mixed convergent parallel design
	Mixed exploratory sequential design
	Mixed multiphase design
The radical humanist paradigm	Participatory action design
	Emancipatory action research
	Mixed transformative design
	Critical discourse analysis
The radical structuralist paradigm	Technical action research
	Experimental research
	Quasi-experimental research
	Mixed embedded design

Table 1: Social Paradigms in guiding Social research design

The four paradigms are influential philosophical stances used to advocate social research designs since they have been supported by eight different lenses and had various functions for analysing social phenomena based on two main analytical approaches, objective and subjective viewpoints. After clarifying their application in social research methods, we have seen that the functionalist paradigm is very compatible with quantitative research methods because, according to the assumption, it utilizes natural science methods to study its subject areas: questionnaire, statistical analysis, test, measurement etc. Shortly, whichever research method uses objective approach to study about the topics related to the status quo, the social order, the social integration, solidarity, equilibrium, the need of satisfaction and actuality is under the umbrella of the functionalist paradigm because it is in the dimension of realism, positivism, determinism and nomothetic. However, if any research design studies the same topic areas, but uses subjective approach because it is located in the dimension of the nominalism, anti-positivism, voluntarism and ideographic.

In addition to the paradigms in sociology of regulation; namely, the functionalist and the interpretive paradigm, the ones in sociology of radical change lead research design which places emphasis on



radical change, potentiality, modes of domination, emancipation, deprivation and potentiality. The distinction between both of them is that the radical humanist paradigm investigate into subjective level, more in-depth by mainly using tools such as interview, observation, focus group discussion. Most of all, it intends to be nominalist, anti-positivist, voluntarist and ideographic. Similarly, the radical structuralist paradigm guides the research that studies the same subject concerns to those of the radical humanist paradigm, but additionally, structural conflict and contradiction is figured prominently in this paradigm. And conversely, it applies objective approach because, philosophically, it is situated in the area of realism, positivism, determinism, and nomothetic.

Besides Burrell and Morgan's strategy, we can use Habermas's theory of knowledge-constitutive interest to choose which paradigm is applicable to which research design. The research methods that are in technical interest part normally are quantitatively oriented because those designs deploy prediction and control procedures such as correlational, experimental, quasi-experimental researchthus, it is consistent with the functionalist and the radical struturalist paradigm. If the research methods hermeneutic interest, it means that research design are also applicable in the interpretive paradigm. In the case that the research methods are in the dimension of emancipatory interest, they are directed by the radical humanist and the radical structuralist paradigm as well. Finally, we observe that some research designs intertwine between two paradigms; for example, mixed convergent parallel, mixed multiphase design, mixed embedded design. Thus, they make the researcher a little confusing.

Acknowledgements: I, Ilhan Gunbayi, would like to dedicate this study to Dr. Paul Garland, who used to be my tutor during my post doctorate study at Faculty of Development and Society on qualitative research methods in Sheffield Hallam University in Sheffield, UK in 2007.

This article would not be published if there were not sponsored by the Scientific and Technological Research Council of Turkey (TÜBİTAK). Therefore, I, Sath SORM, would like to express my heartfelt gratitude for TÜBİTAK that has given me this golden opportunity to pursue PhD in Turkey.

BIODATA AND CONTACT ADDRESSES OF AUTHORS



He completed his BA studies on English Language Teaching, MA on Educational Administration and Supervision, PhD. on Educational Administration, Supervision, Planning and Economy in Hacettepe University in Turkey and Post Doctorate Study on Qualitative Research Methods in Sheffield Hallam University in the UK. He has been working as a Professor Doctor at Akdeniz University, Faculty of Education, Educational Sciences Department since 2003. He is scholarly interested in qualitative research methods, organizational communication, organizational culture and climate, motivation at work, job stressors and school leadership,

vocational education and training linked to employment issues and national development particularly in Turkey but also in Central/Western Asia and Europe.

Prof. Dr. Ilhan Gunbayi Akdeniz University Faculty of Education Educational Sciences Department Antalya- TURKEY E. Mail: <u>igunbayi@akdeniz.edu.tr</u>



International Journal on New Trends in Education and Their Implications April 2018 Volume: 9 Issue: 2 ISSN 1309-6249



He completed his BA studies on English Language Teaching in Asia Euro University in Cambodia and his MA on Educational Economics and Management in Northeast Normal University in China. He is currently a PhD. student at Akdeniz University Educational Sciences Institute Department of Educational Sciences and Educational Administration and Supervision Program in Antalya in Turkey. He is scholarly interested in social paradigms and school leadership.

Sath Sorm Akdeniz University Faculty of Education Educational Sciences Department Antalya- TURKEY E. Mail: <u>sorm sath@hotmail.com</u>

REFERENCES

Amin, A. A. (2017). An Overview of the significance of discourse analysis in language. *International Journal of Advanced Research*, 5(4), 1131-113.

Bali, R. K.; Wickramasinghe, N.& Lehaney. B. (2009). *Knowledge management primer.* Routledge: Taylor & Francis Group.

Baran, M. L. & Jones, J. E. (2016). *Mixed methods research for improved scientific study*. IGI Global.

Blumer, H. (1969). Symbolic Interactionism: Perspective and Method. University of California Press.

Broota, K. D. (1989). Experimental design in behavioural research. New Age International.

Brym, R. J. & Lie, J. (2007). Sociology: Your compass for a new world. Thomson Higher Education.

Burrell, G. & Morgan, G. (1979). *Sociological paradigms and organizational analysis: Elements of the sociology of corporate life*. Heinemann Educational Books Inc.

Clandinin, D. J. & Connelly, F. M. (2000). *Narrative Inquiry: Experience and story in qualitative research.* San Francisco: Jossey-Bass Publishers.

Converse, J. M. (2009). *Survey research in the United States: roots and emergence 1890- 1960.* Routledge: Taylor & Francis Group.

Cooper, J. A. P. (2016). Routledge encyclopaedia of educational thinkers. Routledge: Taylor & Francis Group.

Coghlan, D. & Brydon-Miller, M. (2014). *The SAGE encyclopaedia of action research*. Sage Publication.

Creswell, J. W. (2015). A concise introduction to mixed methods research. Sage Publication

Creswell, J.W. & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research.* Sage Publication.



Creswell, J.W. (2007). *Qualitative inquiry and research design: choosing among five approaches.* Sage Publication Inc.

Davies, P. (2004). Systematic reviews and the Campbell collaboration, in: Thomas, G. & Pring, R. (2004). *Evidence-based practice in education.* Open University Press.

Din Babar, Z. U. (2015). *Pharmacy practice research methods.* Switzerland: Springer International Publishing.

Fairclough, N. (1995). Critical discourse analysis: the critical study of language. New York: Longman Publishing.

Gee, J. P. (1999). *Introduction to discourse analysis*. NY: Routledge.

Giorgi, A. (1985). (Ed). *Phenomenology and psychological research.* Pittsburgh, PA: Duquesne University Press.

Glaser, B. G & Strauss. A. L. (1967). *The discovery of grounded theory: strategies for qualitative research.* Aldine Transaction.

Gray, D. E. (2004). *Doing research in the real world.* Sage Publication.

Greene, J. C. (2007). *Mixed methods in social inquiry*. San Francisco: Jossey-Bass.

Guba, E. G., & Lincoln, Y. S. (1994). *Competing paradigms in qualitative research: Handbook of qualitative research* (pp. 105-117). London: Sage.

Habermas, J. (1987). *Knowledge and human interests: A general perspective in knowledge and human interests.* Cambridge: Policy.

Hesse-Biber, S.N. (2010). *Mixed methods research: Merging theory with practice: emerging theory with practice.* Guilford Press.

Holloway, I. & Wheeler, S. (2010). *Qualitative research in nursing and healthcare.* Blackwell Publishing Ltd.

Husserl, E. (1970). Logical investigation. New York: Humanities Press.

Iannone, A. P. (2001). Dictionary of world philosophy. London: Routledge.

Jorgensen M. & Phillips, L. J. (2002). *Discourse analysis as theory and method.* London: Sage Publication.

Klein, E. K. &. Myers, M.D (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly* 23(1), 67–94.

Killam, L. (2013). *Research terminology simplified: paradigms, axiology, ontology, epistemology and methodology.* Sudbury, ON: Author.

Kraft, C. H. (1979). *Christianity in culture: A study in dynamic biblical theologizing in cross-cultural perspective.* Maryknoll: Orbis Books.

Langdridge, D. (2007). *Phenomenological psychology: theory, research and method*. Pearson Education Limited.



Lawson, T., Jones, M. & Moore, R. (2000). *Advanced sociology through diagrams.* Oxford University Press.

LeCompte, M. D & Schensul, J. J. (1999). *Designing and conducting ethnographic research*. Altamira Press.

Martin , V.B & Gynild, A.(2011). *Grounded theory: the philosophy, method, and work of Barney Glaser.* Brown Walker Press.

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice*, 13(6), 522-525.

Mastin, L. (2008). Positivism. *The Basic of Philosophy.* Retrieved 06.02.2018 from: <u>http://www.philosophybasics.com/branch_positivism.html#Introduction</u>

McBurney, D. H. & White, T. L (2010). *Research methods.* Wadsworth Cengage Learning.

Mertens, D.M. (2009). *Transformative research and evaluation*. Guilford Press.

Mills, A. J., Durepos, G. & Wiebe, E. (2010). *Encyclopaedia of case research.* SAGE Publications, Inc. Book.

Mouton, J. & Marais, H. C. (1988). *Basic concepts in the methodology of the social sciences.* HSRC Press.

New World Encyclopaedia (NWE) (2016). *Voluntarism.* Retrieved 09.01.2018 from <u>http://www.newworldencyclopedia.org/entry/Voluntarism</u>

Noblit, G.W. & Hare, D. R. (1988). *Meta-ethnography: synthesizing qualitative studies.* Sage Publication.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.

Rogers, R. (2011). An Introduction to critical discourse analysis in education. NY: Routledge.

Richardson, J.; Krzyzanowski, M.; Machin, D, Machin, D. & Wodak, R.(2014). *Advances in critical discourse studies*. Routledge.

Shirish. T. S. (2013). *Research methodology in education*. LULU Publication.

Skerritt, O, Z. (1996). *New directions in action research.* The Falmer Press.

Stringer, E.T. (2014). Action research. Sage Publication.

Suri, H. (2017). Meta-analysis, systematic review and research syntheses. In Cohen. L.; Manion, L.& Morrison, K. (Eds.) *Research methods in education.* Taylor & Francies Group.

Schwandt, T. A. (2000). Three epistemological stances for qualitative inquiry: Interpretivism, hermeneutics, and social construction. In N. K. Denzin & Y. S. Lincoln, (Eds). *Handbook of qualitative research*, p. 189-213. Thousand Oaks, CA: Sage.

Torrance, H. (2004). Using action research to generate knowledge about educational practice. In G. Thomas & R. Pring (Eds) *Evidence-based practice in education.*, Open University Press.



Trueman, C.N. (2018) "Anti Positivism". The History Learning Site. Retrieved 06.01.2018 from https://www.historylearningsite.co.uk/sociology/research-methods-in-sociology/ anti-positivism/

Wagner. C., Kawulich, B., Garner, M. (2012). Doing social research: A global context. McGraw-Hill.

Wang, Victor C. X. (2015). *Handbook of research on scholarly publishing and research methods.* IGI Global.

Walsh, D. & Downe, S. (2005). Meta-synthesis method for qualitative research: a literature review. *Journal of Advanced Nursing*, 50(2), 204–211.

Watkins, D.& Gioia, D. (2015). *Mixed methods research: Pocket guides to social work research method.* Oxford University Press.

Webster, L. & Mertova, P. (2007). *Using narrative inquiry as a research method: an introduction to using critical event narrative analysis in research on learning and teaching.* NY: Routledge.

Wiersma, W. & Jurs, S.G. (2004). *Research methods in education: An introduction.* Allyn and Baccon.

Wikipedia (2018). *Design of experiments.* Retrieved on 25.02.2018 from <u>https://en.wikipedia.org/wiki/Design of experiments</u>

Willis, J. W. & Edwards, C. L. (2014). *Action research: models, methods, and examples.* Information Age Publishing Inc.

Yin, R. K. (2009). *Case study research: Design and methods.* Thousand Oaks, CA: Sage.



International Journal on New Trends in Education and Their Implications (IJONTE)

April 2018

Volume: 9 Issue: 2

ISSN 1309-6249

http://ijonte.org