

Extent of Transfer of Problem Solving Skills to Other Domains Facilitated Through Anchored Instruction

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Abstract

This study took deeper look on how much the students applied problem solving skills learned from previous mathematics subject delivered through Anchored Instruction (AI) to other domains using pre-test - post-test Nonequivalent Control Group Design with English proficiency as moderator variable. The contents considered in AI were problems in Arithmetic, Advanced Algebra and Trigonometry. Results revealed that AI affected significantly better extent of transfer of the problem solving skills to General Chemistry but opposite results were found in Solid Mensuration while no significant difference in Analytic Geometry. English proficiency significantly moderated extent of transfer of problem solving skills to other domains like Solid Mensuration and General Chemistry. No interaction effect was found between English proficiency and teaching model. It is recommended that AI be considered as facilitator of transfer of problem solving skills in General Chemistry and enhancements can verify results in Solid Mensuration and Analytic Geometry.

Keywords: *transfer of learning, learning beyond context, anchored learning*

Leyte State University (SLSU) also envisions producing better quality students, particularly engineers, who

1.0 Introduction

Developing the ability of the students to solve mathematical problems with enough provision (by the teacher) of opportunities for transfer of learning to real-life situations is the ultimate goal for all mathematics teachers. This is the most concrete evidence for teachers to be called effective. The Engineering Department of Southern

can really apply the theories they learn in the classroom into their respective work place. Although the university produced commendably higher passing percentage compared to the national passing rate, the mortality from admission to graduation within the prescribed study period is quiet high. This technology-oriented course needs an enriched teaching design that will increase the number of students who

are prepared and equipped of a more functional learning and engineering. This relates to the investigation and understanding of the importance and applicability of the knowledge and skills they learned in the classroom and in their work.

Anchored Instruction (AI) was designed to present problems in a meaningful context to allow for investigations into real life environments (Kurz, 2005). The focus was on finding mathematical dilemmas using AI wherein four cases were evaluated. Results revealed that the pre-service teachers were positive on the utilization of AI which was claimed to have features that support student's learning and growth. In addition, Crews, *et al.* (1997) defined AI theory as a learning strategy that "anchors" instruction in a practical and pragmatic case-study, or problemsolving situation. It challenges and drives learners to find the problem's embedded data through a realistic activity. This theory also provides the learners the opportunity to exercise and practice complicated problems considering realistic learning contexts as avenues of bringing in the content to be learned in an experiential way. As a result, learners tend to transfer skills and link subject matter to other contexts. This study considered opportunities for

transfer and link across the curriculum since other subjects as domains serve as vehicles for measuring the effect of AI design on the transfer of problem solving skills of the respondents to other subjects. Maleki (2007) found out that English Proficiency has significant positive relation with the academic achievement of the students, including Mathematics. This has connection with the report of the Massachusetts Comprehensive Assessment System (Driscoll, 2005) that those students with limited English proficiency at the proficient and advanced levels improved by one percentage point on mathematics test. Driscoll (2005) further revealed that for students in the warning or falling level, a remarkable decline was observed in Science and Technology/Engineering test. This seemed to suggest that English proficiency could moderate the improvement of mathematical problem solving skills of students, particularly in engineering. Similarly, Costillas and Duarte (2013) found out that English proficiency among engineering students is pushed up by their reasoning attributes which has a direct link on the importance of connections between reasoning attributes and mathematical skills among students Donges (2011).

The potential of AI in teaching problem solving in mathematics as an effective tool for transfer of learning to other domains, which is the ultimate goal of making students active, productive, effective, and life-long learners (Mc Keough, Lupart & Marini, 1995), moderated by English proficiency, had encouraged the researcher to conduct this study on a group of first year engineering students.

The freshmen of the Engineering Department of Southern Leyte State University main campus in Sogod, Southern Leyte are not exempted from the groups of students who have poor problem solving ability. But the course they have chosen requires much from them in terms of problem solving. The functionality and transfer of their learning to other domains is equally important as actual practice of applying knowledge learned in one situation to another. There must be a remedy to improve their problem solving skills to produce more and better quality engineers, thus, attain the goal of the department in particular and of the university, in general.

2.0 Theoretical and Conceptual Framework

Jackson and Mansoor (2002) emphasized that person (student) and environment should be viewed as contributors to an activity rather as separately described things and that their adaptation should involve dynamic mutual modification rather than static matching. This is a challenge that all faculty members in SLSU should consider for them to be able to attain their goals and realize the university's vision.

The AI model uses seven interwoven and interdependent cognitive and instructional design principles to create instruction (Crews, *et al.* 1997). First, generative learning format enhances learner's motivation by allowing learners to create or "generate" the solution by solving open-ended problems. Second, video-based and other kinds of presentation improve text book learning by adding related background information and realistic examples. Third, narrative format enhances learning episodes that enrich the realistic and authentic classroom activities. Fourth, problem complexity arouses learner's interests and requires full commitment to follow interrelated steps to solve the problem. Fifth, embedded data

designs incorporate both needed and unneeded data, which allow learners to be engaged in the exploration and discovery process in identifying the problem and search for the pertinent data. Sixth, opportunities for transfer are created in different, realistic settings that allow learners to view other opportunities to use learned skills and knowledge. Lastly, links across the curriculum are rooted within a realistic episode, with content that applies to other areas of study. Therefore, learners are exposed to the new subject matters that may broaden their views to explore other studies of interest.

The traditional definition of transfer model concerns on the application of what one has learned in one situation to another (Reed, 1993; Singly & Anderson, 1989). This is based on the predefined concepts of the researchers that they hope students will transfer (Reed, 1993; Adams, *et al.*, 1988; Basok, and Holyoak (1989); Singly & Anderson, 1989; Brown & Kane, 1988; Nisbett, Fong, Lehmann & Cheng, 1987; Thorndike & Woodworth, 1901). This model focused on the cognitive aspects of transfer, which is viewed to have a static passive process. As cited by Rebello, *et al.* (2005), Thorndike's theory of transfer asserted that transfer of learning

from one activity to another is possible only if these activities share common characteristics or features (Thorndike & Woodworth, 1901). Moreover, Rebello, *et al.* (2005) further mentioned that Judd's theory of deep structure transfer stressed that extent of transfer depends upon the extent to which learner notices the common characteristics or similarities between and among the problems or situations (Judd, 1908).

The recent focus of the researcher is the notion of transfer of learning to other domains and how to assess them (Bransford & Schwartz, 1999; Greeno, Moore & Smith, 1993; Labato, 1996).

Researchers centered their studies on the students' abilities to learn how to solve problems rather than students' abilities to solve successfully a problem. In this regard, researches do not only focus on the cognitive aspect that may affect transfer but also on the mediating factors such as the foundation, scope and validity of previous knowledge of the students and their expectation (diSessa, 1993; Hammer & Elby, 2002). Activation of pieces of knowledge (diSessa, 1993), cognitive resources (Hammer, 2000) in the new domain, and the dynamic construction of similarities between the learning and

transfer contexts (Lobato, 1996) are important. In this study, the focus is both on the problem solving process skills development based on Polya's (1957) framework and on the overall problem solving performance of the students whose scoring rubric is based on Charle's (1987). Both the cognitive aspect and transfer contexts will be considered using Enrichment Mathematics whose contents include Arithmetic, Advanced Algebra and Trigonometry.

Rebello, *et al.* (2005) cited the combination of the contemporary perspective of transfer to construct a model that explains the dynamic transfer of learning which occurs by conducting a "think aloud" interview involving a problem-solving task.

distinctions between productive and unproductive association that a learner might make in a given situation rather, it examines all possible associations that a learner might make in a given situation. It describes the processes of knowledge construction in a new situation.

As presented in Figure 1, this study is based on the Transfer Model of Reed (1993), Singly & Anderson (1989) and Anchored Instruction Theory of Kurz (2005) and Crews, *et al.* (1997). With AI as the teaching model, transfer of problem solving skills to other domains is the dependent variable with English proficiency as moderating variable. Findings are the inputs to English Mathematics Enhancement program.

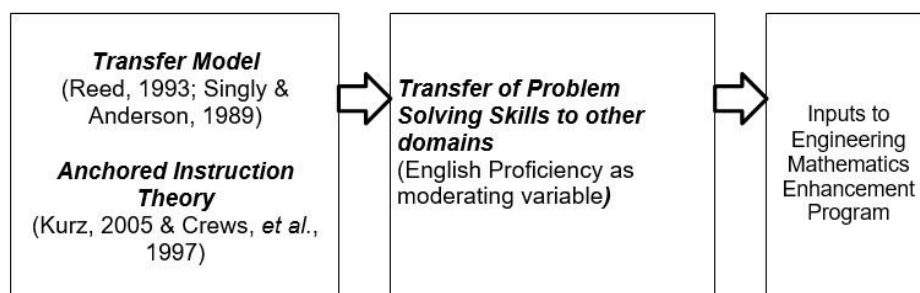


Figure 1. Theoretical and conceptual framework.

The AI model enables the researchers to gain insights into the students' thinking processes as they solve problems in unfamiliar domains. However, it does not make

3.0 Methodology

This study used quasiexperimental design in the

delivery of AI, specifically the pre-test - posttest Non-equivalent Control Group Design. Pre-assessment was done by administering the pre-test to the respondents. Since high school grades in mathematics, the English proficiency test and interview were done before enrolment, students were more or less comparable in ability in mathematics. These are the screening stages for students who would like to take engineering and other degree courses offered in the university. The two groups of freshmen engineering students, CE and EE & ME were randomly assigned to either the experimental group or control group. The pre-test was prepared beforehand by the researcher. It underwent critiquing and content validation prior to its use. The items were taken from topics in Arithmetic, Advanced Algebra and Plane Trigonometry.

Meanwhile, lesson plans for the selected topics taught in the experiment were prepared. Two topics from Arithmetic, six from Algebra, and five from Plane Trigonometry were prepared with two teaching sessions per topic, except Quadratic Equation and Age Problems which called for three sessions each. Altogether, 28 teaching plans were prepared for the experimental group. The topics in Arithmetic included Percent and

Simple and Compound Interests. In Advanced Algebra, the topics were: Quadratic Equations, Age Problems, Work Problems, Mixture Problems, Uniform Motion Problems involving Winds and Water Current, Arithmetic and Geometric

Progressions in Plane Trigonometry, the topics were Angles of Elevation and Depression, Bearings, Oblique Triangle using Right Triangle and vice versa, Oblique Triangles using the Law of Sines and Cosines, and Checking Solutions of Oblique Triangle using Mollweides's Equation.

This study considered English proficiency as a moderating variable since it was found to be significantly related to academic achievement as measured by grade point averages (Maleki, 2007). The academic achievement includes mathematics which contains problem solving. In this study, English proficiency ratings were based on the records of the Office of Student Services (OSS). This office transmuted all scores into percentages as basis for the university's minimum requirement of 75 percent rating for a student to be enrolled in a degree course.

The university's English Proficiency test includes writing and comprehension skills. The content is

composed of vocabulary (antonyms and synonyms), sentence structure and subject-verb agreement. The skills and content are similar to that of Teachers of English for Speakers of Other Languages (TESOL), Inc., 1997, hence, its classification scheme was followed. The range of ratings for each category was primarily based on the transmutation scheme used by the OSS where the lowest possible rating is 70 percent (zero score) and the highest possible rating is 95 percent (perfect score). An interval of 5 percent was considered in a range. Below is the classification and corresponding range of ratings for English proficiency:

<u>Proficiency Level</u>	<u>Rating (%)</u>
Pre-functional	70-75
Beginning	76-80
Intermediate	81-85
Advanced	86-90
Proficient	91-95

The extent of transfer of learning to other domains such as Analytic Geometry, Solid Mensuration and General Chemistry was determined by getting the scores in the problem solving tests in these subjects. The scores were based on how much they got correct based on Polya's framework of problem

solving, wherein a score is 1 means that the students show evidence on "Understanding the Problem"; 2 for "Devising a Plan"; 3 for "Carrying Out the Plan"; and 4 for "Looking Back". These subjects (other domains") are offered every second semester of the same academic year. The same instructor or professor handles each of these subjects for each year level. Hence, the same instructor or professor teaches the subject for both the experimental and control groups. Scores from 10 problem solving items in each subject were considered to describe the extent of transfer of learning to other domains.

4.0 Results and Discussions

The extent of transfer to other domains, namely Analytic Geometry, Solid Mensuration and General Chemistry was determined. This was based on 10 problem solving test results from these domains in a test administered to the two groups of respondents.

Table 1 shows the degree of agreement of the raters' ratings on the extent of transfer to the domains. As presented, the Pearson-r value for Analytic Geometry, Solid

Mensuration and General Chemistry from the control group are 0.912, 0.769 and 0.985, respectively. All of them indicate very high degrees of agreement between the two raters ($p < 0.01$) except Solid Mensuration wherein the group significantly differed only at $p < 0.05$. The Pearson- r coefficients of agreement of raters in

the three domains are 0.617, 0.894 and 0.969, respectively. These are significant at $p < 0.01$ except for the r in Analytic Geometry which is significant at only 0.05.

Comparison of transfer of problems solving skills to domains based on frequency per phase

Group	Other Domain	Comparison of Raters	Pearson's r Value	Interpretation
Control Group	Analytic Geometry	Rater 2 vs Rater 1	0.912**	Very High Agreement
	Solid Mensuration	Rater 1 vs Rater 2	0.769*	Very High Agreement
	General Chemistry	Rater 2 vs Rater 1	0.985**	Very High Agreement
Experimental Group	Analytic Geometry	Rater 1 vs Rater 2	0.617*	Very High Agreement
	Solid Mensuration	Rater 2 vs Rater 1	0.894**	Very High Agreement
	General Chemistry	Rater 1 vs Rater 2	0.969**	Very High Agreement

** - Correlation coefficient is significant ($p < .01$, 2-tailed)

* - Correlation coefficient is significant ($p < .05$, 2-tailed)

according to Polya's framework between the experimental and control groups is presented in Table 2. In Analytic Geometry, students in the control group were able to correctly do more problems in each of the four phases of Polya's framework than those of the experimental group. In phase 1, nine out ten problems were correctly done while the experimental group did only seven. Four more problems were correctly done up to

phase 2 by the students in the control group than those in the experimental group. Five problems were done until phase 3, and three until phase 4 in the control group, while only three and two were done in the experimental group, respectively. Generally, the extent of transfer of problem solving skills to Analytic Geometry was higher in the control group than in the experimental group.

For the extent of transfer to Solid Mensuration, students in the control group were able to correctly do three out of the ten problems up to the fourth phase (“Looking Back”) of Polya’s framework. The number is higher than that in the experimental group who were able to do only two problems up to this phase. Results indicated that more students from the control group successfully did the complete problem solving task than from the experimental group. Moreover, there were four problems done by the students in the control group compared to three in the experimental group done up to the third phase (“Carrying Out the Plan”); six in the second phase (“Devising the Plan”) for the control group and only three for the experimental group. Meanwhile, for Phase 1 (“Understanding the Problem”), students in both groups did eight out of the 10 problems. Generally, the extent of transfer of problem solving skills to Solid Mensuration is better in the control group than in the experimental group.

The extent of transfer of problem solving skills to General Chemistry appeared better in the experimental group than in the control group. Six problems were correctly done up to the fourth phase by the students in the

experimental group compared to only two in the control group. In phase 3, there were six problems correctly done in the experimental group while the control did only three. For phase 2, seven were done in the experimental group while only four were made by those in the control group. Lastly, in phase 1, eight problems were done in the experimental group and only six in the control group.

As frequently quoted by Prime Minister Margaret Thatcher “Don’t bring me problems, bring me solutions” as cited by Beagrie (2013). This suggests that the greater challenge on the part of the teacher is how to develop in a student the capability of bringing solution to every problem that they will encounter. In this study, students’ ability to provide solutions to problems in General Chemistry was found to be better facilitated by AI. Demonstrating problem solving acumen is considered an important indicator of learning outcomes.

Table 2. Extent of transfer of problem solving skills to other domains (based on Polya's Framework).

Other Domains	Control Group					Experimental Group				
	Phase					Phase				
	0	1	2	3	4	0	1	2	3	4
Analytic Geometry	1	9	8	5	3	3	7	4	3	2
Solid Mensuration	2	8	6	4	3	2	8	3	3	2
General Chemistry	4	6	4	3	2	2	8	7	6	6
Average	2	8	6	4	3	2	8	5	4	3

Companies are looking into this competency as important basis for hiring.

Results on the test for significance of comparisons on the extent of transfer of problem solving skills to other domains between the control and the experimental groups are presented in Table 3. There is no significant difference in the extent of transfer of problem solving skills to Analytic Geometry based on the Kolmogorov-Smirnov Two Sample Test (z -value=1.091; p -value=0.185). This means that although the extent of transfer of problem solving skills to Analytic Geometry is higher in the control group than in the experimental group; the difference is not significant. Further, Table 3 reveals a significant difference in the extent of transfer of problem solving skills in Solid Mensuration (z -value=1.134, p -value=0.033<0.05). This implies that the students in the

control group (μ =22) had better problem solving skills (p <.05) in this domain compared to those of the experimental group (mean score = 16).

The same table further discloses that there is significant difference (p -value = 0.000<0.01) in the extent of transfer of problem solving skills to General Chemistry. The experimental group has a higher mean score (μ =27) than the control group (μ =15). Result indicated that the students taught using the situated - cognition teaching model could significantly have better transfer problem solving skills in General Chemistry better than those taught using the conventional teaching model.

Table 3. Comparison of extent of transfer of problem solving skills to other domains between groups.

Other Domain	Mean Score		Statistical Tool Used	z-value	p-value
	Control	Expt'l			
Analytic Geometry	25	17	Kolmogorov-Smirnov Two Sample Test	1.091 ^{ns}	0.185
Solid Mensuration	22	16		1.134*	0.033
General Chemistry	15	27		2.073**	0.000

* - Result is significant ($p < .05$, 2-tailed)** - Result is significant ($p < .01$, 2-tailed)

ns - Result is not significant

As noticed, only one out of the three domains considered in this study showed the favorable effect of AI in terms of transfer of problem solving skills. This result somehow supports the findings published in the Journal of Technology Education (2012) wherein only a small percentage of the students were able to connect mathematics and science concepts (16% and 17% respectively) above the 50th percentile learned in the Project Lead the Way (PLTW) curriculum. In addition, according to Pintrich, *et al.* (2012), transfer of learning requires the use of prior knowledge to have exposure in solving novel problems as frequently as they could. In this case, facilitating instruction is very crucial since this is where the students are crafted to utilize previous learnings in order to attain beyond superficial competencies.

It is worthwhile to note that the K-12 programs specifically on Science, Technology, Engineering and Mathematics (STEM) strand, requires from the students strong foundations in preparation for engineering courses in college. In this case, teaching, reinforcing and transferring of what they learned from other subjects can be very challenging to Engineering and Technology Educators (ETE). But it should be noted that ETE does not only consider mere learning of concepts but more importantly developing students' competency in engineering design (Crismond, 2011, 2006).

On the Differential Effects of English Proficiency on Transfer of Learning

Since the content of this study dealt with mathematical problems, English proficiency was considered

to be related to academic performance (Maleki, 2007). In this study, differential effects of the teaching models among the five

in the mathematical problem solving given as posttest. The results are consonant with what the Michigan State Board of

Table 4. Posttest mean scores in mathematical problem solving test by English proficiency level.

English Proficiency Level	Control Group		Experimental Group	
	<i>N</i>	<i>Mean</i>	<i>N</i>	<i>Mean</i>
Pre-functional	0	0	0	0
Beginning	8	14.25	4	12.63
Intermediate	6	10.50	6	22.00
Advanced	14	12.73	11	26.29
Proficient	2	27.00	5	34.00
Overall Mean		15.31		22.52

English proficiency levels in both the control and experimental groups were investigated for significant differences.

Table 3 presents the posttest mean scores in mathematical problem solving by

English proficiency level. As shown, there were no subjects whose English proficiency level is pre-functional. This is because engineering students in the university are required to have an English proficiency of at least 75 percent. Table 4 shows that students in the experimental group posted a higher mean score than the control group. Students under the situated-cognition teaching model with these English proficiency levels performed better

Education (2004) mentioned as part of its English Language Proficiency Standards, that skills in English are essential for students to function proficiently in social situations as well as learn challenging academic contents throughout the curriculum. Problem solving in mathematics is a challenging subject which requires skills.

However, students with English proficiency level categorized as “beginning” showed an opposite direction of mean scores. At this level, subjects in the control group performed better than those in the experimental group. This indicates that the conventional model of teaching mathematical problem

solving works better for students with a lower level of English proficiency.

To determine if there is a differential effect on the mathematical problem solving skills of the students exposed or not exposed to AI, analysis of covariance was employed after checking homogeneity of error variances (Levene's test result

mathematical problem solving skills of the students.

The Duncan Multiple Range Test (DMRT) showed that the lower three levels were homogeneous and no significant differences on the problem solving skills exist in these levels. The difference was observed on the proficient level which has the

Table 5. Results on test of between subject effect using post-test scores.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
PROFICIENCY	1179.057	3	393.019	4.497	0.007
TEACHING MODEL* PROFICIENCY	452.053	3	150.684	1.724	0.175
Error	4195.164	48	87.399		
Total	27260.000	56			
Corrected Total	7044.000	55			

pvalue=0.265). As revealed in Table 5, English proficiency has a significant effect on the mathematical problem solving skills of the students (f value = 4.497, $p < .01$). This means that better English proficiency should be required of the students who take up engineering courses to be taught using AI. This result underscores the data in Table 5 wherein students in the experimental group with higher English proficiency level had better mean scores than those in the control group. This leads to the rejection of the null hypothesis that

English proficiency has no differential effect on the

highest skills learned ($p < 0.05$). Table 5 also shows that there is no interaction effect between the teaching model used and the English proficiency of the students (fvalue=1.724, $p = 0.175$).

The mean scores of the students in the problem solving tests in other domains by English proficiency level are presented in Table 6 which shows the extent of transfer of problem solving skills of the students to these domains. As observed, the students of different English proficiency levels in both the control and experimental groups had shown varied extents of transfer of problem solving skills to

Analytic Geometry, Solid Mensuration and General Chemistry. In Analytic Geometry, higher intermediate level of English proficiency worked best in Solid Mensuration, although the mean

Table 6. Extent of transfer of problem solving skills to other domains by English proficiency level.

Level	Analytic Geometry		Solid Mensuration		General Chemistry	
	Control	Expt'l	Control	Expt'l	Control	Expt'l
Pre-functional	0.00	0.00	0.00	0.00	0.00	0.00
Beginning	16.00	15.00	15.00	11.50	13.00	25.29
Intermediate	29.00	16.00	27.00	16.00	13.00	26.83
Advanced	25.50	17.00	20.50	15.88	9.38	27.17
Proficient	29.33	16.50	25.67	23.00	29.75	34.00
Over-all Mean	25.00	16.54	21.88	16.31	14.81	27.11

extent of transfer of problem solving skills was observed among students who are “proficient” and “advanced”. This is true for the control group and experimental groups, respectively, in terms of level of English proficiency. The least transfer occurred in those at the lowest or “beginning” level.

In Solid Mensuration, the extent of transfer of problem solving skills in the control group is highest for students whose English proficiency level is “intermediate” ($\mu=27.00$), followed by those in the “proficient” level ($\mu=25.67$), followed by those in the “advanced” ($\mu=20.50$), and lastly those at the “beginning” ($\mu=15.00$). These indicate that students with

score is quite far from the perfect score which was 100.

In the experimental group, students with “proficient” level of English proficiency performed best ($\mu=23.00$), followed by those in the “intermediate” level ($\mu=16.00$), then the “advanced” ($\mu=15.88$), and lastly by those in the “beginning” level ($\mu=11.50$). The results imply that for the students taught in the situated - cognition teaching model, those with high English proficiency had the highest extent of transfer of problem solving skills to Solid Mensuration.

Table 6 shows that in General Chemistry, students in the control group who are at the “proficient” level of English proficiency displayed the best extent of transfer of problem solving skills

($\mu=29.75$). Those who were at the “intermediate” and “beginning” levels followed both with mean score of 13.00. However, those who were in the “advanced” showed the least transfer of skills ($\mu=9.38$). Furthermore, in the experimental group, students who were in the “proficient” level displayed the best extent of transfer of problem solving skills to General Chemistry ($\mu=34.00$). Those in the “advanced” level got the next highest mean score ($\mu=27.17$), followed by those at the “intermediate” level ($\mu=26.83$), and finally, those in the “beginning” level ($\mu=25.29$).

Generally, students at the “proficient” level of English proficiency showed the best transfer skills to General Chemistry. These results imply that extent of transfer of problem solving skills to General Chemistry is better for those whose level of English proficiency is “proficient”. Results were better in the experimental group ($\mu=27.11$) than in the control group.

The between-subject effects of the extent of transfer of problem solving skills are presented in Table 7. Levene’s test for equality of error variances for the extent of transfer to the three other domains showed homogeneity of variances between groups. The p-values were 0.199, 0.499 and 0.229 for Analytic

Geometry, Solid Mensuration and General Chemistry, respectively.

Table 7 also reveals that English proficiency does not significantly affect the extent of transfer of problem solving skills to Analytic Geometry ($p=0.680$). This indicates that although there were differences in the extent of transfer of problem solving skills in this domain across the different levels of English proficiency, these are not significantly different from chance differences. Significant effects were found in Solid Mensuration and General Chemistry, both at the 5 percent level of significance ($p=0.021$ and 0.030 , respectively).

Generally, students with

Table 7. Results on test of between subject effects using extent of transfer of problem solving skills to other domains.

Other Domain	p-value of Levene's Test*	Source of Variation	F-value	p-value	DMRT Homo Subsets
Analytic Geometry	0.199	English Proficiency	0.514	0.680	
		Teaching Model* English Proficiency	0.327	0.806	
Solid Mensuration	0.499	English Proficiency	4.602	0.021*	®B ^a A ^{ab} I ^{bc} P ^c
		Teaching Model* English Proficiency	0.422	0.740	
General Chemistry	0.229	English Proficiency	3.306	0.030*	®I ^a A ^a B ^a P ^b
		Teaching Model* English Proficiency	0.829	0.486	

* Homogeneity test

®B – Beginning, I- Intermediate, A-Advanced, P-Proficient

“proficient” level of English had the best extent of transfer of skills to both Solid Mensuration and General Chemistry based on homogeneous subsets of the DMRT. Specifically, students who are at the “beginning” and “advanced”; an “advanced” and “intermediate” levels, were homogeneous in Solid Mensuration. Furthermore, the three levels namely “beginning”, “intermediate” and “advanced” were homogeneous in General Chemistry.

In terms of interaction effects, the teaching model and the level of English proficiency showed no significant effects in the three other domains (p-values are 0.806,

0.740 and 0.486 for Analytic Geometry, Solid Mensuration and General Chemistry, respectively. As mentioned by Mosqueda (2010), being a native English speaker does not guarantee that a student could become a good problem solver. It strikes out the other mediating factors at the institutional-level and individual-level characteristics. However, Mosqueda (2010) emphasized that those who are good in English may not be restricted to take rigorous courses like engineering, and other mathematics inclined subjects.

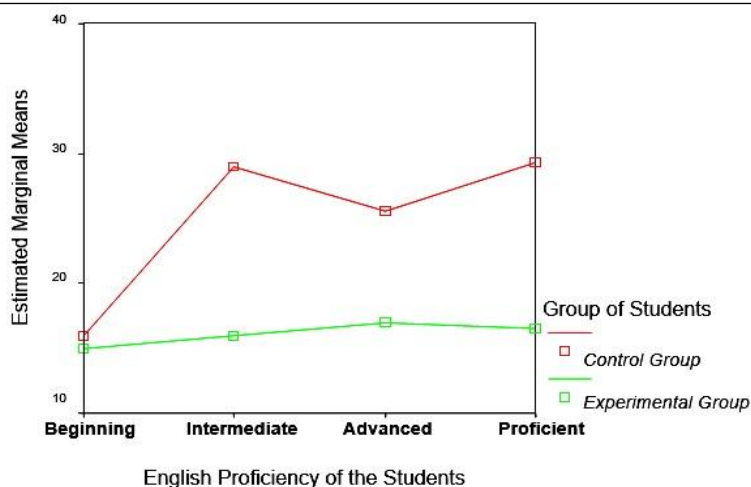


Figure 1. Estimated marginal means of extent of transfer of problem solving skills to Analytic Geometry.

The estimated marginal means on the extent of transfer to other domains were also considered. As shown in Figure 1, the marginal means across the different levels of English proficiency fluctuated in the control group while increasing results were observed in the experimental group. It appeared that the higher the level of English

proficiency of the students taught using the AI, the higher the extent of transfer of problem solving skills to Analytic Geometry. However, the English proficiency did not moderate the extent of transfer to Analytic Geometry as found in Table 7. Results imply that the extent of transfer of problem solving skills in this subject was higher than those

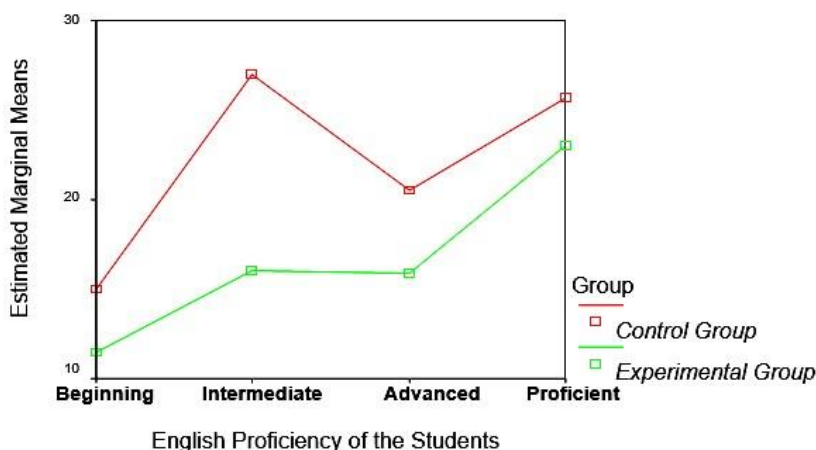


Figure 2. Estimated marginal means of extent of transfer of problem solving skills of the students in Solid Mensuration.

who were not exposed to AI than those who were.

were fluctuating in the control group but increasing in the experimental group. As observed, the students with “advanced” level of English proficiency had lower estimated marginal mean scores compared to those with “intermediate” level of proficiency.

In the experimental group, result generally showed that as the level of English proficiency increased, the

The behavior of the estimated marginal mean scores of the students in Solid Mensuration, was similar to that of Analytic Geometry (Figure 2). The means of problem solving skills to Solid Mensuration.

The estimated marginal mean scores for the extent of transfer of problem skills to General Chemistry are shown in Figure 3. As shown, students at any level of English proficiency in the experimental group had higher marginal mean scores than those in the control group.

Results of this study showed

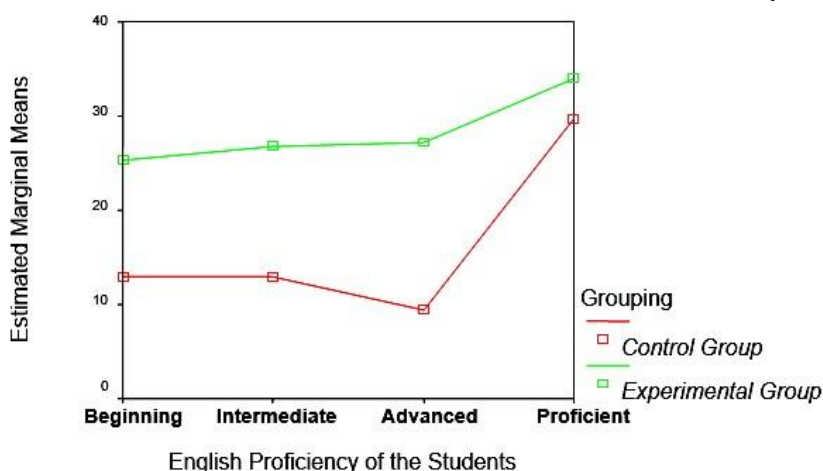


Figure 3. Estimated marginal means of extent of transfer of problem solving skills of the students in General Chemistry.

estimated marginal mean score also increased. The engineering students who have higher English proficiency level, also had high extent of transfer

an understanding of the extent of transfer that students exposed to AI tend to have transfer of problem solving skills predictable from their

level of English proficiency. In this case, the Southern Leyte State University may devise strategies that would provide intervention that strengthens English proficiency among engineering students so that their extent of transfer of problem solving skills will increase.

5.0 Conclusions

From the aforementioned findings, it can be concluded that the anchored instruction can help improve the mathematical problem solving skills of the students. However, this method is effective in transferring these problem solving skills only to selected domain like General Chemistry, while the conventional model have better transfer in Solid Mensuration. It is therefore possible to enhance transfer of problem solving skills using AI to selected domains. In addition, English proficiency significantly moderates extent of transfer of problem solving skills only to General Chemistry and Solid Mensuration. Therefore, English proficiency is deemed a necessary factor in enhancing the extent of transfer of problem solving skills to selected domains.

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