IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 16, Issue 4 Ser. 4 (July. – August. 2026) 32-39
www.iosrjournals.org

Effectiveness of a Program to Promote Reflective Thinking among Higher Secondary Students

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Abstract:
Reflective thinking is considered a crucial aspect for deep and effective learning as it promotes active engagement and personal responsibility towards the learning process. With this factor in mind, this research aimed to design an educational intervention that would promote reflective thinking skills among higher secondary students and examine its effectiveness. The research design used was experimental, for testing the effectiveness of the program. 176 higher secondary students participated in the study and completed a questionnaire developed by Kember et al. Subsequent analysis of the post-test data, with the help of an independent-samples t-test, revealed a substantial variation in levels of reflective thinking within both the control and experimental groups. Furthermore, a matched-samples t-test was conducted amongst the experimental group, which indicated a substantial drop in habitual action, coupled with an increase in understanding, critical reflection, and reflection. Based on the results derived through this study, conferences and in-service training courses might be held to familiarize teachers with ways for promoting reflective thinking in students.

Keywords*: Higher secondary learners, reflective thinking, reflection levels, critical reflection, habitual action, reflection.*

Date of Submission: 13-08-2026 Date of Acceptance: 27-08-2026

I. Introduction

Educators have largely agreed that thinking skills play a significant role across almost all disciplines and occupations and are continually needed to meet every academic objective (Iyer, 2019). Regardless of the importance of higher order thinking skills, specialized efforts to enhance them have been largely overlooked in the context of school education. It has been contended by Mutakinati et al. (2018) that most learners focus on acquiring better scores in tests that are founded on rote learning and ultimately exit the K - 12 school system lacking 'cognitive' skills necessary for achieving success in higher education or professional life. Now, more than ever, especially with the advent of artificial intelligence, it is of utmost importance that education focuses on promoting higher order thinking skills. One particularly important higher-order skill is reflective thinking. Student learning ultimately occurs when students tend to reflect on whatever takes place within their classroom. If teachers are indeed desirous that students go beyond depending on their memory, then it becomes imperative to teach students to emerge as reflective thinkers. This needs to be the norm in higher secondary schools. In view of these factors, this research aims to design an appropriate program that will promote reflective thinking skills among higher secondary students and examine its effectiveness.

II. Literature Review

Wang et al. (2018) state that reflective thinking is an integral factor of problem solving. Several studies link reflective thinking with post-practice analysis of experience (Huma, 2017; Satjatam et al., 2016). Hidayat et al. (2020) describe reflective thinking as a type of mental processing which is deployed to acquire an enhanced understanding of comparatively complex or unstructured ideas. Tisngati and Genarsih (2021) state that reflective thinking is an important element of self-regulatory learning. A study conducted by Chen et al. (2019) proposed a reflective thinking approach to promote engagement and active learning in a flipped classroom. The authors divided this approach into three stages: pre-reflection, guided reflection, and post-reflection. The purpose of this approach was to help students reflect on their learning experiences and to encourage them to apply analytical skills to their project work. Additionally, Yilmaz and Keser (2016) found

that e-learning using podcasts with reflective thinking activities improved students' academic success and motivation more than other learning methods.

Findings derived from literature related to reflective thinking tend to differ. For instance, Kaplan et al. (2017) employed a mixed-methods approach to investigate the efficacy of reflective thinking abilities in problem-solving among 31 gifted students. They found that gifted students possess a high level of reflective thinking abilities, which correlates positively with their performance in problem-solving. An investigation conducted by Eğmir and Ocak (2018) showed that the curriculum intended to enhance critical thinking skills resulted in greater reflective thinking levels among learners in the experimental group, compared to the control group. However, there was no statistically significant difference in gain scores based on gender. In contrast, a study by Deringol (2017) undertaken with the purpose of establishing a correlation between reflective thinking abilities and academic achievement in mathematics among primary school pupils in fourth grade revealed that female pupils outperformed their male counterparts in terms of reflective thinking proficiency.

Despite extensive literature on reflective thinking, tools for measuring reflective thinking are rare. Kember et al. (2000) provided a robust tool with good psychometric properties for evaluating reflective thinking levels. The tool comprised four key constructs, which included: habitual action (HA), understanding (U), reflection (R), and critical reflection (CR). HA in this case refers to the automatic performance of learners with scant conscious thoughts (Bermúdez & Felletti, 2021; Kember et al., 2008); U implies that learners could comprehend and get an understanding of a concept within academic learning but were unable to apply it in other domains. R indicates that learners tend to analyze learning and experience and eventually derive novel understanding and appreciation (Kember et al., 2008; Rodgers, 2002). Finally, critical reflection is a crucial aspect of advanced cognitive processing, as it involves a rigorous analytical approach that can result in perspective transformation (Kember et al., 2008; Lundgren & Poell, 2016).

Although there are several short studies on enhancing reflection levels, literature offers scant insight into robust programs designed to promote reflective thinking, particularly among higher secondary students. This study aimed to design a program to enhance the reflective thinking skills of higher secondary students and test its effectiveness. Based on the review of extant literature, the following hypotheses were developed:

H_{A1}: There is a significant difference in the mean for HA, U, R, and CR of the control and experimental groups in the Pretest.

H_{A2}: There is a significant difference in the mean for HA, U, R, and CR of the control and experimental groups in the Posttest.

H_{A3}: There is a significant difference in the mean gain scores for HA, U, R, and CR for the experimental group between the Pretest and Posttest.

H_{A4}: There is a significant difference in the mean for HA, U, R, and CR for the control group between the Pretest and Posttest.

III. Methodology

Participants

A total of 176 students, comprising both boys and girls, from two private higher secondary schools located in western India, participated in the study. All participants were enrolled in a grade 12 (ages 16-18 years) biology laboratory course. The experimental group consisted of 85 students, while the control group comprised 91 students. Before the commencement of the study, written consent was obtained from all participants and their parents, with anonymity assured.

Data Collection Tool

To facilitate quantitative data collection, the researcher utilized the 'Reflective Thinking Questionnaire', developed by Kember et al. (2000). This questionnaire, comprising 16 items, was specifically designed to be used within academic programs across disciplines to evaluate the extent to which the learners engage in reflection. Both the experimental and control groups completed the survey, with data being collected both prior to and following the program's implementation, in order to evaluate its effectiveness.

Data analysis

Data were analyzed using version 25 of the Statistical Package for Social Sciences (SPSS). Pretest and posttest data were analyzed using independent sample t-tests. A matched-samples t-test was conducted amongst the experimental group to analyze the changes in students' reflection levels after program implementation. A matched-samples t-test was also conducted for the control group. The level $P < 0.001$ was considered as the cutoff value or significance.

Program

The program was implemented during the biology laboratory course for Grade 12 students. Eight biology laboratory sessions were conducted using reflective strategies for the experimental group. Suitable reflective strategies were integrated at various stages of each laboratory session. The program incorporated individual, paired, and group reflection activities (see Figure 1). In contrast, conventional teaching methods of direct instruction and demonstration were used for the control group.

The program was documented in the form of teachers' handbook. It could serve as a resource material by teachers for enhancing the reflection levels of their students.

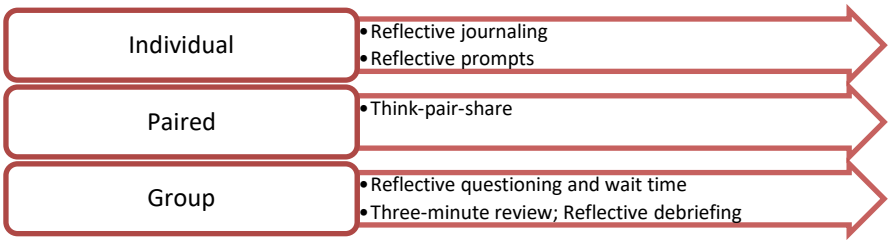

Figure 1. Strategies used in the Program

IV. Results

The reliability values for the control group ranged from 0.709 to 0.834. Reliability values had a greater significance than 0.70, indicating good reliability among variables. For the experimental group, the reliability values ranged from 0.618 to 0.865. This indicated acceptable reliability amongst variables.

The results of this study showed no significant variation in mean scores for HA, U, R and CR between the control and experimental groups in the pre-test. Therefore, Hypothesis A1, which stated that "there is a significant difference in mean for HA, U, R and CR of the control and experimental groups in the Pretest," could not be accepted. These results are presented in Table 1.

Table 1: Independent sample t-test results comparing pre-test scores between the experimental group and the control group for HA, U, R and CR.

Factors	Experimental (n=85)	Control (n=91)	t - value	p-value
	Mean			
Habitual action	4.22	4.29	-1.109	.269
Understanding	3.13	3.19	-.695	.488
Reflection	3.15	3.23	-.919	.359
Critical Reflection	2.84	2.89	-.680	.498

The findings further revealed a significant variation in HA, U, R and CR between the control and experimental groups in the post-test. Thus, Hypothesis A2, which proposed that "there is a significant difference in mean for HA, U, R and CR of control and experimental groups in the posttest," was accepted. These results are presented in Table 2.

Table 2: Independent sample t-test results comparing post-test scores between the experimental group and the control group for HA, U, R and CR.

Factors	Experimental (n=85)	Control (n=91)	t - value	p-value
	Mean			
Habitual action	3.21	4.26	-15.695	<0.001
Understanding	4.18	3.27	10.647	<0.001
Reflection	4.19	3.33	9.665	<0.001
Critical Reflection	3.92	2.98	10.577	<0.001

The results revealed a significant difference in mean scores for HA, U, R and CR between the pre-test and post-test for the experimental group. Therefore, Hypothesis A3, which proposed that "there is a significant difference in the scores for HA, U, R and CR for the experimental group between the pre and posttest," was accepted. These results are presented in Table 3.

Table 3: Matched sample t-test results comparing pre-test and post-test scores for HA, U, R and CR. (For the Experimental group, n=85)

Factors	Pretest	Post-test	t - value	p-value
	Mean			
Habitual action	4.22	3.21	13.611	<0.001
Understanding	3.13	4.18	-10.906	<0.001
Reflection	3.15	4.19	-10.696	<0.001
Critical Reflection	2.84	3.92	-10.747	<0.001

Further, the findings showed no significant variation in mean scores for HA, U, R and CR between the pre-test and post-test for the control group. Therefore, Hypothesis 05, which suggested that "there is a significant difference in mean scores for HA, U, R and CR for the control group between the pre and posttest," could not be accepted. These results are presented in Table 4.

Table 4: Matched sample t-test results comparing pre-test and post-test scores for HA, U, R and CR (For the Control group, N=91)

Factors	Pretest	Post-test	t - value	p-value
	Mean			
Habitual action	4.29	4.26	.595	.553
Understanding	3.19	3.27	-1.284	.203
Reflection	3.23	3.33	-1.276	.205
Critical Reflection	2.89	2.98	-1.348	.181

V. Discussion

Reflective thinking is an important high order cognitive skill.There have been multiple studies that have exemplified the significance of learners' ability to engage in reflective thinking during and after the learning process. Consequently, scholars have proposed that reflective thinking is an essential skill as it helps learners to derive learning from experiences (Korstange, 2016). Reflection enables incorporation of new learning into current skills and knowledge, while improving learning to an in-depth approach (Chang 2019) . Hence, this study aimed to design a program to enhance reflective thinking among higher secondary school students and study its effectiveness. The secondary education represents a crucial stage as it represents an important transition in students' preparation for higher education. The idea behind conducting this study during

laboratory sessions was to inculcate a scientific thought process amongst students. Being reflective thinkers within science laboratories would enable them to think like scientists and carry out experiments for determining whether a knowledge claim was true, instead of accepting it without any critical evaluation.

The findings of this study revealed that following the implementation of the program based on strategies for promoting reflective thinking, a major variation was noticed within post-test mean HA, U, R and CR between experimental and control groups. The experimental group showed a substantial drop in mean for HA and significant increase in mean for U, R and CR following the program implementation. Conversely, the control group, which was taught using the conventional instructional method, did not show any statistically significant change in reflection levels between the pre-test and post-test. These findings were similar to previous studies where use of reflective strategies showed increase in students reflective thinking skills at primary and secondary (Chen et al., 2019; Kaplan et al., 2017; Saraçoğlu & Kahyaoğlu, 2021). Moreover, Lodge et al. (2018) demonstrated that reflective learners tend to evaluate their actions, thereby becoming more self-aware of their learning and hence do not rely on rote learning. In a related study by Deringöl (2019) middle school students displayed higher reflective thinking skills when problem based learning was implemented. In contrast, Erdogan (2020) found that secondary school students exhibited lower levels of reflection in similar problem situations. These differences in reflective thinking skills may be attributable to differences in teaching methodologies, classroom environments, and the degree to which educators utilize techniques to promote reflective thinking. Hence, the expertise of teachers is an important factor in enhancing students reflective thinking skills. With this in view, the program successfully implemented during this study was documented in the form of a teachers' handbook which can be used by teachers who are interested in encouraging reflective learners.

VI. Conclusion

The present study aimed to design a program to enhance reflective thinking among higher secondary school students and study its effectiveness. The independent sample t-test conducted on the pretest data indicated no statistically significant difference in the reflection levels of the control group students and their experimental group, suggesting that the two groups were comparable at baseline. However, analysis of the posttest data after implementation of the program revealed a statistically significant difference in the reflection levels of the two groups. Additionally, the outcomes of the matched sample t-test conducted on the experimental group demonstrated a substantial drop in HA, and increase in U, R and CR. In contrast, the matched sample t-test conducted on the control group indicated no statistically significant difference in the reflection levels in the pretest and posttest. This indicates that the program was effective in enhancing the students' reflection levels.

The program was subsequently documented in the form of a comprehensive handbook for teachers. The handbook includes theoretical principles of reflective thinking, a detailed description of strategies for promoting reflective thinking, laboratory session plans based on use of reflective strategies, activity sheets, a reflection journal guide and assessment tools. It is recommended that professional development opportunities, such as conferences and in-service training courses, be provided for teachers to assist them in teaching students about enhancing their reflective thinking skills. The handbook could be used as a resource material for in-service training programs. Therefore, it is suggested that a course be introduced that offers students the habits of effective studying and learning.

References

[1]. Bermúdez, J.-P., & Felletti, F. (2021). Introduction: Habitual Action, Automaticity, and Control. In *Topoi* (Vol. 40, Number 3, pp. 587–595). Springer Science and Business Media B.V. https://doi.org/10.1007/s11245-021-09754-1

[2]. Chang, B. (2019). Reflection in learning. *Online Learning*, *23*(1), 95–110.

[3]. Chen, M., Hwang, G. J., & Chang, Y. Y. (2019). A Reflective Thinking-Promoting Approach to Enhancing Graduate Students' Flipped Learning Engagement, Participation Behaviors, Reflective Thinking and Project Learning Outcomes. *British Journal of Educational Technology*, *50*(5), 2288–2307. https://doi.org/10.1111/bjet.12823

[4]. Deringöl, Y. (2019). The relationship between reflective thinking skills and academic achievement in mathematics in fourth-grade primary school. *International Online Journal of Education and Teaching (IOJET)*, *2019*(3), 613–622. http://iojet.org/index.php/IOJET/article/view/532

[5]. Hidayat, N., Usodo, B., & Saputro, D. R. S. (2020). Reflective Thinking Ability of Junior High School Students of 2 Pleret Viewed from Self-Confidence. *International Journal of Multicultural and Multireligious Understanding*, *7*(8), 117. https://doi.org/10.18415/ijmmu.v7i8.1818

[6]. Huma, A. (2017). Improving Exercises of Reflective Thinking and Practice in Teacher Education at a State University in USA. *Pakistan Journal of Education*, *34*(1). https://doi.org/10.30971/pje.v34i1.194

[7]. Iyer, L. (2019). *Critical Thinking and it's Importance in Education*.

[8]. Kaplan, A., Doruk, M., & Öztürk, M. (2017). Examine of reflective thinking skill toward problem solving of talent students: A sample of Gümüşhane. *Bayburt Education Faculty Journal*, *12*(23), 415–435. https://dergipark.org.tr/en/download/article-file/326118

[9]. Kember, D., Leung, D. Y. P., Jones, A., Loke, A. Y., McKay, J., Sinclair, K., Tse, H., Webb, C., Yuet Wong, F. K., Wong, M., & Yeung, E. (2000). Development of a Questionnaire to Measure the Level of Reflective Thinking. *Assessment & Evaluation in Higher Education*, *25*(4), 381–395. https://doi.org/10.1080/713611442
[10]. Kember, D., Mckay, J., Sinclair, K., & Kam Yuet Wong, F. (2008). A four-category scheme for coding and assessing the level of reflection in written work. *Assessment and Evaluation in Higher Education*, *33*(4), 369–379. https://doi.org/10.1080/02602930701293355
[11]. Korstange, R. (2016). Developing growth mindset through reflective writing. *Journal of Student Success and Retention*, *3*(1).
[12]. Lodge, J. M., Kennedy, G., Lockyer, L., Arguel, A., & Pachman, M. (2018). Understanding Difficulties and Resulting Confusion in Learning: An Integrative Review. In *Frontiers in Education* (Vol. 3). Frontiers Media S.A. https://doi.org/10.3389/feduc.2018.00049
[13]. Lundgren, H., & Poell, R. F. (2016). On critical reflection: A review of Mezirow's theory and its operationalization. In *Human Resource Development Review* (Vol. 15, Number 1, pp. 3–28). SAGE Publications Ltd. https://doi.org/10.1177/1534484315622735
[14]. Mutakinati, L., Anwari, I., & Kumano, Y. (2018). Analysis of Students' Critical Thinking Skill of Middle School through STEM Education Project-Based Learning. *Jurnal Pendidikan IPA Indonesia*, *7*(1), 54–65. https://doi.org/10.15294/jpii.v7i1.10495
[15]. Rodgers, C. (2002). Defining Reflection: Another Look at John Dewey and Reflective Thinking. *Teachers College Record*, *104*(4), 842–866. https://doi.org/10.1111/1467-9620.00181
[16]. Saraçoğlu, M., & Kahyaoğlu, M. (2021). Learning and Studying Approaches as a Predictor of Reflective Thinking Skills towards Problem-solving of Secondary School Students. *International Journal of Education and Literacy Studies*, *9*(4), 132. https://doi.org/10.7575/aiac.ijels.v.9n.4p.132
[17]. Satjatam, P., Sarintip, R., & Teerachai, N. (2016). Developing reflective thinking instructional model for enhancing students' desirable learning outcomes. *Educational Research and Reviews*, *11*(6), 238–251.
[18]. Tisngati, U., & Genarsih, T. (2021). Reflective thinking process of students in completing mathematical problems based on mathematical reasoning ability. *Journal of Physics: Conference Series*, *1776*(1). https://doi.org/10.1088/1742-6596/1776/1/012035
[19]. Wang, M., Yuan, B., Kirschner, P. A., Kushniruk, A. W., & Peng, J. (2018). Reflective learning with complex problems in a visualization-based learning environment with expert support. *Computers in Human Behavior*, *87*, 406–415. https://doi.org/10.1016/j.chb.2018.01.025
[20]. Yilmaz, F. G. K., & Keser, H. (2016). The impact of reflective thinking activities in e-learning: A critical review of the empirical research. *Computers & Education*, *95*, 163–173. https://doi.org/10.1016/J.COMPEDU.2016.01.006

Appendix

Experiment 1: Dissection of a Flower

Aim of the experiment: To dissect the Hibiscus flower, display different whorls, and compare it with a typical flower.

Duration of session: 3 hours

Objectives:

1. To study the structure of different floral whorls – epicalyx, calyx, corolla, androecium, and gynaecium of the given flowers
2. To compare the floral parts of the Hibiscus flower with those of a typical flower

Learning outcomes:

- Student dissects a Hibiscus flower and displays different floral parts.
- Student compares the different whorls of the Hibiscus flower with those of a typical flower.

Resources/materials required:

- Flowers **(**Hibiscus and any other conspicuous flowers)
- Dissection kits, Microscopes.
- Worksheets for students
- Reflective journal guide
- Sheets of paper

Reflective strategies used:

- Questioning and wait time
- Think-pair- share
- Reflective journal writing

Previous knowledge

Students know the structure of a typical flower, the names of various floral parts, and their functions.

Detailed procedure:

Procedure	Reflective strategy used
Warm up (15 minutes) • The teacher shows students a diagram of a typical flower and prompts students to reflect on their previous knowledge by asking the following questions: ▪ Can you identify the different floral parts seen in the diagram? ▪ Do the flowers that you have seen in nature show variations? ▪ Can you describe the floral variations you have observed? ▪ Do you think the variation you have described serves a purpose? • After each question, the teacher waits for some time (minimum 30 seconds) so that as many students as possible raise their hands. She then randomly invites students to answer.	Questioning and wait time
Main activity (120 minutes) • The teacher demonstrates the dissection of a Hibiscus flower and displays various floral parts. • The teacher tells the students to dissect the Hibiscus flowers individually and display the floral whorls. • The teacher tells the students to note similarities and differences between a typical flower and a Hibiscus flower, then share their observations with their partner and discuss. • The teacher tells each pair to note their observations in the graphic organizer given in the activity sheet. • The teacher randomly invites a pair to share their observations with the class.	Think-pair-share
Wrap up (40 minutes) • The teacher tells the pairs to review and reflect on the session based on the following points – ▪ their understanding ▪ feelings and emotions ▪ skills they acquired ▪ changes they would like in the next session • Then she randomly invites students to share it with the class • The teacher tells the students to reflect on the session critically and write in their reflective journals. (20 minutes)	Three-minute review Reflective journal writing