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ABSTRACT

This study compared the effects of the combined strategies following the Metacognitive Learning Cycle (MLC) Model and the Traditional Model on the conceptual understanding and problem-solving skills of first year college students in Mendelian and non-Mendelian genetics. The MLC strategies include the discussion of discrepant events, use of a research-made learning manual during group work activities done under a cooperative learning atmosphere, class problem solving that employed think-aloud and modeling strategies, and metacognitive reflections by the students after each phase of the lesson. The traditional model includes lectures, discussions and problem-solving with teacher modeling the solution followed by individual seatwork activities.

Four intact classes, two from the high-ability and two from the low-ability groups, consisting of 185 first year college students enrolled at a teacher education institution in Tacloban City, Leyte were randomly assigned to the experimental and control groups.

The students in the sample were pretested simultaneously on the researcher made tests (*e.g.,* Conceptual Understanding Test and Problem-solving Skills Test with reliability coefficient values of 0.64 and 0.80, respectively) as well as the four moderator variables (mental ability, prior knowledge, disembedding ability test and cognitive level).

The researcher taught both the experimental and control classes. The experiment proper lasted for about eight weeks equivalent to 24 contact hours during the second semester of School Year 2003-2004.

Data collected from the pre-and post-test in the conceptual understanding and problem-solving skills test were both subjected to quantitative and qualitative analyses. Included in the quantitative analyses were the students' test scores in the four moderator variables. The qualitative interpretation was done on the results of the conceptual trace analysis and students' answers to the posttest on conceptual understanding. The same was done with their answers to the pretest/posttest items (*i.e.,* the first four items only) on problem-solving, and the analysis of their metacognitive reflections on each phase of the five lessons.

The profile of the students as regards the four moderator variables is as follows: Majority have average mental ability (about 44%), followed by below-average (21%), dull (19%), above-average (8%), superior (about 7%), and very superior (about 0.02%). Fifty-five percent (55%) has low level of prior knowledge, while forty-five percent (45%) has high level of prior knowledge. Majority of the students in the sample are in the concrete level (83%), followed by

transition (about 16%) and formal level (about 1%). Majority of the sample are field-independent (64%), followed by field intermediate (31%) and field-dependent (about 5%).

The results of the pretests show that students initially had a very low level of conceptual understanding as well as problem-solving skills in genetics. After the intervention, the results of the conceptual trace analysis show that, under the three main categories of conceptual change (No change, Change for the Better and Change for the Worse), the experimental high-and low-ability groups outperform their counterparts in the control groups.

In terms of gain scores, both groups of students exposed to the MLC model and the traditional method have a significant increase in their scores in both the conceptual understanding and problem-solving skills tests. However, comparing the posttest mean scores, students exposed to the multiple strategies of the MLC model posted a significantly higher posttest mean scores in the conceptual understanding test and problem-solving skills tests than students exposed to the traditional model. However, the results indicate a no significant interaction between students' ability level and the treatment conditions when the conceptual understanding and problem-solving are the dependent variables.

The correlation analyses reveal that the pre-and posttest mean scores on the conceptual understanding test are highly correlated to the pre-and pos-test mean scores in the problem-solving skills test. All of the four moderators variable are all highly correlated to the pre-and post-test mean scores in both tests.

With conceptual understanding as the dependent variable, no moderating effect is observed between the four moderator variables and the treatment conditions. However, with problem-solving as the dependent variable, of the four cognitive variables it is only prior knowledge and cognitive level that moderate learning. The MLC model is more effective in helping students with low level of prior knowledge and with the concrete level of cognition to achieve higher performance in problem-solving than those exposed to the traditional model.

The metacognitive reflections by students after each phase of the MLC lesson reveal that stimulation activities help concretize and enhance their learning about abstract concepts in genetics; the enrichment part of each simulation activity, the heuristics of solving genetic problems and the modeled exercises help students in solving genetic problems. The written reflections make them realize that personal efforts and involvement in the learning task greatly enhance the status of their learning (*i.e.,* intelligibility, plausibility and fruitfulness). As revealed in their metacognitive reflections, the researcher-made learning manual most likely helps both low- and high-ability students not only develop scientific conceptions in genetics but also improve their skills in problem-solving.

This study has proven that the MLC model of teaching does enhance students' conceptual understanding and problem-solving skills in Mendelian and non-Mendelian genetics. In this study, the research-made learning manual containing simulation activities and problem-solving exercises has facilitated the progress of students in the experimental high- and low-ability groups as revealed in their metacognitive reflections. These are the main contributions of this research to biology education.