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Benefiting Science Students with Synectics: An SR Approach

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Abstract *Students' understanding of science education in Pakistan is not up to the standard level. The main aim of the study is to see either comprehension level is raised through Synectics among high school students. A systematic review of related literature and Meta-analysis has been done. Literature leads to conclusion that there is a need to study the utility of Synectics model. Findings show that Synectics is more effective than routine methods in teaching. Synectics help in the development of creativity, training in creativity, and scholastic achievement. It is recommended that teachers and students must be familiar with Synectics and also implement this technique into teacher training institutes for quality education.*

Key Words: Synectics, Meta-analysis, teacher training institutes, quality education.

Introduction

SR is used in several ways as the key tool in the emerging society of technology. Usage with the internet is growing rapidly in all kind of fields, agriculture, commerce, business, industry, medicine, companies, banks, communications and government for different official functions. Tahis has become an essential instrument.

Science education in schools plays a vital role in student's career development. It involves logical thinking and mathematical modelling and problem-solving skills. With the internet is a powerful device that enables students to learn new skills and current lessons with advanced version. helps students to explore creativity and problem solving but also help to understand technologies. Science deals with different theoretical aspects. It also deals with technical content, teaches a secondary school student to write programs using various programming languages such as FORTRAN, COBOL or BASIC.

Today existing science education in Pakistan faces a lot of problems. Yet the students learn very little about different concepts of science courses. There is no satisfactory science learning for difficult concepts and programming of different languages. In programming, students first spend a lot of time to learn the syntax and semantics of that language then they can represent algorithms. In this process, the level of frustration gets higher because students are unable to comprehend difficult concepts of a topic. Another reason is inexperienced teachers that they do not indulge in them with interesting examples and problems that are suitable for students' level of knowledge and understanding. Students neither learn difficult concepts to analyze nor compare different solutions. Lack of subject knowledge, poor pedagogical skills are also another factor. Teachers use outdated teaching methodology which does not match with the ground realities (Rashid & Mukhtar, 2012).Analytical, logical and critical thinking cannot be nurtured in students without comprehension (Ali, 2011). Conceptual understanding also enhances students' comprehension level. Learning concepts are very important for comprehension and cognitive development (Moreira, 2011).

Some general problems related to science education in Pakistan are lack of motivation, non-familiarity of teachers with ICTs, lack of training, illiterate family background and shortage of skilled persons (Taimur-ul-Hassan & Abdul Raheem, 2013). Teachers are unaware of students learning difficulties in science and not use

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Student centred computing pedagogy approach to make learning more comprehensive (Anders & Anna, 2009). Many students of science education at secondary level find difficulty in learning programming because of non-determinism and not understanding of algorithm (Jan Erik, 2011). Poor pedagogical methods, poor study methods and lack of problem-solving abilities are also major problems that affect students learning capabilities (Josephat O, Herbert, & Fredrick, 2012). Most of the students leave the science subject because of misunderstanding and bad experience (Maureen, Anne, & Tuba, 2008). Another major problem is the science curriculum that is not very effective at the secondary level in Pakistan so that students are unable to comprehend the knowledge given in the textbooks (Fariha, Mumtaz, & Mehwish, 2011).

How to Improve the Current State of Science Education

To improve the current state of science education in Pakistan, teachers must know the core difficulties of this subject. Teachers should be trained to advance pedagogical skills and techniques to build knowledge and make connections between prerequisites and what they need to know. Motivational level of student must increase to choose science as this is also a technical subject which is used now a day's almost in every field of life. Teachers make student think logically and to solve problems through creative thinking.

With the rapid increase in the development of technology and technology and the big flow of information in our society desires innovative getting to know abilities to maintain pace with present-day technology. One of these techniques Synectics increase the power of students' creativity in science comprehension is mapped by means of systematic literature review. So that this study is an effort for the development of science comprehension through the Synectics teaching model at secondary level in District Rawalpindi.

Synectics Model of Teaching: -

Synectics is a technique of the Information Processing family of the teaching model. It was designed by William J. J. Gordon and his colleague in 1961. The model was used to develop creativity group in industrial organizations. Later on, it was adopted in education. Synectics model has two major characteristics that distinguish it from others. First, it attacks underlying concept of the problem rather than the problem itself. Second, it examines the problem in many ways to try to discover an analogy (Evans, 1996). The main element of Synectics is the use of analogies (Joyce, Weil, & Calhoun, 2014).

Synectics process follows two basic activities. These are:

I. Making the familiar strange/Creating Something New
II. Making the Strange Familiar

Objectives

The following are the objectives of the study.

1. To review the previous researches on Synectics systematically

Research Questions

- How well students can comprehend science through synectics in underdeveloped countries?
- How well students can comprehend science through synectics in developed countries?

Significance of the Study

The study will be of significant for:

Working Teachers

Synectics model of teaching provides an interesting systemic approach. So the use of this model will enhance the quality of instruction. This model will help teachers and students articulate new solutions to a problem.

Students

The use of this model will improve students' learning of concepts on the subject of science. Also, this model

provides an interactive environment. This will enhance the academic performance of the students and will make them more confident.

Curriculum Planner and Training Institutions

The findings of the proposed study will be helpful for curriculum planners in the curriculum. They will be able to select appropriate instructional material and contents for a course. It will also helpful for the training institutions so that the same model will be implemented in teachers' training.

Systematic Review

A brief synthesis of the findings of previous studies on Synectics model of teaching reveals that there are not many studies in this area, particularly in Pakistan, it is relatively limited and underused. General steps of previous tips may additionally lead researchers to a scientific evaluation: hassle formulation, assessment planning, and literature search, records collection and information evaluation, information synthesis and interpretation, effects presentation and evaluation replace.

Research Methodology

Research Method

The research is classed as a review of the literature. The literature review is a dependable research approach. Regarding its technique, its miles considered as qualitative, because it seeks to establish meaning and importance to the object of study.

Procedure of Experiment

The study examined that was conducted in 4 stages. The research problem becomes described in the first step and studies became completed within the google student database in the second step and the third step reading of text and classification of underdeveloped and developed countries was done. The fourth step of research was the analysis of all work of articles according to year, country and universities.

Analysis of Results

A total of 50 numbers of papers were obtained, which has a considerable amount of contributions to the relevant topic. The literature of developed and developing countries was reviewed systematically. The number of countries was maximum in which the synectics approach was applied and results were remained positive regarding educational activities and trainings as ahead.

S	Year	Country	Authors	Findings
1	2004	China	His- Chi Hsiao, Ying-Hsin-Liang, Teng-Ying –Lin	It is the creative thinking teaching model. Through Synectics students' needs in terms of cognitions, skills, affections and creativity along with learning computer network can be met.
2	2013	India	Hema V Nalini	It helps students and teachers to think creatively; and develops meta cognition and helps the concept get learnt.
3	2015	India	Dr. Bapi mishra, riki choudury	It helps in problem solving and also enhances creativity.
4	2014	India	Girija, C	It helps in skill development and also in content knowledge.

S	Year	Country	Authors	Findings
5	2014	India	Kiranjit Kaur & Sesadeba Pany	Methods of teaching to enhance creativity as brainstorming, the synectics model of teaching and role playing. Creative teaching leads a child to give his best to society.
6	2014	India	Dr.S.Chandrasekaran	Synectics technique enhances the interest and motivation levels in Biology.
7	2013	India	Sumamol and Dhanya	Synectics model is more effective with respect to creativity for teaching Physics
8	2012	India	Patil	Synectics model is more effective to increase the achievement of students
9	2008	India	Paltasingh	Synectics model is better than traditional method for: (i) the development of creativity, (ii) gain in creativity, (iii) training in creativity, and (iv) scholastic achievement
10	2015	Indonesia	Tri-martini Nurharyani, St. BudiWalayo, Wardono	It helps in learning mathematical literacy in geometry and stats.
11	2012	Indonesia	Masda Tumangger ,Tjut Ernidawati	Synectics teaching method can help students to be more dynamic in teaching and learning process
12	2013	Indonesia	Arye Dika Wijaya	Synectic model use to improve students' writing skill.
13	2012	Iran	Mandana Aiamy, Fariba Haghani	It helps in brainstorming.
14	2015	Iran	Soheila Abed, Amir Hosein Mohammad Davouddi, Davoud Hoseinzadeh	It helps in critical thinking.
15	2014	Iran	Hamidreza Fatemipour, Masoumeh Kordnaeej	The students who were in the group where the Synectics technique was used outstanding
16	2011	Iran	Tayebeh tajari , Fateme Tajari	Teaching by Synectics method increases the creativity, fluency, felexibility and elaboration, but can increase individual differences.
17	2014	Iran	Gholamhossein Afshari, Nasser Ghaemi	Synectics training enhances the academic achievement in the course of writing essay
18	2014	Iran	Ali Yousefi	Synectics in science teaching and learning, student's creative performance than more traditional methods increases.
19	2012	Iran	Zavaraki e.z., Norouzi d., Safavi S.M.R.	Teaching by means of Synectics is more effective than teaching by traditional method suggesting using Synectics method any time appropriate.

S	Year	Country	Authors	Findings
20	2011	Iran	Shabani	Synectics and metaphors enable students and teachers to find new ways of thinking towards a concept
21	2006	Iran	Taijri	Students who learned using Synectics model outperformed than those who learned using lecture method
22	2001	Iran	Dastjerdi	Synectics model clarifies the concept.
23	2017	Pakistan	Aftab Ahmed Khan, Nasir Mehmood	Comprehension of abstract concept of geometry in mathematics can be improved by the Synectics.
24	2016	Tailand	Dr.Paitoon Kantunyaluk, Asst.Prof.Dr.Surapon Boonlue	The development of Synectics blended classroom to enhance creative thinking enhances the students to use information technology in the instructional activities integrating problem based learning and collaborative learning to work interactively among learners.
25	2012	Tailand	Hsien-Hui Tanga, Ying-Ling Chena and John S. Gerob	Use of various design techniques affects the design manner. Brainstorming became more orientated towards useful thinking. Situation becomes more orientated toward the design of consumer-oriented merchandise. synectics changed into extra orientated toward the considering product structures and their combination.
26	2017	Tailand	Sasipong Srisawat	Better for creativity.

Articles of Developed Countries on Synectics

S	Year	Country	Author	Findings
1	2001	Australia	David Conley	The group that used Synectics techniques out-performed the other group in creativity.
2	1994	Cyprus	Georgiou	Use of Synectics model not only improves creative thinking but also interpersonal skills of the students
3	2010	New England	Sadathoseini, Memaria	It enhances performance. Increases creativity.
4	2009	Germany	Duin, Hauge, and Thoben	Synectics fit very well for the development of concept
5	2011	Greece	Pavlos Kallonis, Demetrios G.Sampson	Good for teachers development.

S	Year	Country	Authors	Findings
6	2006	Italy	Emilia Barone, Diana Olivieri	Findings have been favourable for media literacy, which highlights that how teens need to be educated for the crucial TV watching and to trendy mass media use.
7	2017	Poland	Sebastian Koziołek	In computing education Synectics proved to be difficult in use but it help to attain a rich body of knowledge.
8	2017	Turkey	Nalan Bayraktar Balkır, Ece Zehir Topkaya	Synectics had positive effect on writing fluency but not increase in lexical.
9	2017	Turkey	Bahadır ERİŞTI, Mustafa POLAT	This increases vocabulary.
10	2008	Turkey	Mehmet Asmalı, Saniye Sanem Dilbaz Sayın	Students can retain vocabularies longer through Synectics.
11	2011	Turkey	Kaplan, Ercan	Students develops creativity through synectics applications rather than creating of original product.
12	2011	USA	Christina Sierra-Jones	It promotes scientific concept development. It also helps in questioning.
13	2001	USA	David Gonzalez	The study indicated that it is not possible to rank each of these methods against each other.
14	2016	USA	Jessica J. Monk, Adarsh K. Gupta, Lucia Weiss	Synectics technique may additionally improve the fine and variety of techniques used to achieve every day bodily pastime
15	1994	USA	Karen S. Meador	Synectics is such kind of strategy that is useful for both gifted and non-gifted kindergarten students. It develops individual level of thinking in students.
16	1986	USA	Jack Tapleshay	Synectics is good as teaching style of individual Instructor.
17	1973	USA	Leanna Gail Dent	Synectics treatment that increased the level of creative thinking exhibited in the written responses
18	1996	USA	Sylvia C Gendrop	There are different potential strength and one weakness, in the reflective reasoning of nurses and also Synectics developed creative abilities of nurses.
19	2009	USA	Walker	Synectics model of teaching promotes metaphorical and deep thinking.
20	2006	USA	Laura	Synectics enables students to solve a multitude of academic challenges
21	2003	USA	Nalon	Synectics model can be used in a variety of situations

S	Year	Country	Authors	Findings
22	1997	USA	Dykstra, and Dykstra	Metaphor and analogies can be difficult for some students to understand, yet these are necessary for creative writing
23	1996	USA	Evans	Synectics model attacks the underlying concept of the problem rather than the problem itself and thus, enable students to develop concept. Synectics model examines the problem from many angles; this again gives better understanding of the concept.

Conclusion

This study performed literature review on effectiveness of synectics in different institutions of different developing and developed countries. Synectics approach was applied in both developing and developed countries and there is no significant difference between the effectiveness of synectics in both categories. It is concluded from the under developing countries that synectics model is very useful in different situation of educational activities and developed countries are also in favour of synectics to employs in education sector. It is suggested for future work that teacher must use synectics in any subject at any level of education that can enhance student's ability to perform better and thinking abilities can be boosted up during educational activities.

References

Abed, S., Davoudi, A. H., & Hoseinazadeh, D. (2015). The effect of Synectics pattern on increasing the level of problem solving and critical thinking skills in student of Alborz province. *WALLA Journal,* 31 (S1), 110-118.

Afshari, G., & Ghaemi, N. (2014). Synectics Teaching Effect on the Academic Performance of Students' Composition among Male Fifth Grade Students in Dezful City. *Journal of Life Science and Biomedicine*, 448-451.

Ahmad Khan, A., & Mahmood, N. (2017). The Role of Synectics Model In Enhancing Student's Understanding Of Geometrical Concepts. *Journal of Research and Reflections in Education*, 253-264.

Aiamy, M., & Haghani, F. (2012). The Effect of Synectics & Brainstorming on 3 rd Grade Students'development of Creative Thinking on Science. *Procedia - Social and Behavioral Sciences*, (pp. 610-613). Iran.

Ali, T. (2011). Exploring Students' Learning Difficulties in Mathematics Classroom in Gilgit Baltistan Teachers' Effort to Help Students Overcome These Difficulties. *Bulletin of Education Research*, *33*(1) 47-67.

Anders, B., & Anna, E. (2009). Learning Computer Science: Perceptions, Actions and Roles. *Educational Research Impacting Engineering Education*, 327-338.

Arye Dika, W. (2014). Improving Students' Writing Skill Using Synectics Model. *Muhammadiyah University of Ponorogo*, 45.

Asmalı, M., & Dilbaz Sayın, S. S. (2016). The Effects of the Synectics Model on Vocabulary Learning, Attitude and Desire to Learn English. *Asian EFL Journal*, 321-344.

Balkır, N., & Topkaya, E. Z. (2017). Synectics as Prewriting Technique: Its Effect On Writing Fluency And Lexical Complexity. *Eurasian Journal of Applied Linguistic*, 325-347.

Barone, E., & Olivieri, D. (2006). Music education and critical thinking in early adolescence: A synectic literacy intervention. *9th International Conference on Music Perception and Cognition*, (pp. 238-289). Itlay.

Chandrasekaran, S. (2014). Effectiveness of Synectics Techniques in Teaching of Zoology at Higher Secondary Level. *International Journal of Humanities and Social Sciences Invention*, 37-40.

Conley, D. (2001). Deliciously Ugly: Pursuing creativity in feature writing. *Austrailian Journalisim Review*.

Dastjerdi, N. (2001). Studying the effect of Synectics teaching pattern on educational attainment and fostering creativity of students in social education in female and male primary schools in Isfahan. *Alborz province WALLA Journal*, 110-118.

Dykstra, Jeanne, Dykstra, & E, F. (1996). Imagery and Synectics for Modeling Poetry Writing. *Annual Conference of the International Visual Literacy Association.* Cheyenne.

Erik, M. (2011). A Study of Student Problems in Learning to Program. *Department of Computing Science Umea University Swedan*.

ERİŞTİ, B., & POLAT, M. (2017). The Effectiveness of Synectics Instructional Model on foreign Language Vocabulary Teaching. *International Journal of Languages' Education and Teaching*, 59-76.

Evans, J. R. (1996). *Creativity in OR/MS: Creativity Enhancing Strategies.* Interfaces.

Fariha, G., Mumtaz, A., & Mehwish, A. (2011). Secondary School Computer Science Curriculum: Perceptions of Stakeholders. *Pakistan Journal of Education*, Vol XXVIII.

Fatemipour, H., & Kordnaeej, M. (2014). The Effect of Synectics and Journal Creative Writing Techniques on EFL Stduents' Creativity. *International Journal of Language Learning and Applied Linguistics World*, 412-424.

Gail, L. (1988). Using Synectics to Enhance The Evaluation of Works of Art. *SAGE Journals*.

Gendrop, S. C. (1996). Effect an Intervention in Synectics on the Creative Thinking of Nuses. *Creativity Research Journal*, 201-209.

Georgiou, S. N. (1994). Synectics: A problem solving tool for educational leaders. *International Journal of Educational Management*, 5-10.

Girija, C. (2014). How learning techniques initiate simulation of human mind. *Educational Research and Reviews*, 606-609.

González, D. (2001). *The Art of Solving Problems: Comparing the Similarities and Differences Between Creative Problem Solving (CPS), Lateral Thinking and Synectics: a Project for Studies in Creativity.* New York.

Heiko, D. (2013). An Ideation game conception based on synectics method. *Journal of Science and Technology*.

Hsiao, H.-C., Liang, Y.-H., & Lin, T.-Y. (2004). A creative thinking teaching model in a computer network course for vocational high school students. *World Transactions on Engineering and Technology Education*, 243-248.

Khatoon, R., Sachan, B., Khan, M. A., & Srivastava, J. P. (2017). Impact of school health education program on personal hygiene among school children of Lucknow district. *Journal of family medicine and primary care*, *6*(1), 97.

Josephat O, O., Herbert, W., & Fredrick, N. (2012). Challanges of Teaching and Learning Computer Programming in Developing Countries. *INTED2012 Conference.* Valencia, Spain: ResearchGate.

Joyce, B., Weil, M., & Calhoun, E. (2014). *Models of Teaching (9th Ed).* Allyan and Bacon.

Kallonis, P., & Sampson, D. G. (2011). A 3D Virtual Classroom Simulation for supporting School Teachers' Training based on Synectics - "making the strange familiar". *11th IEEE International Conference on Advanced Learning Technologies*, (pp. 433-452). Greece.

Kane, M. J., & Engle, R. W. (2002). The Role of Prefrontal cortex in working memory capacity, executive attention and general fluid intelligence: An individual differences perspective. *Psychonomic Bulletin and Review*, *9*(4), 637-671.

Kantunyaluk, D., & Boonlue, S. (2015). A Development of Blended Classroom by Synectics Technique to Enhance Creative Thinking. *ICEMIS.* Thonburi Thailand.

Kaplan, A. Ö., & Ercan, S. (2011). A sample study on synectics activities from creative thinking methods: creativity from the perspective of children. *Journal of Human Science*.

Kaur, K., & Pany, S. (2014). Creative Teaching: The Need of the Hour. *Scolarly Reseach Journal for humanity Science and English Language*, 2348-3083.

Khan, A. A., & Mahmood, N. (2017). The Role of the Synectics Model in Enhancing Students' Understanding of Geometrical Concepts. *Journal of Research and Reflections in Education*, 253-264.

Kim, E. (2017). Workshop Design for Enhancing the Appropriateness of Idea Generation Using Analogical Thinking. *International Journal of Innovation Studies*, 134-143.

Koziołek, S. (2016). Design by Analogy: Synectics and Knowledge Acquisition Network. *Proceedings of the 13th International Scientific Conference.* Poland.

Kyaw, E. K., & Sinhaneti, k. (2012). A Study of the Role of Rote Learning in Vocabulary Learning Strategies of Burmese Students. *US- China Education Review*, 12, 987-1005.

Laura. (2006). Synectics for Creative Thinking in Technology Education. *International Technology Education Association*, 22-27.

Loy, C. J. (2011). The Impact of Synectics on Engagement, Quality, and Enjoyment of Creative Writing. *SAGE Journal*.

Lutz, S. T., & Huitt, W. G. (2003). *Information Processing and Memory: Theory and Applications.* Retrieved 2003, from Educational Psychology Interactive, Valdosta State University: http://www.edpsycinteractive.org/papers/infoproc.pdf

Maureen, B., Anne, B., & Tuba, Y. (2008). Student Perceptions of Computer Science: a retention study comparing graduating seniors with cs leavers. *SIGCSE Technical Symposium on Computer Science Education* (pp. 402-406). Portland, USA: ACM SIGCSE Bulletin.

Meador, K. S. (1995). The Effect of Synectics Training on Gifted and Nongifted Kindergarten Students. *SAGE Journals*.

Michal, F., & Monika, S. (2012). Metaphors and Analogies for Teaching Algorithms. *SIGCSE' 12, North Carolina, USA*.

Mishra, D. B., & Choudhury, R. (2015). A study on the Importance of William Gordon's Synectic Model of Teaching on Creative Teaching for Secondary Students in Malda District. *International Journal of Informative and Futuristic Research*, 2237-224.

Monk, J. J., Gupta, A. K., & Wei, L. (2016). An Adaptation of the Synectics Model for Effective Physician Counseling. *Journal of Life Science and Biomedicine,* 53-59.

Moreira, A. M. (2011). Why concepts, Why Meaningful Learning, Why Collaborative Activities and Why Concept Maps? *Meaningful Learning Review*, *1*(3), 1-1

Murat, G. (2013). The Effect of Analogy based Teaching on students' Achievement and Students' views about Analogies. *Asia Pacific Forum on Science Learning and Teaching*, Vol 14,Issue 2, Article 14.

Nalini, V. H. (2013). Cognitive Science Perspective: Synectics as A Model Of Learning Metaphor. *International Journal of Scientific Research*, 143-148

Navaneedhan, C. G. (2012). Usage of Synectic technique in teaching –learning Chemistry Simulates human mind. *Society for Information Technology & Teacher Education International Conference.* India.

Nolan, V. (2003). Whatever Happened to Synectics? *Creativity and Innovation Managment*.

Nurhariy, T. M., Waluyo, B., & Wardon. (2015). Analysis of Literacy Abilities and Self-Efficacy Mathematics through PBI-Synectics Gordon with Scientific Approach. *International Conference on Mathematics Science and Education.* Indonesia.

Paltasingh, S. (2008). IMPACT OF Synectics Model of Teaching in Life Science to Develop Creativity Among Pupils. *E-journal of All India Association for Educational Research*.

Patil, R. (2012). Effectiveness of Synectics Model. *Indian Stream Research Journal*, 1-4.

Rashid, K., & Mukhtar, S. (2012). Education in Pakistan: Problems and their solution. *International Journal of Academic Research in Business and Social Sciences*, *2*(11).

Reigeluth, C. M., & Stein, F. (1983). The Elaboration Theory of Instruction. *Hillsdale, NJ Lawrence Erlbaum Association*.

Ryan, C. E. (2006). Analogies are like Bowling Balls or Why Analogies to English need some Explanation to help students learn scheme. *MSc CS thesis, Berkeley University of California*.

Sadat Sadathoseini, A., & Memarian, R. (2010). The Effect of empooying synectic model in teaching Palliative Care in children on nursing students writing creativity and academic performance. *Iranian Journal of Medical Education*, 239-248.

Sedaghat, H., Darivash, Y., & Fooladi, M. (2015). Investigating the impact of synectics teaching pattern on training the composition lesson creativity for the Third Grade Elementary School girls in the first district schools of Bandar Abbas. *Australian Journal of International Social Research*, 23-31.

Seligmann. (2007). *Reaching Students Through Synectics: A Creative Solution.* Retrieved from http://www.ellieseligmann.com/essays/synectics seligmann.pdf.

Shabani, & Hassan. (2003). Advance Teaching Methods: teaching skills and strategies of thinking. *Creative Research Journal*.

Sierra-Jones, C. (2011). Applied synectics to teach community development for living and learning communities to resident advisors and community assistants at California State University Monterey Bay. California.

Srisawat, S. (2017). The Development of Creative Writing Skills for Undergratuate Students through the Instructional Package of Creative Writing with Synectics Instruction Technique. *Journal of Education, Mahasarakham University*, 199-210.

Taimur-ul-Hassan, & Abdul Raheem, S. (2013). ICTs in Learning: Problems faced by Pakistan. *Journal of Research and Reflections in Education*, 52-64.

Tajari, T., & Tajari, F. (2011). Comparison of effectiveness of synectics teaching methods with lecture about educational Progress and creativity in social studies lesson in Iran at 2010. *Procedia Socail and Behavioral Sciences* (pp. 451-454). Iran: SciVerse ScienceDirect.

Tajiri, T. (2006). Studying and comparing Synectics teaching method and lecture method in fostering creativity and educational attainment in social education. *Alborz province WALLA Journal*, 110-118.

Tanga, H.-H., Chena, Y.-L., & Gerob, J. S. (2011). The Influence of Design Methods on the Design Process: Effect of Use of Scenario, Brainstorming, and Synectics on Designing. *Proceedings of Design Research Society*, (pp. 324-353). Bangkok Thailand.

Tapleshay, J. (1986). *Synectics: Applying its methods and techniques to the composition class.* CA United State.

Tumangger, M., & Ernidawati, T. (2012). The Application of Synectics Model to improve Students's Speaking Ability., (pp. 302-340). Indonesia.

Walker, D. E. (2009). Promoting Metaphorical Thinking through Synectics: Developing deep thinking utilizing Abstractions. *Journal of Advance Active Learning*.

Yousefi, A. (2014). The Effects of Synectics Teaching Model in Fostering Creativity. *Management and Administrative Sciences Review*, 1225-1231.