



A STUDY OF REFLECTIVE THINKING AS A CORRELATE OF ACADEMIC ACHIEVEMENT AMONG SECONDARY SCHOOL PHYSICS LEARNERS.

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Abstract

This study examines the relationship among Secondary school Physics Learners considering Gender and Educational Board types. The Academic Achievement test includes Physics test scores across grade six to nine from Secondary School learners of; Central Board of Secondary Education (CBSE), Council For The Indian School Certificate of Examinations (CISCE), The Maharashtra State Board of Secondary and Higher Secondary Education (MSBSHSE) and Cambridge Assessment for International Education (CAIE). The Study found Statistically Significant differences in the Reflective Thinking skills of male and female Physics learners. Male Physics learners showed higher scores as compared to female Physics learners in Reflective Thinking. There was also a significant difference observed in the Reflective Thinking Skills across the different boards under study. However, the Study found no significant Gender based difference in the Correlation between Reflective Thinking and Academic Achievement across the different Educational boards under study. The study emphasizes the importance of integrating Reflective Learning Strategies into teaching practices to improve Academic outcomes in Physics. The findings suggest that while Reflective Thinking development may vary across demographic and curricular contexts, its impact on Academic Achievement remains consistent.

Key words: Reflective Thinking and Academic Achievement

Introduction

Academic Achievement in an academic setting refers to the extent an individual has accomplished specific learning goals. Academic Achievement is often measured through grades, test scores, and performance in assignments, projects, and exams. However, academic Achievement is more than just numbers; it also involves critical thinking, creativity, communication skills, and the ability to apply knowledge in real-world settings. There are many aspects to Academic Achievement that involve the learner's ability to score in tests, projects assignments etc. It is also the level of skill acquisition, like problem-solving, analytical thinking, communication, and collaboration.

The ability to apply academic knowledge in practical scenarios, such as organizing events, mentoring younger students, or tackling social and environmental challenges, is also a hallmark of Academic Achievement.

The National Education Policy (NEP) 2020 in India offers a broader and more holistic definition of Academic Achievement. It aims to shift the focus from traditional rote learning to the holistic development of students by emphasizing critical thinking, creativity, communication, and problem-solving skills. In the light of this, it is important to understand that an individual's thinking will have a direct bearing on his Academic Achievement.

Y. Deringöl (2019) conducted a meta-analysis to examine the relationship between Academic Achievement and Reflective thinking and he concluded that there is a positive relationship between the two. Ghazanfar Ali and Riffat-un-Nisa Awan (2021) also confirms that critical thinking has a direct bearing on Academic Achievement. This gives the researcher a cause to think that Reflective Thinking can be a precursor to Academic Achievement.

HYPOTHESIS

1. There will be no significant difference in Reflective thinking of secondary school Physics learners on the basis of Gender.
2. There will be no significant difference in Reflective thinking of secondary school Physics learners on the basis of Types of Boards
3. There will be no significant difference in the Correlation between Reflective Thinking and Achievement among secondary school physics learners on the basis of Gender.
4. There will be no significant difference in the Correlation between Reflective Thinking and Academic Achievement among secondary school physics learners on the basis of Types of boards.

DATA ANALYSIS**HYPOTHESIS 1**

There is a significant difference in the Reflective Thinking of secondary school Physics learners based on Gender.

Table 1: Mean calculation of Reflective Thinking based on Gender

GENDER	N	Mean
Male Physics Learners	658	41.125
Female Physics Learners	552	34.5

The results of the independent t-test are as follows:

- t-statistic: 21.69
- p-value: < 0.001 (extremely small)

Finding:

Since the p-value is significantly less than 0.05, the null hypothesis is rejected.

Conclusion:

There is a statistically significant difference in the reflective thinking of secondary school Physics learners based on gender. male Physics learners (mean = 41.125) have higher reflective thinking scores compared to female Physics learners (mean = 34.5).

Discussion:

In the data collected from 297 middle school students who were in 6th, 7th and 8th grades in Zonguldak city center of Turkey (Akdemirelif, 2018) a similar study was carried out and one of its significant findings was that female students' reflective thinking skills are higher than male students' reflective thinking skills which is contrary to the result obtained in this study. It could be because the Reflective Thinking skill is analysed within a narrow spectrum of Physics as a subject.

Another contrary finding is a research article on the Relationship between Concept Mapping and Reflective Thinking (Pushpendra Yadav, 2020). Findings of this research paper highlighted that there is a minimal difference in the relationship between concept mapping and reflective thinking based on gender, and this difference indicates towards other factors. however, this study was with teachers as well as teacher educators so the minimal difference could be attributed to age maturity and practice of reflective thinking over a period of time.

In another study in Pakistan (Tabassum, F., Bibi, A., & Mazhar, U, 2024). on student teachers gender-based differences of opinions about reflective practice were discovered as the female teachers showed more concern towards reflective practice as compared to their male colleagues. However, when reflective thinking is measured in terms of Physics learners in particular, male learners show a better performance than female learners. Possibly because male learners are culturally encouraged for STEM-related fields while female learners are encouraged for humanities or social sciences.

HYPOTHESIS 2

There is a significant difference in the Reflective thinking of secondary school Physics learners based on the Types of Board.

Table 2: Mean calculation of Reflective Thinking based on Type of Educational Board

BOARDS	N	Mean
MSBSHSE	489	3.1725
CBSE	247	3.243
CISCE	290	3.125
CAIE	184	3.3875

The results of the one-way ANOVA are as follows:

- F-statistic: 293.31
- p-value: < 0.001 (extremely small)

Finding:

Since the p-value is significantly less than 0.05, null hypothesis is rejected.

Conclusion:

There is a statistically significant difference in reflective thinking among Secondary School Physics learners based on the type of board (MSBSHSE, CBSE, CISCE, CAIE).

Discussion:

Broadwise, there have been no detailed studies conducted in India that support or negate the relationship between Reflective Thinking and the different educational boards. However, the differences in Reflective Thinking across boards mentioned in the table 2 is probably due to differences in curriculum structure, assessment styles, teaching methods, and emphasis on modern teaching methods such as Blended learning, Problem-based learning, Inquiry-based learning and Experiential learning, with MSBHSE being the least and CAIE being the most. The mean values of CBSE and CISCE boards are in the middle of the table, with a stronger tilt in the Reflective Thinking mean value of the CBSE board learners.

HYPOTHESIS 3

There is no significant difference in the Correlation between Reflective Thinking and Academic Achievement among secondary school physics learners on the basis of Gender.

Fisher's r-to-z Test for Gender-Based Differences in Correlation

Fisher's r-to-z transformation was conducted to determine whether there is a significant difference in the correlation between Reflective Thinking (RT) and Academic Achievement (AA) among the Secondary School Physics learners based on gender.

Statistical Analysis

The correlation coefficients for males and females were as follows:

- **Male Physics learners:** $r=0.998$ $r = 0.998$ (average across levels)
- **Female Physics learners:** $r=0.999$ $r = 0.999$ (average across levels)

Using Fisher's r-to-z transformation, the difference between these correlations was tested. The results were:

- **Z-score:** -1.08
- **P-value:** 0.280

Discussion:

Since the p-value (0.280) is greater than 0.05, the difference in Correlation between Reflective Thinking and Academic Achievement based on gender is not statistically significant. This indicates that gender does not significantly influence the relationship between Reflective Thinking and Academic Achievement in this dataset.

Thus, the null hypothesis is accepted, confirming that the correlation between Reflective Thinking and Academic Achievement remains consistent across male and female Physics learners.

Conclusion:

Since there is no notable difference in the correlation patterns or significance between genders, the null hypothesis is accepted. This means that there is no significant difference in the relationship between Reflective Thinking and Academic Achievement among secondary school Physics learners based on gender.

Discussion:

Studies of different researchers have reported a relationship between Reflective Thinking skills and Academic Achievement, belief, and attitude (Baş and Kırılcım, 2013; Demirel et al., 2015; Köseoğlu et al., 2017; Kızılkaya and Aşkar, 2009). Collectively, these studies underscore the significant role of Reflective Thinking skills in students' academic performance, beliefs, and attitudes. Educators are encouraged to implement strategies that promote Reflective Thinking to support and improve student learning experiences and Academic Achievement.

A study titled "Gender Issues in Achievement and Retention among Secondary School Physics Students" found that physics students, regardless of gender, achieved higher mental thinking levels when taught using metacognitive scaffolding teaching strategies. This suggests that both male and female learners benefit equally from instructional methods that promote Reflective Thinking (Agu, P. A., & Iyamu, 2020).

Riegle-Crumb, C., & Moore, C. (2014), in their research considering the context of Local Communities, indicated that boys and girls exhibited similar achievements in Mathematics and Physics. This aligns with other studies showing no significant gender differences in Physics Achievement, suggesting that reflective thinking contributes equally to success among all students.

However, when focusing on Reflective Thinking and Academic Achievement, the study found no significant gender differences, indicating that both male and female students possess similar capabilities in Physics when provided with equitable learning environments (Cwik, S. 2022)

This clearly indicates that appropriate and adequate variations in teaching-learning experiences will help learners think better about the Physics problem at hand and can be guided toward the appropriate solution.

HYPOTHESIS 4

There is no significant difference in the Correlation between Reflective Thinking and Academic Achievement among secondary school physics learners on the basis of Types of boards.

Conclusion:

The data reveals a strong positive relationship between Reflective Thinking and Academic Achievement across all stages in the different Boards (MSBSHSE, CBSE, CISCE and CAIE). As students engage in reflective thinking, their Academic performance improves. The high correlation values and statistically significant p-values (≤ 0.002) confirm the consistency and reliability of these relationships, suggesting that Reflective Thinking is an important factor in improving academic outcomes across the different boards under the study. The null hypothesis is accepted.

Discussion:

The relationship between Reflective Thinking and Achievement remains strong and significant across all types of educational boards. Therefore, the types of board do not have a significant impact on the correlation between these two variables.

In other words, the better the individual's reflective thinking skills the better academic achievement (Ghanizadeh, 2017; Hsieh & Chen, 2012; Yang et al. 2016) irrespective of the learner's board.

Adebisi (2020) investigated the effects of Reflective Teaching strategies on Secondary School Physics learners' performance in Ekiti State, Nigeria, and found that such strategies positively influenced students' Academic Achievement. However, this study did not compare results across different educational boards

Pascual, E. A. (2023) explored how Reflective Teaching strategies can enhance students' engagement and understanding by immersing them in the learning process irrespective of the board of study.

Educational Implications based on Hypothesis

The educational implications of the hypotheses provide insights into how reflective thinking and academic achievement are influenced by gender and the type of educational board:

1. Reflective Thinking and Gender

- Since the hypothesis is rejected, it means there is a significant difference in reflective thinking between male and female Physics learners. Educators should recognize and address gender-based differences in Reflective Thinking. Teaching-Learning strategies in Physics should be modified to accommodate differences in thinking styles based on gender.
- Teaching strategies should be tailored to encourage reflective practices equally among all students, ensuring that both male and female Physics learners develop strong critical thinking skills.
- Further research can explore whether societal, cognitive, or instructional factors contribute to these differences.

2. Reflective Thinking and Types of Boards

- A significant difference exists in reflective thinking among students from different educational boards (e.g., MSBSHSE, CBSE, ICSE, CAIE). Different curricula, teaching methodologies, and Assessment patterns may impact how students develop reflective thinking.
- Standardized training for teachers across boards may be beneficial to promote reflective learning approaches.
- Schools should evaluate and adopt best practices from different boards to enhance students' Critical and Reflective Thinking skills.

3. Correlation between Reflective Thinking and Achievement (Gender wise)

- Since the hypothesis is accepted, it means there is no significant gender-based difference in the relationship between Reflective Thinking and Academic Achievement. Reflective thinking benefits both male and female learners equally in terms of Academic performance in Physics.
- Schools should focus on fostering Reflective Thinking strategies for all students, rather than designing gender-specific interventions.

4. Correlation between Reflective Thinking and Achievement (Types of Boards)

- The correlation between reflective thinking and academic achievement does not vary significantly across different boards.
- This suggests that regardless of curriculum differences, reflective thinking plays an equally important role in Academic success.
- Schools across different boards should emphasize metacognitive skills and self-reflection to enhance student learning outcomes.

Overall Educational Implications:

- Curriculum Design: Schools should integrate reflective learning techniques across different boards to develop higher-order thinking skills.
- Teacher Training: Educators should be trained to encourage reflective questioning, journaling, and self-assessment strategies in physics learning.
- Assessment Methods: Evaluations should not only test knowledge but also incorporate components that assess students' ability to reflect on concepts and problem-solving processes.
- Policy Making: Education boards may consider standardizing aspects of Reflective learning across curricula to ensure equal skill development opportunities.
- Further Research: More studies can explore the specific factors within gender and board types that influence reflective thinking patterns and how they can be optimized for better learning outcomes.

Conclusion

The study's findings highlight that reflective thinking among secondary school physics learners varies significantly based on gender and the type of educational board, indicating the need for tailored instructional strategies. However, the relationship between Reflective Thinking and Academic Achievement remains consistent across both gender and different boards, emphasizing its universal role in enhancing learning outcomes. These results suggest that while reflective thinking may develop differently across demographic and curricular contexts, its impact on academic success remains stable.

From an educational perspective, this underscores the importance of integrating reflective learning strategies into teaching practices across all educational boards. Schools should focus on fostering metacognitive skills through curriculum enhancements, teacher training, and student-centered assessments. By recognizing and addressing disparities in reflective thinking development, educators can create more inclusive and effective learning environments that empower all students to think critically and achieve academic excellence in Physics.

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