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The Effect of 7E-Learning Cycle Instruction on Middle School Students' Conceptual Understanding of Respiratory System

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Contribution

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In last decades, studies in the literature showed that students hold naive ideas about scientific phenomena. Many researchers revealed that these ideas play important role in the learning process. Students bring their deep-rooted prior knowledge or conceptions related with real world to the class and their existing knowledge influences understanding of introduced concepts (Hewson & Hewson, 1983). Consequently, learning consists of not only acquisition of new knowledge but also iterative interactions between new knowledge and students' existing conceptions. Thereby, these existing conceptions may facilitate or impede learning. In fact, Ausubel (1968) argued the influence of existing conceptual knowledge on the learners' conceptual development and research in the literature empirically supported this idea. Some of the prior experiences can support learning in school, such as language. On the other hand, some of them may be obstacles for further learning since they are in conflict with the currently accepted scientific knowledge. In the literature, these conceptions are labeled as 'misconceptions' or 'alternative conceptions' (Nakhleh, 1992; Hewson et al., 1983). Several studies explored children's misconceptions about the human body concepts (Mann & Treagust, 1998; Reiss & Tunnicliffe, 1999; Sungur, Tekkaya & Geban, 2001; Alparslan, Tekkaya & Geban, 2003). Scientifically acceptable or not, concepts and ideas already possessed by the learner are so powerful in that they influence students' further learning. To solve this problem, researchers developed and suggested various learning. Learning cycle is one of these instructional approaches designed to promote conceptual understanding based on Piaget's mental functioning model.

Learning Cycle is grounded on constructivism and first version included three phases initially called preliminary exploration, invention and discovery (Karplus & Their, 1969). As it started to be implemented, investigated and refined over years, the phases extended. Different versions of the model generated as 3E, 5E and 7E.7E-Learning Cycle model includes seven phases, namely; Elicit, Engagement, Exploration, Explanations, Elaboration, Evaluation and Extension. The phases comprise activities to elicit prior knowledge and misconceptions, gain students' attention, to let the students explore the concept and realize the insufficient explanations on their minds, to connect students' explanations with scientific clarification, to deepen students' understanding by alternative activities, to evaluate their conception, and finally to transfer the knowledge in new situations, respectively (Allen & Tanner, 2005; Eisenkraft, 2003; Settlage, 2000). The sequence of the phases effectively increases students' knowledge and learning motivation (Liu, Peng, Wu & Lin, 2009). Moreover, the phases of learning cycle help students to explore their belief system and provide knowledge construction (Odom & Kelly, 2001). Additionally, Marek, Laubach and Pederson (2003) reports that the learning cycle is not a method, it is a comprehensive approach that accommodate methods, such as group work, laboratory investigations and lectures, and models of instructions, such as cooperative learning and direct instruction. The studies also show that, the learning cycle is an effective method to clarify students' thought process and correct their misconceptions while promoting understanding in science concepts (Balci, Cakiroglu & Tekkaya, 2006; Yılmaz, Tekkaya & Sungur, 2011).

On the basis of findings of relevant research this study aimed at comparing the effectiveness of 7E-Learning Cycle Instruction (7E-LCI) and Traditionally Designed Science Instruction (TDSI) on middle school students' conceptual understanding in Human Respiratory System. In the current study, students' conceptual understanding of Respiratory System was examined because relevant literature revealed that students experience difficulties in understanding respiratory system and possess several misconceptions about related concepts (Alparslan et al., 2003). Based on the previous findings, it is expected that 7E-LCI may support the students' conceptual understanding of respiratory system.

Method

The subjects of the study were 159 sixth-grade students (81 boys and 78 girls) attending six intact classes in an urban middle school.
For the specified purpose, quasi-experimental design was conducted. Two instructional methods were randomly assigned to intact classes of two different teachers. Each teacher had both 7E-LCI classes TDSI classes. Experimental group (n = 83) instructed Human Respiratory System concept with 7E-LCI and worked on hands-on and minds-on activities in a constructivist environment. Control group (n = 76) received the subject by TDSI based on teacher's explanations, discussions, and textbooks. The implementation process took about 2 weeks in spring semester of 2010-2011.
Students' conceptual understanding was assessed by Respiratory System Conceptual Inventory (RSCI) developed by researchers. It is a 10-item multiple-choice test designed specifically for middle school science courses. Each of the items has a scientifically accepted correct answer and three common misconceptions worded in the language that the students use to express the concepts. Additionally, each item has a fifth choice as 'I have no idea about this question.' to identify students without any prior knowledge on the concept assessed by the item, to avoid the missing items as well as to minimize guessing. After each items, the inventory asks to students their confidentiality for their answers with a yes/no question to be able to distinguish students with deep misconceptions or students who select the correct answer just by guessing. Each item counts as correct if the students are able to pick up the correct answer and choose yes for their confidentiality. The KR20 value of the test was .67 for the present study.
The RSCI was implemented to students three times, before the instruction (Time 1), after the instruction (Time 2) and again one month later (Time 3). After assumption check, Mixed between-within subjects ANOVA was performed to determine whether there was a significant mean difference among students' conceptual understanding received 7E-LCI and TDSI. In addition, the change in students' conceptual understanding related with Human Respiratory System over time was analyzed.

Expected Outcomes

The results showed a statistically significant interaction effect between time and treatment which indicates the change of scores over time were not similar for groups, Wilk's $\lambda=0.92$, $F(2,156)=6.39$, $p<0.05$, $\eta2=0.08$. Moreover, results revealed a significant treatment effect $F(1,157)=12.09$, $p<0.05$ with a moderate effect size, $\eta2=0.07$ and time effect, Wilk's $\lambda=0.73$, $F(2,156)=28.67$, $p<0.05$ with a high effect size, $\eta2=0.27$.
After having statistically significant interaction effect, simple main effects were examined through seperating the data based on group and time categories. Bonferroni Adjustment was requested on SPSS to decrease Type 1 error on multiple comparisons.
The result indicates that there were not a significant mean difference between groups before the instruction (Time 1), $p> 0.05$. After the instruction (Time 2), a significant mean difference was found between experimental ($M=3.59$) and control group ($M=2.33$), $p< 0.05$. Similarly, a statistically significant treatment effect was found in favour of experimental group ($M=3.37$) comparing to control group ($M=2.30$) one-month later the instruction (Time 3), $p< 0.05$.
To examine how the instruction contributed each group students' understanding within group differences were investigated. There was a significant change in The 7E-LCI students' conceptual understanding from Time 1 ($M=2.00$) to Time 2 ($M=3.59$), from Time 1 to Time 3 ($M=3.37$), $p<0.05$. However, there was no significant change from Time 2 to Time 3, $p>0.05$. On the

other hand, the only significant difference at TDSI students' scores was between Time 1 (M=1.78) and Time 2 (M=2.33), $p<0.05$.
To sum up, the result of the study revealed a statistically significant interaction effect between time and treatment. Follow-up analysis revealed that students received 7E-LCI understood the Respiratory System concepts better and their knowledge was significantly higher than the students one-month later comparing the control group. Students' scores on the RSCI over three time period indicated that 7E-LCI developed a better conceptual understanding.

References

Allen, D., & Tanner, K. (2005). Infusing active learning into the large-enrollment biology class: Seven strategies, from the simple to complex. Cell Biology Education, 4, 262-268.
Alparslan, C., Tekkaya, C., & Geban, O. (2003). Using the conceptual change instruction to improve learning. Journal of Biological Education, 37(3), 133-137.
Ausubel, D. P. (1968). The psychology of meaningful learning. New York: Grune & Stratton.
Balcı, S., Cakiroglu, J. & Tekkaya, C. (2006). Engagement, exploration, explanation, extension, and evaluation (5E) learning cycle and conceptual change text as learning tools. Biochemistry and Molecular Biology Education, 34(3), 199-203.
Eisenkraft, A. (2003). Expanding the 5E model. The Science Teacher, 70(6), 56-59.
Hewson, M. & Hewson, P. (1983). Effect of instruction using student prior knowledge and conceptual change strategies on science learning. Journal of Research in Science Teaching, 20, 731-743.
Karplus, R., & Thier, H. D. (1967). A new look at elementary school science: Science curriculum improvement study. Chicago: Rand McNally.
Liu, T.-C., Peng, H., Wu, W.-H., & Lin, M.-S. (2009). The Effects of Mobile Natural-science Learning Based on the 5E Learning Cycle: A Case Study. Educational Technology & Society, 12(4), 344–358.
Mann, M., & Treagust, D. F. (1998). A pencil and paper instrument to diagnose students' conceptions of breathing, gas exchange and respiration. Australian Science Teachers Journal, 44, 55-60.
Marek, E. A., Laubach, T. A. & Pedersen, J. (2003). Preservice elementary school teachers' understanding of theory based science education. Journal of Science Teacher Education, 14(3), 147-159.
Nakhleh, M.B. (1992). Why some students don't learn chemistry. Journal of Chemical Education, 69(3), 191-196.
Odom, A. L. & Kelly, P. V. (2001). Integrating concept mapping and the learning cycle to teach diffusion and osmosis concepts to high school biology students. Science Education, 85, 615-635.
Reiss, M. J., & Tunnicliffe, S. D. (1999). Children's knowledge of the human skeleton. Primary Science Review, 60, 7 – 10.
Settlage, J. (2000). Understanding the learning cycle: Influences on abilities to embrace the approach by preservice elementary school teachers. Science Teacher Education, 84(1), 43-50.
Sungur, S., Tekkaya, C., & Geban, Ö. (2001). The Contribution of Conceptual Change Texts accompanied by Concept Mapping to Students' Understanding of the Human Circulatory System". School Science and Mathematics, 101(2), 91-101.
Yılmaz, D., Tekkaya, C. & Sungur, S., (2011). The Comparative Effects of Prediction/Discussion-Based Learning Cycle, Conceptual Change Text, and Traditional Instructions on Student Understanding of Genetics. International Journal of Science Education, 33, 607-628.

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