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Think-Tac-Toe Differentiated Instruction Strategy: Enhancing the Academic Performance and Engagement in Chemistry of Grade 8 Students

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ABSTRACT

The study investigated the effects of the Think-Tac-Toe differentiated instruction strategy on the academic performance and engagement in Chemistry of students. It was conducted among sixty grade 8 students of Bukidnon State University – Secondary School Laboratory (BukSU-SLS) during the school year 2016-2017. Quasi-experimental pretest-posttest research design was employed in the study. Validated 30-item achievement test and a 30-item engagement scale in Chemistry were used to assess the academic performance and engagement of students respectively. The data gathered were subjected to statistical techniques such as mean, standard deviation and the analysis of covariance (ANCOVA) at 0.05 level of significance. The findings revealed that the academic performance of the experimental and control groups is Satisfactory. There was no significant difference in the academic performance between the two groups. The results further revealed that the engagement level of students in Chemistry of both groups is Average before and after the given intervention. However, the experimental group demonstrated a higher cognitive engagement than the control group. Moreover, there was no significant difference in the engagement of students in Chemistry in both groups. Hence, academic performance and engagement may be influenced by interplay of other factors.

KEYWORDS: *Differentiated Instruction, Chemistry, Academic Performance, Engagement, Grade 8*

INTRODUCTION

Differentiated instruction means tailoring instruction to meet individual needs. Whether teachers differentiate content, process, products, or the learning environment, the use of ongoing assessment and flexible grouping makes this a successful approach to instruction (Tomlinson, 2000). When a teacher reaches out to an individual or small group to vary his or her teaching to create the best learning experience possible, that teacher is differentiating instruction. Differentiated instruction can be effectively integrated if the activities set by the teacher target the differences of students in terms of their learning styles and multiple intelligences.

Think-Tac-Toe choice board is one of the many differentiated instruction strategies created to respond to various learners in the classroom. It is a three by three grid consisting of an activity per grid. It allows students to choose how they will show what they are learning by giving them a variety of activities to choose from (Neal, 2014). In this mode of teaching, teachers can address multiple learning styles because students can choose from the activities

designed by the teacher which they can complete successfully. These activities may vary in content, process, and product and can be modified to address different levels of student interests and learning styles.

The educational reform in the Philppines in 2012 has paved way to the emergence of the K-12 curriculum that aims to enhance basic knowledge and skills of students in science, mathematics and linguistics to prepare them for life-long learning and employment. Specifically, the K-12 science curriculum is designed to be learner-centered and inquiry-based. The concepts and skills in Life Sciences, Earth and Space, Physics, and Chemistry are presented with increasing levels of complexity from one grade level to another to promote a deeper understanding of core concepts.

InBukidnon State University – Secondary School Laboratory (BukSU – SSL), it was observed that grade 8 students have difficulties in understanding some topics in Chemistry. Their difficulty is manifested by their low academic performance in the subject. It is often regarded as a difficult subject, an observation which sometimes repels learners from conceptualizing challenging concepts in Chemistry. This is because Chemistry as per Taber (2002) is a subject that commonly incorporates many abstract concepts, which are central to better understand Chemistry and other sciences.

These abstract concepts on matter are important because further Chemistry concepts or theories cannot be easily understood if the underpinning concepts are not sufficiently grasped by the student and that Chemistry classes require a high-level skill set (Nicoll, 2001; Zoller, 1990). The abstract concepts and lack of relevance contributed to the low academic performance of students and engagement in this subject. Kuh (2003) posited that student engagement is generally considered to be among the better predictors of learning and personal development.

Several researches have been conducted in relation to the integration of differentiated instruction in class which showed promising results in enhancing the academic performance and engagement of students in a subject matter. Significant improvement in the test scores of low-scoring students following the use of differentiated instruction and results of these studies indicated that students were more motivated and enthusiastic about learning (Aranda& Zamora, 2016; McAdamis, 2001; Ganuc, 2014; Glaser, 1995).However, there were limited studies conducted to investigate the effects of differentiated instruction specifically in Chemistry education.

It is in this context that the researcher conducted this study to investigate further the effects of differentiated instruction on the academic performance and engagement in Chemistry of grade 8 students. Specifically, the study utilized the Think-Tac-Toe differentiated instruction strategy as it provides more activities targeting the varied learning styles of students in the classroom.

Moreover, the study answered the following questions:

1. What is the academic performance in Chemistry of those students taught with Think-Tac-Toe teaching strategy and of those students taught with the conventional teaching approach?
2. Is there a significant difference in the academic performance in Chemistry between the experimental and control groups?

3. What is the level of engagement in Chemistry of those students taught with Think-Tac-Toe teaching strategy and of those students taught with the conventional teaching approach?
4. Is there a significant difference in the engagement in Chemistry between experimental and control groups?

REVIEW OF LITERATURE

This study was anchored on differentiated instruction. It is an approach to teaching and learning for students of differing abilities in the same class (Tomlinson, 2001). It can be employed in the classroom to engage the students into meaningful learning. To differentiate instruction is to recognize students varying background knowledge, readiness, preferences in learning, interests, and to react responsively.

Tomlinson (2001) identified three elements of the curriculum that can be differentiated: content, process, and products. Tomlinson (2003) asserted that differentiated instruction is rooted in the belief that there is variability among any group of learners and that teachers should adjust instruction accordingly. This signifies that the approach encompasses the planning and delivery of instruction, classroom management techniques, and expectations of learners' performance that take into consideration the diversity and varied levels of readiness, interests, and learning profiles of the learners.

According to Heacox (2005), differentiated instruction is a philosophy, and the Think-Tac-Toe provides teachers with a strategy for enacting this philosophy in instruction. Think-Tac-Toe is a useful strategy for differentiating based on a variety of modalities that students can use to demonstrate what they learned during the unit.

Dotger (2010) added that the Think-Tac-Toe can evaluate students' learning during and at the conclusion of a unit. The Think-Tac-Toe is arranged like a tic-tac-toe board with each space used to specify a task or product aligning with an intelligence described in multiple intelligence theory. Prior to its creation, teachers should pre-assess students to be certain that the content of the Think-Tac-Toe will capture the array of readiness and skills present in the classroom.

The constructivist viewed learning as an individual matter. Students construct reality regarding their prior experiences, their conceptual knowledge, their values, their attitudes, and their preferred ways of knowing. Constructivist theory informs teachers that each learner needs time, space, and suitable experiences to support the learning processes (Taber, 2009).Vygotsky (1978), a proponent of constructivism, emphasized that there is a zone for each learner, the zone of proximal development (ZPD), which is bounded on one side by the developmental threshold necessary for learning and on the other side by the upper limit of the learner's current ability to learn the material under consideration.

Dewey (1938) stated that students learn best when they are personally engaged in the learning process. He explained that the educator is responsible for both knowledge of individuals and for knowledge of subject matter, enabling the educator to select activities that encourage social organization. Meaningful learning only takes place when teaching is pitched beyond what is currently known and understood, and within reach of existing knowledge and understanding.

Moreover, learners must be active recipient of knowledge and skills. The outcomes of the teaching and learning process depend on how the teacher structures classroom instruction. Many factors influence students' learning – such as students' learning style preferences, their interest in the material under study, and the learning environment(Eniayeju (2010). Student's learning style preference refers to the way they respond to stimuli in a learning context, and to their characteristic way of acquiring and using information (Bailey, 2002).

In this study, the effects of Think-Tac-Toe teaching strategy on students' academic performance in Chemistry were investigated. According to Narad and Abdullah (2016) academic performance is the knowledge gained which is assessed by a teacher and is measured by continuous assessment. Engagement is an important contributory factor in the teaching and learning process (Coates 2009). Quite a number of studies have focused on the engagement of students towards Chemistry. It was revealed that in spite of realization of the recognition given to Chemistry among the science subjects, it is evident that students still show negative attitude towards the subject, thereby leading to poor performance and that students' academic performance in Chemistry is a function of their attitude (Adesokan, 2002; Gibbons, 1997; Udida, 2010). Furthermore, attitudes are important outcomes of Science education in secondary school and that those those who have positive attitude toward science tend to perform better in the subject (Kaplan, 1998; Papanastasiou, 2001; Cheung, 2009).

Engagement is associated to students' academic achievement (Ganuc, 2014) and was defined by Fredricks (2004) as a multifaceted construct which operates at three levels: cognitive, affective and behavioral. Attard (2002) elaborated the three engagement dimensions.The cognitive dimension involves the idea of investment, recognition of the value of learning and a willingness to go beyond the minimum requirements. Affective dimension on the other hand, includes students' reactions to school, teachers, peers and academics, influencing their willingness to become involved in school work. Finally, behavioral dimension encompasses the idea of active participation and involvement in academic and social activities, and is considered crucial for the achievement of positive academic outcomes.

METHODOLOGY

The study was conducted at BukSU-SSL during the school year 2016-2017. The school is located in Malaybalay City, Bukidnon. A quasi-experimental pre-test-post-test research design was used in the study. Two intact classes in grade 8 level were the participants of the study. One of which was randomly selected as the experimental group and the remaining was the control group. The experimental group was taught using the Think-Tac-Toe differentiated instruction strategy. On the other hand, the control group was taught using the conventional teaching approach. The groups were taught using the same instructional materials and classroom instructions; the varying factor was only the integration of the Think-Tac-Toe teaching strategy to the experimental group. All students in both groups were involved during the conduct of the study; however, only 30 students with comparable performance from each group were included in the analysis of data.

In this study, four developed lessons on the Particulate Nature of Matter, Properties of Matter, Phase Changes of Matter, and Atomic Structures were used and were structured in accordance to the treatment needed in the study. These topics were identified based on the needs assessment conducted by the researcher.The development of the lessons was guided by

a Task Analysis Matrix (TAM). The TAM contains the topics, concepts, and instructional objectives, procedural activities with Think-Tac-Toe teaching strategy, skills, assessment and references that were based on the K-12 curriculum guide.

Further, a multiple intelligence inventory was administered to the experimental group to determine the learning styles of the students. The results served as bases in choosing the activities in the Think-Tac-Toe choice boards. This was done to ensure the optimum utilization of the differentiated instruction strategy.Thelessons developedwere validated by panel of experts, who were also teaching Chemistry, prior to the conduct of the study. Experts on content, pedagogy, and technicalities were made as evaluators of the developed lessons based on content and content accuracy, clarity and appropriateness.

The research instruments used in this study were the researcher's developed achievement test and an engagement scale instrument. The 30-item achievement test was created for the assessment of the academic performance of students in Chemistry. To assess students' engagement level, an engagement scale used was adopted from the study of Gaylo (2016) and was based on Attard's (2002) construct of knowledge. There were three dimensions of engagement that were taken into consideration: cognitive, affective, and behavioral. The researcher modified the engagement scale instrument to suit the present study. Each engagement dimension consisted of 10 items answered by the students in both experimental and control groups. The research instruments were subjected to evaluation and validation by experts and were tried out for reliability testing. The same instruments were administered to the experimental and control groups.

In the researcher-made achievement test, every correct answer was given one (1) point and the perfect score is thirty (30). A scoring scale was set based on DepEd Order No. 8, s. 2015: Policy Guidelines on Classroom Assessment for the K-12 Basic Education Programto determine the academic performance of students from their scores in the achievement test.

Scoring Scale for the Academic Performance

Score Range	Performance Level	Qualifying Statements
25-30	Outstanding	Exceeds the core requirements in terms of knowledge, skills and understanding of the topics and can transfer them automatically and flexibly through authentic performance tasks
19-24	Very Satisfactory	Developed the fundamental knowledge and skills and core understandings of the topics and can transfer them independently through authentic performance tasks
13-18	Satisfactory	Developed the fundamental knowledge and skills and core understandings of the topics with little guidance from the teacher and peers, and can transfer these under standings through authentic performance tasks
7-12	Fairly Satisfactory	Possesses the minimum knowledge and skills and core understanding of the topics but needs help throughout the performance of authentic tasks
0-6	Did not Meet Expectations	Struggles with understanding; prerequisite and fundamental knowledge and/or of the topics and have not been acquired or developed adequately to aid understanding

The engagement of students in Chemistry was measured using an engagement scale instrument. The scale ranges from 1 to 4; where:(1) Never, (2) Sometimes, (3) Usually, and (4) Always.

Scoring Scale for the Engagement Level

Scale	Range	Response	Qualifying Statements
4	3.25-4.00	Always	Students have *high* engagement in Chemistry
3	2.50-3.24	Usually	Students have *average* engagement in Chemistry
2	1.75-2.49	Sometimes	Students have *low* engagement in Chemistry
1	1.00-1.74	Never	Students have *no* engagement in Chemistry

The data obtained in this study were interpreted statistically. To assess the academic performance and engagement in Chemistry among grade 8 students, mean and standard deviations were computed. To determine the significant difference in the students' academic performance and engagement level, Analysis of Covariance (ANCOVA) was used at 0.05 level of significance.

RESULTS AND DISCUSSIONS

The Academic Performance of Students

The academic performance of students in this study was based on the scores they obtained from the pre-test and post-test administered to them. The mean scores and standard deviations before and after the conduct of the study obtained from the experimental and control groups are presented and described in Table 1. The data indicated that both groups were initially at par with regards to their pretest results.

Table 1.Pretest-Posttest Scores of the Experimental and the Control Groups

Score Range	Performance Level (PL)	Pre-test				Post-test			
		Experimental		Control		Experimental		Control	
		No. of students	Percent (%)	No. of students	Percent (%)	No. of students	Percent (%)	No. of students	Percent (%)
25-30	Outstanding (O)	0	0	0	0	1	3	1	3
19-24	Very Satisfactory (VS)	1	3	2	7	10	33	11	37
13-18	Satisfactory (S)	13	43	14	47	16	53	14	47
7 - 12	Fairly Satisfactory (FS)	16	53	13	43	3	10	4	13
0-6	Did not Meet Expectations (DE)	0	0	1	3	0	0	0	0
		30	100	30	100	30	100	30	100
		Mean = 13 SD= 3.11 PL = S		Mean = 13 SD= 3.56 PL = S		Mean = 18 SD= 3.90 PL = S		Mean = 17 SD= 3.84 PL = S	

This result can be attributed to the fundamental knowledge which students have acquired in the previous years. The post test results for the experimental and control groups showed that both

groups had a comparable performance level in the achievement test administered after the experimentation. Also, the post test mean scores of the participants in the two groups were slightly widespread as compared to the mean scores attained by the same group in the pretest results.

Although students in both groups have performed satisfactorily before and after the conduct of the study, the data indicated that there was a marginal difference in the mean scores of both groups in the pretest and post test conducted by the researcher. This implies that there was a minimal improvement in the academic performance of students in the two groups after the conduct of the study. It can be substantiated that the Think-Tac-Toe differentiated instruction strategy influenced the academic performance of students in the experimental group in the same way the conventional teaching approach had influenced the academic performance of students in the control group.

This signifies that it was not only the teaching strategies employed in the experimental and control groups influenced their academic performance, other factors might have played significant roles that in return affected the performance level of students in class. Recognizing the importance of students' diversity in class in terms of their readiness, interests and learning profiles is indispensable for the learners to achieve their potential.This is parallel to the study of Tomlinson(2000) on the factors affecting the performance of students in Chemistry which revealed that students' readiness, interests and learning profiles were contributory factors in a differentiated classroom.

Similarly, one of the common factors influencing students' academic performance as responded by some students was the nature of the subject matter itself. The nature of Chemistry concepts and the way the concepts are represented - macroscopic, microscopic, or representational make Chemistry difficult to learn (Johnstone, 1991; Abraham, 1992).Thus, the purpose and programs of the educational system must be designed to meet the needs of each individual child (Eshiwani, 1983).

Table 2.Comparison of the Academic Performance in Chemistry between the Experimental Group and the Control Group

Source	Type III Sum of Squares	df	Mean Square	F	.p
Corrected Model	118.96[a]	2	59.48	4.51	0.01
Intercept	563.18	1	563.18	42.70	0.00
Pretest	115.70	1	115.70	8.77	0.00
Group	4.324	1	4.32	0.32	0.56
Error	751.76	57	13.18		
Total	19386.00	60			
Corrected Total	870.73	59			

*R-squared = 0.13

The results of this statistical procedure showed that there was no significant difference in the academic performance in Chemistry between the experimental and control groups controlling the effect of pretest. It can be seen that there is no statistically significant difference between the adjusted means since p = 0.56 > 0.05.

The results further revealed that the integration of the Think-Tac-Toe differentiated instruction strategy on topics on matter had little impact on the academic performance of the experimental group. The academic performance of students was affected by interplay of factors such as the nature of the subject, students' readiness, interests and motivation to learn. This supports the findings of Mulder (2014) that differentiated instruction and student science achievement have no significant difference which may have been caused by various factors. This was explicitly seen in the works of Schibeci and Riley (1986) who investigated the factors influencing students' background and perceptions on Science attitudes and achievement.

They found out that not only the cognitive variables but also some affective characteristics are important factors in influencing Science achievement. Henceforth, students in the control group who were taught using the conventional teaching approach managed to have a comparable academic performance with students in the experimental group who were taught using the Think-Tac-Toe teaching strategy because the students' academic performance was not solely influenced by the said strategy.

The Engagement Level of Students

The engagement level of students of both groups was measured by answering an engagement scale instrument adopted and modified from the study of Gaylo (2016). It consisted of three dimensions: cognitive, affective and behavioral.

Table 3.Engagement of Students in Chemistry

	Experimental Group								Control Group							
	Pretest				Posttest				Pretest				Posttest			
Engagement	x̄	s.d.	QS	QD	x̄	s.d.	QS	QD	x̄	s.d.	QS	QD	x̄	s.d.	QS	QD
Cognitive	2.32	0.10	S	L	2.73	0.09	U	A	2.34	0.33	S	L	2.37	0.67	S	L
Affective	2.93	0.11	U	A	3.23	0.15	U	A	2.51	0.26	U	A	3.04	0.09	U	A
Behavioral	2.94	0.14	U	A	3.05	0.19	U	A	2.54	0.35	U	A	3.05	0.39	U	A
	Mean = 2.73				Mean = 3.00				Mean = 2.74				Mean = 2.93			
	SD = 0.34				SD = 0.31				SD = 0.30				SD = 0.33			
	QS = U				QS = U				QS = U				QS = U			
	QD = A				QD = A				QD = A				QD = A			

Legend: [QS: *Always (A); Usually (U); Sometimes (S); Never (N)] and [QD: High (H); Average (A); Low (L); None (N)]*

As can be inferred in Table 3, students in the experimental and control groups had an average engagement in Chemistry before and after the conduct of the experimentation. The pre-assessment of the engagement level conducted by the researcher in both groups indicated that both groups had a very close and almost similar engagement level as seen in the mean scores. The pretest result suggested that an improvement in the engagement of students in Chemistry must be considered. This implied that intervention and strategies must be given in order to improve students' engagement level (Ganuc, 2014).

The results of the post-test of the engagement level of both groups have slightly improved in comparison to the results in the pre-test. This explicates that the lessons carried out in class have slightly influenced the learning engagement of students in Chemistry. Also, the distribution of scores for both groups showed homogeneity with respect to the mean scores presented. Further, the increase in the mean scores obtained in the posttest of the experimental group is slightly higher than that of the control group so the integration of the

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Think-Tac-Toe differentiated instruction strategy caused such improvement in the mean scores of students in the experimental group.

It is clear now that employing a differentiated instruction may improve the engagement level of students (Hess, 1999;MacAdamis, 2001;Twoli, 2006). Furthermore, the Think-Tac-Toe strategy served as an avenue for students to express what they have learned in different modalities. Each student is valued for his or her unique strengths, while being offered opportunities to demonstrate skills through a variety of assessment techniques (Tuttle, 2000; Felder, 1993).

Looking at the posttest mean scores of the two groups in the cognitive dimension however, it can be seen that students in the experimental group had an average engagement in Chemistry while the control group had a low engagement in this dimension. Clearly, this showed that there was an impact of the Think-Tac-Toe differentiation in teaching Chemistry especially on the cognitive dimension. This was highlighted in the activities that were included in the Think-Tac-Toe choice boards that have challenged students' higher order thinking skills and as a result, students obtained an average engagement in the cognitive dimension. Hence, the integration of the Think-Tac-Toe strategy enhanced students' comprehension, critical and creative thinking skills.

Ganuc (2014) mentioned that engagement is associated to students' academic achievement such that student engagement according to Kuh (2007) and Coates (2008) means participation of students in educationally effective practices, both inside and outside the classroom, which leads to a range of measurable outcomes.

Table 4.Comparison of the Engagement in Chemistry between the Experimental Groupand the Control Group

Source	Type III Sum of Squares	Df	Mean Square	F	.p
Corrected Model	1.60[a]	2	0.80	10.08	0.00
Intercept	1.95	1	1.95	24.63	0.00
Pretest	1.52	1	1.52	19.20	0.00
Group	0.08	1	0.08	1.01	0.31
Error	4.52	57	0.07		
Total	534.58	60			
Corrected Total	6.12	59			

*R-squared = 0.26

It can be seen that there was no significant difference in the learning engagement in Chemistry between the groups controlling for the effect of pretest. Also, there was no statistically significant difference between adjusted means ($p = 0.31 > 0.05$). This implies that the use of Think-Tac-Toe differentiated instruction strategy did not exclusively contribute to the improvement of the level of learning engagement of students in Chemistry. It can be deduced that there were other factors affecting the level of learning engagement of students in a particular subject area.

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Research supports the view that curricula should be designed to engage students; it should have the ability to connect to their lives and positively influence their levels of engagement (Coleman, 2001). Knowing students well allows teachers to figure out their strengths; thereby helping students to move forward (Rueda, 2001). A study conducted by Salta (n.d.) revealed that students' attitudes towards Chemistry indicate a low level of student motivation to engage in Chemistry learning, a fact which could be related to the following issues: difficulty of the Chemistry course, demanding curriculum in combination with little allocated teaching time, use of unattractive teaching methods, and lack of career opportunities.

CONCLUSION

The general findings of this study signify that the academic performance and engagement in Chemistry of students were not solely influenced by the teaching strategies integrated in their lessons, other factors such as student readiness, interest and motivation and classroom setting and learning environment have played an important role in the teaching-learning process.

RECOMMENDATION

Based on the results of the study, it is recommended that a similar study could be conducted with longer span of time, different grade levels and with different subject areas to determine the effectiveness of the intervention used.

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REFERENCES

i. Abraham, C. (1992). Student Engagement in Higher Education. https://doi.org/https://www.heacademy.ac.uk/sites/default/files/studentengagementliteraturereview_1.pdf.

ii. Adesokan, C. (2002). Students' attitude and gender as determinants of performance in JSS Integrated Science. https://doi.org/ http://www.bisd.us/specialservices/ Special%20Services/ RTI/Science/Science%20Differentiation%20Brief.pdf.

iii. Aranda, M. R. R., & Zamora, L. (2016). Using Differentiated Instruction in Improving the Academic Performance of Students in Filipino Language.

iv. Billey, B. (2002). Differentiated Curriculum.https://doi.org/ http://www.principals.in/uploads/pdf/Instructional_Strategies/DI_Marching.pdf.

v. Cheung, A. (2009). Students' Attitudes Toward Chemistry Lessons: The Interaction Effect Between Grade Level and Gender. https://doi.org/ https://erepository.mku.ac.ke/bitstream/ handle/123456789/2327/MUSYOKI%20JOEL%20MASIKA%20.pdf?sequence=1.

vi. Coates, H. (2009). Engaging Students for Success. https://doi.org/https://www.heacademy.ac.uk/sites/default/files/studentengagementliteraturereview_1.pdf.

vii. Coleman, M. (2001). Curriculum differentiation: Sophistication. https://doi.org/ http://www.principals.in/uploads/pdf/Instructional_Strategies/DI_Marching.pdf.

viii. Dewey, J. (1938). Differentiated Instruction. Retrieved June 16, 2016 from http://www.principals.in/uploads/pdf/Instructional_ Strategie/ DI_Marching.pdf.

ix. Dotger, A. (2010). Theory of multiple intelligences: Is it a scientific theory? https://doi.org/http://www2.uwstout.edu /content/lib/thesis/2011/2011gangis.pdf.

x. Eniayeju, D. (2010). Competencies Required of Science Education Teachers. https://doi.org/http://ifrnd.org/ Research%20Papers/V5(2)2.pdf.

xi. Eshiwani, G. (1983). Factors affecting performance among primary and secondary school pupils in Western province of Kenya. https://doi.org/ http://www.bisd.us/specialservices/Special%20Services/RTI/Science/Science%20 Differentiation%20Brief.pdf.

xii. Felder, R. (1993). Reaching the Second Tier: Learning and Teaching Styles in College Science Education. https://doi.org/http://science.uniserve.edu.au/pubs/procs/wshop10/2005Yeung.pdf.

xiii. Fredricks, J. (2004). School engagement: Potential of the concept state of the evidence. https://doi.org/http://cpl.asn.au /sites/default/files/journal/C%20%20%20Engagment%20and %20Mathematics.pdf.

xiv. Ganuc, S. (2014). The Relationship Between Student Engagement and Their Academic Achievement. https://doi.org/http://www.ijonte.org/FileUpload/ks63207/File/19.ganuc.pdf.

xv. Gaylo, D. (2016). Metacognitive Strategies: Their Effects on Students' Academic Achievement and Engagement in Mathematics. Unpublished Master's Thesis, Bukidnon State University, Malaybalay City, Bukidnon.Retrieved June 26, 2016.

xvi. Gibbons, S. (1997). Changing teacher behavior through development: Implementing the teaching and content standards in science. https://doi.org/http://science.uniserve.edu.au/ pubs/procs/wshop10/2005Yeung.pdf.

xvii. Glaser, R. (1995). Chemistry is in the news: Assessment of student attitudes toward authentic news media-based learning activities. https://doi.org/ http://www.krepublishers.com/ 02-Journals/IJES/IJES-08-0-000-15-Web/IJES-08-3-000-15-Abst-PDF/IJES-8-3-605-15-435-Ejidike-I-P/IJES-8-3-605-15-.pdf.

xviii. Heacox, D. (2005). Promoting Student Independence and Responsibility in Academically Diverse Classrooms.

xix. Hess, M. (1999).Teaching in Mixed Ability Classrooms. https://doi.org/http://www.bisd.us/specialservices/Special%20Services/RTI/Science/Science%20Differentiation%20Brief.pdf.

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xx. Johnstone, A. (1991). Nyholm lecture: Chemical education research: Facts, findings and consequences.

xxi. Kaplan, M. (1998). A structural model of parent and teacher influences on students‟ attitudes of eight grades. Retrieved July 13, 2016 from http://etd-library.ku.ac.ke/bitstream/handle/123456789/6495/OGEMBO%20JOHN%20OTIENO.pdf?sequence=3&isAllowed=y.pdf.

xxii. Kaplan, M. (1998). A structural model of parent and teacher influences on students‟ attitudes of eight grades. https://doi.org/http://etd-library.ku.ac.ke/bitstream/handle/123456789 /6495/OGEMBO%20JOHN%20OTIENO.pdf?sequence=3&isAllowed=y.pdf.

xxiii. Kuh, G. (2003). Assessing What Really Matters to Student Learning: Inside the National Survey of Student Engagement.

xxiv. McAdamis, S. (2001). Teachers Tailor Their Instruction to Meet a Variety of Student Needs. https://doi.org/http://www.bisd.us/specialservices /Special%20Services/RTI/Science/Science%20Differentiation%20Brief.pdf.

xxv. Mulder, Q. (2014). The Effect of Differentiated Instruction on Student Mathematics Achievement in Primary School Classrooms.

xxvi. Narad, A., & Abdullah, B. (2016, July).*Academic Performance of Senior Secondary School Students: Influence of Parental Encouragement and School Environment*. http://rupkatha.com/v8n2.php URL of the article: http://rupkatha.com/V8/n2/02_Academic_Performance.pdf.

xxvii. Neal, A. (2014). Differentiated Instruction With Think TacToe. https://doi.org/http://www.teachingwithsimplicity.com/2014/01/differentiated-instruction with-think-tac-toe.html

xxviii. Nicoll, G. (2001). A Report of Undergraduates' Bonding Misconceptions. Retrieved from https://books.google.com.ph/books?id=SiA9DgAAQBAJ&pg=PA112&lpg=PA112&dq=Chemistry+by+Nicoll+2001&source=bl&ots=EMyPK5x_8v&sig=4aAVX3jYBahwUZWCQTfHFjaOJiQ&hl=en&sa=X&ved=0ahUKEwjvu8ejv9LTAhVEHJQKHYLdC8gQ6AEIKDAB#v=onepage&q=Chemistry%20by%20Nicoll%202001&f.

xxix. Papanastasiou, E. (2001). Willingness to follow Math related careers among seniors in Math classes. https://doi.org/http://science.uniserve.edu.au/pubs/procs/wshop10/2005Yeung.pdf.

xxx. Reuda, R. (2001). Rating Instructional Conversations: A Guide.National Centre for Research on Cultural Diversity and Second Language Learning.https:// doi.org/http://www.inclusiveschooling.com/app/uploads/articles/Science_Think_Tac_Toe .pdf.

xxxi. Salta, K. (n.d.). Students' Motivation to Learn Chemistry.https://doi.org/http://conference.pixel-online.net/ science/ common/download/Paper_pdf/292-SSE20-FP-Salta-NPSE2012 .pdf.

www.ijmas.com

xxxii. Schibeci, R., & Riley.(1986). Influence of students' background and perceptions on Science attitudes and achievement.https://doi.org/http:// www.stcloudstate.edu/file:///C:/ user/ Downloads/ 5300-34260-2-PB.pdf.

xxxiii. Taber, K. (2009). Constructivism as Educational Theory. https://doi.org/https://www.google.com.ph/?gfe_rd=cr&ei=PWA V96vMoSG1ASaxbOoBA&gws_rd=ssl#q=constructivism+theory+pdf.

xxxiv. Tomlinson, C. (2000). Fulfilling the Promise of the Different Classroom: Strategies and Tools for Responsive Teaching.4-6. Retrieved June 06, 2016, from http://www.readingrockets.org/article/ what-differentiated-instruction.

xxxv. Tomlinson, C. (2001). Differentiated instruction in the regular classroom.3-6. Retrieved June 26, 2016 from http://www.inclusivesch ooling.com/app/uploads/articles/Science_Think_Tac_Toe.pdf.

xxxvi. Tomlinson, C. (2003). Deciding to teach them all.Educational Leadership. 6-11. Retrieved June 26, 2016 from http://www.inclusiveschooling.com/app/uploads/articles/Science_Think_Tac_Toe.pdf .

xxxvii. Tuttle, J. (2000). Differentiated Classrooms.Retrieved June 06, 2016 from http://www.principals.in/uploads/pdf/Instructional_Strategies/ DI_Marching.pdf.

xxxviii. Twoli, W. (2006). Teaching secondary school Chemistry. Retrieved July 13, 2016 from http://science.uniserve.edu.au/pubs/procs/ wshop 10/2005Yeung.pdf.

xxxix. Udida, L. (2010). Cognitive styles, secondary school students‟ attitude and academic performance in Chemistry.

xl. Vygotsky, L. (1978). Differentiated Instruction. https://doi.org/http://www.principals.in/uploads/pdf/Instructional_Strategies/DI_Marching.pdf.

xli. Zoller, U. (1990). Students' Misunderstandings and Alternative Conceptions in College Freshman Chemistry.

www.ijmas.com