

## Critical Reflection in Teaching and Learning Mathematics towards Perspective Transformation: Practices in Public and Private Schools

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**Abstract:** The study investigated the practices in critical reflection being employed in teaching and learning mathematics in public and private schools for students to achieve perspective transformation in psychological, convictional and behavioral dimensions. There were 1,969 senior high school and college student-respondents selected at random from 33 schools. Process reflection was most commonly practiced in both public and private schools. Convictional dimension of perspective transformation was most frequently achieved. There was no significant difference in practices of process reflection between senior high school and college students. However, there was significant difference in perspective transformation in behavioral dimension achieved by students from public and private schools. Also, there were significant differences in psychological, convictional and behavioral dimensions of perspective transformation achieved by senior high school and college students. There was high and significant relationship between critical reflection practices and perspective transformation of students. The researcher concluded that there were teaching strategies like discovery learning that facilitated critical reflection, and that there were learning activities like technology-based problem solving that altered students' perspective of mathematics as an abstract field. The researcher further concluded that consistent use of appropriate teaching and learning activities could bring about perspective transformation in students with success.

**Keywords:** Critical reflection, Perspective transformation, Process reflection, Convictional dimension, Teaching and learning mathematics

### Introduction

During the school year 2011-2012, the Philippines implemented the Kindergarten Education Act that made kindergarten mandatory for all school children before their entry to elementary. In the following school year, 2012-2013, Grade 7 in the K (Kinder) to 12 Basic Education Curriculum of the Philippines was implemented. Pupils admitted in Grade 7 during the said school year were the first to experience senior high school when it was implemented for the first time in the history of Philippine Education.

Thus, in the school year 2016-2017, Grade 11 was implemented in public and private schools across the Philippines. By the end of the school year 2017-2018, the Philippines produced the first batch of senior high school graduates under the K to 12 Basic Education Curriculum that is very promising in many aspects.

The Department of Education of the Philippines claims that the K to 12 Basic Education Curriculum is value-driven, competency-based, decongested, seamless, responsive, relevant, flexible, contextualized, and Information and Communications Technology-based, among many other features. In particular, pedagogical approaches that teachers employ in the implementation of the said curriculum are constructivist, inquiry-based, collaborative, integrative, and *reflective* (Ocampo, 2014).

### Transformative Learning Theory of Mezirow

The researcher thought that the implementation of K to 12 Basic Education Curriculum of the Philippines offers great opportunities for mathematics teachers to transform the perspective of Filipino students towards

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mathematics as an abstract field of study. From the researcher's own personal experience as mathematics teacher, majority of Filipino students have fear of mathematics and they find it most difficult to overcome what is popularly known as math anxiety. Hence, the researcher was motivated to undertake a study on how the implementation of K to 12 Basic Education Curriculum has helped change the perspective of Filipino students towards mathematics through *critical reflection*.

According to the theory of transformative learning of Jack Mezirow (2000), learners have to be engaged in learning activities that would encourage them to go through critical reflection. It is critical reflection that can bring about perspective transformation among learners, and it is through learning that perspective transformation can be achieved. Hence, it is in the teaching and learning process that teachers can take the significant role of facilitating perspective transformation through the practices they employ in their classes.

Furthermore, perspective transformation can occur in three dimensions, namely, psychological, convictional and behavioral dimensions. Learners who achieve perspective transformation in psychological dimension demonstrate changes in self-awareness and self-understanding; those learners who achieve perspective transformation in convictional dimension demonstrate changes in beliefs; and learners show evidences of changes in habits and actions when they achieve perspective transformation in behavioral dimension.

In the case of teaching and learning mathematics, there are three ways by which learners can interpret their experiences through reflection with facilitation provided by teacher. These are through content reflection, process reflection and premise reflection. In content reflection, learners should be made to be aware and to understand what they are doing that lead ultimately to their outcome. In process reflection, learners should reflect on strategies they employ that worked and that did not work. Premise reflection involves questioning the activity itself or the problem itself, where learners should be able to tell why the activity or solving the problem is relevant for them.

#### *Statement of the Problem*

Primarily, the study was conducted to probe into the practices in teaching and learning mathematics that employ critical reflection in terms of content reflection, process reflection and premise reflection. By identifying the practices of teachers in teaching mathematics, the study sought to find out how perspective transformation of students was facilitated in learning mathematics in terms of psychological, convictional and behavioral dimensions.

Since student-respondents came from senior high school and tertiary levels in public and private schools, the researcher determined whether there were significant differences in the experiences of student-respondents in terms of perspective transformation achieved in three dimensions, as well as in terms of three types of reflection that facilitate perspective transformation.

Finally, the researcher wished to establish whether there was significant relationship between practices in critical reflection and perspective transformation achieved by student as facilitated by teachers in teaching and learning mathematics.

## **Method**

The researcher employed the descriptive research design that permitted construction and validation of researcher-made questionnaire. The questionnaire was a Likert-scale questionnaire that consisted of six categories of indicators, and each category had five indicators. For meeting the purpose of the study, student-respondents were senior high school and college students. So as not to discriminate among senior high school and college students, actual respondents were selected randomly. Data gathered by survey method were analyzed statistically using Statistical Package for Social Sciences (SPSS).

## **Respondents of the Study**

The study was conducted during the second quarter of the school year 2017-2018 when Grade 12 of the K to 12 Basic Education Curriculum of the Philippines was first implemented. There were a total of 1,969 student-

respondents who participated in the study, of which 613 students were from public schools and 1,356 students were from private schools. Moreover, student-respondents came from 33 schools, mostly from the South of Metro Manila, of which 1,232 were senior high school students and 737 were college students.

The sample of college student-respondents were among the last batch of students who entered college without completion of senior high school. On the other hand, the sample of senior high school student-respondents were among the first batch of students who would enter college with diploma in senior high school.

### *Statistical Treatment of Data*

To summarize the ratings of respondents, mean was computed for each indicator and was interpreted accordingly. Using 5% level of significance, independent t-test was utilized to determine if there were significant differences in experiences in content, process and premise reflection between students in public schools and students in private schools. The same parametric test was used to determine if there were significant differences in experiences in content, process and premise reflection between senior high school students and college students.

To determine whether there were significant differences in perspective transformation achieved in terms of psychological, convictional and behavioral dimensions between students from public schools and students from private schools, as well as between senior high school students and college students, independent t-test was also used at 5% level of significance.

The relationship between practices in critical reflection being employed in teaching and learning mathematics and the perspective transformation achieved by student-respondents was obtained by Pearson r Product-Moment Correlation Coefficient. The test for significance of computed Pearson r was carried out using 5% level of significance.

## **Results and Discussion**

In terms of content reflection, use of discovery learning and customized classroom activities with mean rates of 3.79 and 3.77, respectively, are “Often” practiced in public and private schools. Student-respondents said that discovery learning makes them aware of their confusion with mathematical rules; while customized classrooms activities are appreciated by students because they address their individual weaknesses in mathematics.

Common practices for process reflection in public and private schools include allowing students to listen to how others solve problems and allowing students explain their work, with mean rates of 3.81 and 3.78, respectively, which meant that these practices were “Often” employed by teachers. According to student-respondents, listening to other students helped them see the differences in approaches in problem solving; while explaining their work helped them see what they are doing right and what they are doing wrong.

In terms of premise reflection, teachers “Often” practiced students’ assessment of mathematical rules in problem solving and students’ evaluation of a mathematical activity’s significance in real life with mean rates of 3.80 and 3.73, respectively. By assessing the importance of mathematical rules, student-respondents said that it helped them arrive at correct solution; while evaluating the significance in real life what students do in mathematics class help them appreciate mathematics better.

To facilitate perspective transformation in psychological dimension, common practices in public and private schools included the use of team work and active participation of students in group or in class with mean rates of 3.81 and 3.79, respectively, which meant that these practices were “Often” employed in teaching and learning mathematics. In team work, students were assigned task, role and responsibility according to their ability. It was in this way that student-respondents became aware of what they were capable of doing that improved their expectation for success and, consequently, their self-confidence. Through actively participating in class, student-respondents said that this practice made them to think aloud and to be aware of how they think.

For perspective transformation in convictional dimension, provision of proper guidance by either the teacher or responsible peer and use of collaborative learning with mean rates of 3.88 and 3.81, respectively, were “Often” practiced in teaching and learning mathematics in public and private schools. Result implied that teachers could

be influential and could have great impact in changing the beliefs of students who only need to be guided properly. Student-respondents confirmed this with their highest appreciation for proper guidance provided to them by their teachers. The impact of collaborative learning could not be underestimated for it could inspire students to think differently when they learn with their peers.

Utilization of technology-supported mathematics exercises and provision of mathematics activities that challenge students to be creative and innovative with mean rates of 3.82 and 3.80, respectively, were “Often” practiced in public and private schools to facilitate perspective transformation of students in behavioral dimension. Learners nowadays are into computer games, gadgets and internet. Teachers’ use of technology was very much appreciated by student-respondents. It helped them develop habits in using technology to better understand and learn mathematics. Student-respondents love to be creative and innovative, and they appreciated activities in mathematics that helped them better express themselves and their thoughts through creativity and innovativeness, that also helped in formation of good habits.

In general, with the highest mean rate of 3.76 process reflection was most commonly practiced in both public and private schools. Among the three dimensions of perspective transformation, student-respondents most frequently achieved perspective transformation in convictional dimension with the highest mean rate of 3.81. More generally, critical reflection, with overall mean rate of 3.74, was “Often” practiced in teaching and learning mathematics in public and private schools. Perspective of student-respondents towards learning mathematics was “Often” transformed, with overall mean rate of 3.78, through practices in critical reflection.

### **Differences in Practices in Critical Reflection**

Table 1 below summarized the comparisons of practices in critical reflection between public schools and private schools. Specifically, Table 1 showed the results of independent t-tests at 5% level of significance for the said comparisons.

Table 1. Differences in Practices in Critical Reflection between Public and Private Schools

Reflection	School	N	Mean	SD	t-value	p-value	Decision on H <sub>0</sub>	Conclusion
Content	Public	613	3.74	0.73	-0.38	0.70	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.75	0.68				
Process	Public	613	3.72	0.68	-1.63	0.10	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.78	0.69				
Premise	Public	613	3.67	0.71	-2.34	0.02	Reject H <sub>0</sub>	Significant
	Private	1356	3.75	0.70				
Critical	Public	613	3.71	0.60	-1.71	0.09	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.76	0.59				

The results confirmed that process reflection was commonly practiced in both public and private schools. It was shown in Table 1 above that there was no significant difference in practices in process reflection being employed in teaching and learning mathematics in public schools and private schools. Additionally, there was no significant difference in content reflection being practiced in public and private schools. However, results showed that public schools and private schools differ significantly in their practices of critical reflection in terms of premise reflection. Generally, public and private schools showed no significant difference in practices in critical reflection.

Table 2 below summarized the comparisons of practices in critical reflection being employed for senior high school students and college students. In particular, the Table 2 showed the results of independent t-tests at 5% level of significance.

Table 2. Differences in Practices in Critical Reflection between Senior High School and College Students

Reflection	Students	N	Mean	SD	t-value	p-value	Decision on H <sub>0</sub>	Conclusion
Content	Senior	1232	3.82	0.70	5.98	0.00	Reject H <sub>0</sub>	Significant
	College	737	3.63	0.67				
Process	Senior	1232	3.76	0.69	0.24	0.81	Accept H <sub>0</sub>	Not Significant
	College	737	3.76	0.67				
Premise	Senior	1232	3.76	0.73	2.70	0.01	Reject H <sub>0</sub>	Significant
	College	737	3.67	0.66				
Critical	Senior	1232	3.78	0.61	3.51	0.00	Reject H <sub>0</sub>	Significant
	College	737	3.68	0.55				

There was significant difference between the experiences of content reflection and premise reflection of senior high school and college students. But there was no significant difference in the experiences of process reflection of senior high school and college students. In general, the senior high school students and college students differed significantly in their experiences with practices in critical reflection being employed by their teachers in teaching and learning mathematics. The senior high school students having the higher mean rate of 3.78 than the mean rate of 3.68 for college students. This implied that implementation of Philippine K to 12 Basic Education Curriculum works better for perspective transformation of senior high school students.

Table 3 below summarized the comparisons of perspective transformation achieved in psychological, convictional and behavioral dimensions between student-respondents in public schools and student-respondents in private schools. Specifically, Table 3 showed the results of independent t-tests at 5% level of significance.

Table 3. Differences in Perspective Transformation Achieved between Students in Public and Private Schools

Transformation	School	N	Mean	SD	t-value	p-value	Decision on H <sub>0</sub>	Conclusion
Psychological	Public	613	3.75	0.69	-0.75	0.45	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.78	0.69				
Convictional	Public	613	3.77	0.67	-1.92	0.06	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.83	0.68				
Behavioral	Public	613	3.72	0.91	-2.00	0.045	Reject H <sub>0</sub>	Significant
	Private	1356	3.80	0.70				
Perspective	Public	613	3.75	0.63	-1.81	0.07	Accept H <sub>0</sub>	Not Significant
	Private	1356	3.80	0.61				

In terms of behavioral dimension, students from public schools and students from private schools differed significantly in perspective transformation achieved, with students from public schools having obtained a lower mean rate of 3.72 than the mean rate of 3.80 for students from private schools. This provided one of the confirmations in the difference in behavior of students from Philippine public and private schools in terms of their habits and actions. However, results showed that, in general, there was no significant difference in perspective transformation achieved by students from public and private schools. In particular, critical reflection could equally and effectively bring about changes in self-understanding and change in beliefs among students from both public and private schools.

Table 4 below summarized the comparisons of perspective transformation achieved in psychological, convictional and behavioral dimensions between senior high school students and college students. Particularly, Table 4 showed the results of independent t-tests at 5% level of significance.

Table 4. Differences in Perspective Transformation Achieved between Senior High School and College Students

Transformation	Students	N	Mean	SD	t-value	p-value	Decision on H <sub>0</sub>	Conclusion
Psychological	Senior	1232	3.79	0.71	2.18	0.03	Reject H <sub>0</sub>	Significant
	College	737	3.73	0.64				
Convictional	Senior	1232	3.84	0.69	2.13	0.03	Reject H <sub>0</sub>	Significant
	College	737	3.77	0.64				
Behavioral	Senior	1232	3.83	0.82	4.33	0.00	Reject H <sub>0</sub>	Significant
	College	737	3.68	0.67				
Perspective	Senior	1232	3.82	0.64	3.38	0.001	Reject H <sub>0</sub>	Significant
	College	737	3.72	0.57				

As it was shown in Table 4 above, results pointed out that there were significant differences in perspective transformation achieved by senior high school students and college students in terms of the psychological, convictional and behavioral dimensions. The senior high school students were observed to have higher mean rates in all three dimensions of perspective transformation than the mean rates of college students in the same dimensions.

Result implied and constituted one of the early proofs that the K to 12 Basic Education Curriculum may be working in helping students in transforming their perspective about teaching and learning, particularly in mathematics. It was because teachers in implementing the K to 12 Basic Education Curriculum employed pedagogical approaches that are reflective among others.

*Relationship between Practices in Critical Reflection and Perspective Transformation Achieved by Students*

Table 5 below summarized the computed Pearson r correlation coefficients between perspective transformation achieved in terms of psychological, convictional and behavioral dimensions and practices in critical reflection in terms of content, process and premise reflections.

Table 5. Relationship between Perspective Transformation and Practices in Critical Reflection

Transformation	Practices	Pearson r	Relationship	p-value	Decision on H <sub>0</sub>	Conclusion
Psychological	Content Reflection	0.56	Moderate	0.00	Reject H <sub>0</sub>	Significant
	Process Reflection	0.62	High	0.00	Reject H <sub>0</sub>	Significant
	Premise Reflection	0.65	High	0.00	Reject H <sub>0</sub>	Significant
	Critical Reflection	0.72	High	0.00	Reject H <sub>0</sub>	Significant
Convictional	Content Reflection	0.54	Moderate	0.00	Reject H <sub>0</sub>	Significant
	Process Reflection	0.63	High	0.00	Reject H <sub>0</sub>	Significant
	Premise Reflection	0.62	High	0.00	Reject H <sub>0</sub>	Significant
	Critical Reflection	0.70	High	0.00	Reject H <sub>0</sub>	Significant
Behavioral	Content Reflection	0.51	Moderate	0.00	Reject H <sub>0</sub>	Significant
	Process Reflection	0.52	Moderate	0.00	Reject H <sub>0</sub>	Significant
	Premise Reflection	0.60	High	0.00	Reject H <sub>0</sub>	Significant
	Critical Reflection	0.64	High	0.00	Reject H <sub>0</sub>	Significant
Perspective	Content Reflection	0.61	High	0.00	Reject H <sub>0</sub>	Significant
	Process Reflection	0.68	High	0.00	Reject H <sub>0</sub>	Significant
	Premise Reflection	0.72	High	0.00	Reject H <sub>0</sub>	Significant
	Critical Reflection	0.78	High	0.00	Reject H <sub>0</sub>	Significant

Results showed that there was positive and direct correlation between the practices in critical reflection being employed in teaching and learning mathematics and the perspective transformation achieved by students. In particular, the correlation coefficient of 0.78 meant that there was high and significant relationship between practices in critical reflection of teachers and perspective transformation achieved by students.

More specifically, practices in critical reflection had high and significant relationship with perspective transformation achieved by students in terms of psychological, convictional and behavioral dimensions, with Pearson r correlation coefficients of 0.72, 0.70 and 0.64, respectively. Practices in premise reflection had significant and the highest correlation coefficients of 0.65 and 0.60 with perspective transformation achieved by students in terms of psychological and behavioral dimensions. Practices in process reflection had significant and the highest correlation coefficient of 0.63 with convictional dimension of perspective transformation achieved by students.

**Conclusion**

The researcher concluded that there were teaching strategies such as discovery learning that facilitated critical reflection among students. It was further concluded that there were learning activities in mathematics such as technology-based problem solving that altered students’ perspective of mathematics as an abstract field.

The researcher also concluded that mathematics teachers from public and private schools employ practices in teaching and learning mathematics that engage students in different types of reflection which bring about, more or less, the same perspective transformation in students from both public and private schools. However, senior

high school students were better able to achieve perspective transformation in psychological, convictional and behavioral dimensions than college students, since senior high school students were taught using innovative pedagogical approaches including reflective teaching as it was specified in the Philippine K to 12 Basic Education Curriculum.

Since it was shown that there was high and significant relationship between critical reflection practices and perspective transformation achieved by students, the researcher concluded that consistent use of appropriate teaching and learning activities that engage students in critical reflection could actually create perspective transformation in students with success.

## **Recommendations**

It was recommended that mathematics teachers in public and private schools incorporate the utilization of technology in teaching and learning mathematics, though students from public schools have less access to technology than students from private schools. Hence, it was also recommended that mathematics teachers continue to be creative, innovative and flexible in the use of a variety pedagogical approaches in their instruction as well as in employing the use of practices to engage students in content, process and premise reflection, and help them attain improved perspective transformation in psychological, convictional and behavioral dimensions.

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