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# A system thinking approach to develop higher order thinking skills of student teachers

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## Abstract

*Development of Higher order thinking skills (HOTS) is a vital objective of higher education. It is an important skill to be achieved in the 21st century teaching learning process. It extends beyond simple memorisation to diverse cognitive processes such as exploring consequences, reviewing options, monitoring progress, making judgements, generating ideas etc. The present study involved use of a system thinking approach to develop Higher Order thinking skills in student teachers. The experimental method involved a sample consisted of 74 student teachers at Diploma Level. The experimental group was given intervention using the System Thinking Instructional Module, while the control group was taught by conventional method. A researcher made tool was used to measure the achievement of higher order thinking skills. The findings revealed that the System Thinking Instructional Module has improved the post test scores of HOTS of the experimental group, whereas the conventional teaching method did not show any significant difference in the post test scores of HOTS of the control group. Also, it was seen that the post test scores of HOTS did not show any significant difference with respect to stream at entry level and mental ability of student teachers. The findings suggest that a system thinking based programme should be made part of the teacher education at Diploma Level.*

**Keywords:** System Thinking Approach, Higher Order Thinking Skills, Student teachers.

## Introduction

Higher order thinking skills (HOTS) are an important outcome of higher education. It is one of the important skills to be achieved in the 21st century teaching learning process. It is more than simple memorisation and involves a variety of cognitive processes such as exploring consequences, reviewing options, monitoring progress, making judgements, generating ideas etc. According to revised Blooms taxonomy, the higher order thinking skills include analysing, evaluating and creating[1]. It is said that teachers teach in the way they learn to teach. Hence it is important that student teachers get themselves trained in improving the Higher Order Thinking Skills.

The studies by Panicker to identify the elements of higher-order thinking skills in student teachers' lesson plan has shown that less than 50% of the student teachers incorporated HOTS in the lesson plans[2]. Nagappan has remarked teachers are not always sure of how to teach higher order thinking[3]. Logeswari *et al* while studying the issues related to the teaching and learning of higher order thinking skills among TESL student teachers, stated that pre service teachers should be enabled with the skills to teach HOTs, so that the number of students who are passive learners and lacking problem-solving skills could be reduced[4]. The results of the study conducted by Yuliati showed that improvement in the thinking ability level of students in answering HOTS practice questions is a necessity[5].

The study conducted by Retnawati *et al* showed that teachers not only had low knowledge about HOTS but also lacked ability to enhance HOTS of students, resolve HOTS-based problems and assess HOTS of students[6].

Hence the present study was undertaken to find out: i. The effect of system thinking approach in teaching on higher order thinking skills of student teachers. ii. The effect of system thinking approach in teaching on higher order thinking skills of student teachers with respect to their (a) Stream at entry level. (b) Mental ability. iii. The effect of conventional method in teaching on higher order thinking skills of student teachers. iv. The effect of the conventional method in teaching on higher order thinking skills of student teachers with respect to their (a) Stream at entry level. (b) Mental ability.

## Methodology

In the present study using experimental method, the randomised group pre-test- post-test experimental design was chosen. The researcher has selected student teachers studying in the second year of Diploma in Elementary Education as the sample. The sample consisted of 37 students in experimental group which was taught by system thinking approach while 37 students in the control group was taught by conventional method.

The researcher has used the following tools for the purpose of research: i. OTIS Self Administering Tool of Mental Ability, ii.

A researcher made questionnaire to measure the higher order thinking skills of student teachers. iii. An Instructional Module based on System Thinking approach.

In addition to this personal information including name, stream at entry level were also collected.

## Results and Discussion

The collected data have been analysed by descriptive and inferential analysis and is given below.

Hypothesis-1: $H_0$-There is no significant difference in the effect of the System Thinking Approach on higher order thinking skills of student teachers with reference to their pre-test and post test scores.

From the Table-1 it is observed that the difference in mean scores of post test and pre-test of higher order thinking skills of the student teachers taught by System Thinking Approach is 17.73 and $SE_D$ is 0.95. The calculated t value is 18.73 at df 36. The table value of t at 0.05 level is 2.02 and at 0.01 level is 2.72. The obtained t value is greater than the table value of t and hence the hypothesis is rejected.

Hypothesis-2: $H_0$-There is no significant difference in the effect of the System Thinking Approach Module on higher order thinking skills of student teachers on the basis of their pre-test and post test scores with reference to: i. Mental Ability, ii. Stream at Entry Level.

From the Table-2a it is observed that for the pre-test scores the calculated F value is 2.56 which is lower than the table value of 3.26 at 0.05 level and also lower than the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

From the Table-2a it is observed that for the post test scores the calculated F value is 0.35 which is which is lower than the table value of 3.26 at 0.05 level and also lower than the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

**Table-1:** Experimental group Pre -Test Post test. df =36.

| Scores | Mean | Std. Dev | Mean difference | $SE_D$ | Calculated t value | Significance |
|---|---|---|---|---|---|---|
| Pre-test | 9.51 | 4.72 | 17.73 | 0.95 | 18.73 | S |
| Post test | 27.24 | 5.66 | | | | |

**Table-2a:** Experimental Group Pre -Test Post Test w.r.t mental ability.

| Test | | Sum of Squares | df | Mean Square | F | Significance |
|---|---|---|---|---|---|---|
| Pre -test | Between Groups | 105.0 | 2 | 52.5 | 2.56 | NS |
| | Within Groups | 696.25 | 34 | 20.48 | | |
| | Total | 801.24 | 36 | | | |
| Post test | Between Groups | 23.0 | 2 | 11.5 | 0.345 | NS |
| | Within Groups | 1131.81 | 34 | 33.29 | | |
| | Total | 1154.81 | 36 | | | |

**Table-2b:** Experimental group Pre -Test Post-test w.r.t stream at entry level.

| Test | | Sum of Squares | df | Mean Square | F | Significance |
|---|---|---|---|---|---|---|
| Pre -test | Between Groups | 23.039 | 2 | 11.52 | 0.50 | NS |
| | Within Groups | 778.204 | 34 | 22.89 | | |
| | Total | 801.243 | 36 | -- | | |
| Post test | Between Groups | 5.20 | 2 | 2.59 | 0.08 | NS |
| | Within Groups | 1149.62 | 34 | 33.81 | | |
| | Total | 1154.81 | 36 | -- | | |

From the above Table-2b it is observed that for the pre-test scores the calculated F value is 0.50 which is lower than the table value of 3.26 at 0.05 level and the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

From the above Table-2b it is observed that for the post test scores the calculated F value is 0.08 which is which is lower than the table value of 3.26 at 0.05 level and the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

Hypothesis-3: $H_0$-There is no significant difference in the effect of conventional method on higher order thinking skills of student teachers with reference to their pre-test and post test scores.

From the Table-3 it is observed that the difference in means of pre-test and post test scores of higher order thinking skills of the student teachers taught by conventional method is 0.87 and $SE_D$ is 0.67. The calculated t value is 1.28 at df 36. The table value of t at 0.05 level is 2.02 and at 0.01 level is 2.72. The obtained t value is lesser than the table value of t and hence the null hypothesis is accepted.

Hypothesis-4: $H_0$-There is no significant difference in the effect of conventional method on higher order thinking skills of student teachers on the basis of their pre-test and post test scores with reference to: i. Mental Ability, ii. Stream at Entry Level.

From the Table-4a it is observed that for the pre-test scores the calculated F value is 1.61 which is lower than the table value of 3.26 at 0.05 level and the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

From the Table-4a it is observed that for the post test scores the calculated F value is 0.99 which is which is lower than the table value of 3.26 at 0.05 level and also lower than the table value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

**Table-3:** Control group Pre- test-Post test.

| Scores | Mean | Std. Dev | Mean difference | $SE_D$ | Calculated t value | Significance |
|---|---|---|---|---|---|---|
| Pre-test | 8.43 | 4.63 | 0.87 | 0.67 | 1.28 | NS |
| Post test | 9.30 | 2.56 | | | | |

df =36

**Table-4a:** Control Group Pre-test-Post-test w.r.t Mental Ability.

| Test | | Sum of Squares | df | Mean Square | F | Significance |
|---|---|---|---|---|---|---|
| Pre -test | Between Groups | 66.50 | 2 | 33.25 | 1.61 | NS |
| | Within Groups | 704.58 | 34 | 20.72 | | |
| | Total | 771.08 | 36 | | | |
| Post test | Between Groups | 12.92 | 2 | 6.46 | 0.99 | NS |
| | Within Groups | 22.81 | 34 | 6.55 | | |
| | Total | 235.73 | 36 | | | |

**Table-4b:** Control Group Pre-test-Post-test w.r.t Stream at entry level.

| Test | | Sum of Squares | df | Mean Square | F | Significance |
|---|---|---|---|---|---|---|
| Pre-test | Between Groups | 17.85 | 2 | 8.92 | 0.40 | NS |
| | Within Groups | 753.23 | 34 | 22.15 | | |
| | Total | 771.08 | 36 | | | |
| Post test | Between Groups | 10.96 | 2 | 5.48 | 0.83 | NS |
| | Within Groups | 224.77 | 34 | 6.61 | | |
| | Total | 235.73 | 36 | | | |

From the Table-4b it is observed that for the pre-test scores, the calculated F value is 0.40 which is lower than the table value of 3.26 at 0.05 level and the value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

From the Table-4b it is observed that for the post test scores the calculated F value is 0.83which is which is lower than the table value of 3.26 at 0.05 level and the value of 5.27 at 0.01 level. Hence the null hypothesis is accepted.

**Major Findings:** i. The post test scores of higher order thinking skills of student teachers taught by system thinking approach showed a significant difference from the pre-test scores. ii. The pre-test scores of higher order thinking skills of student teachers taught by system thinking approach did not show a s significant difference with respect to mental ability and stream at entry level. iii. The post test scores of higher order thinking skills of student teachers taught by system thinking approach did not show any significant difference with respect to mental ability and stream at entry level. iv. The post test scores of higher order thinking skills of student teachers taught by conventional method did not show any significant difference from the pre-test scores. v. The pre-test scores of higher order thinking skills of student teachers taught by conventional method did not show any significant difference with respect to mental ability and stream at entry level. vi. The post test scores higher order thinking skills of student teachers taught by conventional method did not show any significant difference with respect to mental ability and stream at entry level.

## Conclusion

Achieving proficiency in higher order thinking skills (HOTS) has its own challenges. It needs to be given more emphasis in teaching. Focus should be on developing competency in student teachers towards developing student's capability to think along with achieving mastery in subject. The system thinking approach has found to improve the higher order thinking skills of student teachers. Hence it is imperative to include a training module based on system approach in teacher education curriculum. The effectiveness of teaching HOTS will materialize only in such situations where constructivist learning occurs while keeping the conventional view of transmission of information as secondary. The study has shown that there is no effect of either mental ability or stream at entry level on the development of higher order thinking skills by the student teachers. This gives a hope that any programme to promote system thinking in student teachers can be expected to bring about good results irrespective of the academic background of student teachers.

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