CHAPTER III - METHODOLOGY

The present study being exploratory in nature was carried out in three phases.

*Figure 3.1* Flowchart depicting the procedure adopted in the present study

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Findings of Phase 1 – Common disciplines – Mathematics and Sanskrit Grammar

Tool construction - based on Revised Blooms taxonomy for Mathematics and Sanskrit grammar

Pilot study - small sample from ancient and modern schooling systems

Compilation and analysis of data

Consultation with subject experts - Tools and Findings of the pilot study validated - Fine tuning of the tools

Data collection - Main study

Compilation and analysis of data

Verification of hypotheses.

**Aim**

To study the differences in learning as per the revised Blooms Taxonomy between the ancient and modern schooling systems.

**Objectives**
1. To study the differences in learning as per the revised blooms taxonomy between the ancient and modern schooling systems.
   a) To study the differences in learning of mathematics as per the revised blooms taxonomy between the ancient and modern schooling systems.
   b) To study the differences in learning of Sanskrit grammar as per the revised blooms taxonomy between the ancient and modern schooling systems.
2. To study the differences in the learning styles used by the students of the ancient and modern schooling systems.
3. To study the differences in the pedagogy using the differentiated instruction between the ancient and modern schooling systems

**Operational definitions**

a. Learning – In the present study, learning is restricted to the dimensions of the cognitive process and knowledge dimensions of the Revised Blooms taxonomy. According to Krathwohl (2002) the dimensions are:

Cognitive process dimensions:

- Remembering refers to retrieving relevant knowledge from the long-term memory.
- Understanding refers to determining the meaning of instructional messages, including oral, written, and graphic communication.
- Applying refers to carrying out or using a procedure in a given situation.
Analyzing refers to breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.

Evaluating refers to making judgments based on criteria and standards.

Creating refers to putting elements together to form a novel, coherent whole or make an original product.

Knowledge dimensions - The knowledge category includes 4 sub-dimensions namely - Factual knowledge, Conceptual knowledge, Procedural knowledge and Metacognitive knowledge.

- Factual Knowledge refers to the knowledge of the basic elements that learners must know to be acquainted with a given discipline or solve problems in it.

- Conceptual Knowledge refers to the knowledge of the interrelationships among the basic elements within a larger structure that enable them to function together.

- Procedural Knowledge refers to the knowledge of How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.

- Metacognitive Knowledge refers to the knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

b. Ancient schooling system – refers to the traditional schools often termed as Gurukulas having a primary focus on curriculum in Sanskrit along with other subjects
c. Modern schooling system – refers to the schools that follow the curriculum pattern prescribed by the Karnataka State Higher Secondary education board.

d. Learning styles – in the present study learning styles is assessed using the VARK questionnaire. The VARK questionnaire was primarily developed by Fleming, 1998. The VARK instrument, which is based on interaction and response to learning environment of the students, divides students into four categories, including; Visual (a group of learners who learn best by observation and visual presentation, such as diagrams, pictures and figures, which are associated with clarification), Aural or auditory (a group of learners who learn best through listening and verbal instructions), Reading/writing (a group of learners who learn best by taking notes during lectures or reading written or printed texts) and Kinesthetic or practical (a group of learners who learn best by doing practicals, through gaining of experience and by manipulation of objects during a physical process) (Fleming, 2009).

e. Differentiated Instruction - Tomlinson defines the terms “Differentiated instruction is a philosophy of teaching purporting that students learn best when their teachers effectively address variance in students’ readiness levels, interests, and learning profile references. A key goal of differentiated instruction is maximizing the learning potential of each student” (Tomlinson 2001, 2003). Tomlinson identifies six underpinnings of effective differentiation namely – Student interest, Assessment, lesson planning, content, process and product.

Variables

Independent variable: Ancient and modern schooling systems
Dependent variable:

1. Learning of Sanskrit grammar and Mathematics in terms of the Revised Blooms Taxonomy which organizes learning outcomes across two different aspects – Knowledge and Cognitive processes.
   - The Knowledge process has four levels: Factual Knowledge, Conceptual Knowledge, Procedural Knowledge and Metacognitive Knowledge.
   - The Cognitive process has six levels: Remembering, Understanding, Applying, Analysing, Evaluating and Creating.

Relevant variables:

1. Learning styles based on Fleming’s VARK model (Fleming 1995)
2. Understanding and implementation of differentiated instruction.

**Hypotheses**

In line with the objectives of the present study, the following hypotheses were formulated.

H1: There will be no significant difference in learning as per the revised blooms taxonomy between the students of the ancient and modern schooling systems.

H1a: There will be no significant difference in the learning of mathematics as per the revised blooms taxonomy between the students of the ancient and modern schooling systems.
H1b: There will be no significant difference in the learning of Sanskrit grammar as per the revised blooms taxonomy between the students of the ancient and modern schooling systems.

H2: There will be no significant difference in the learning styles of the students of the ancient and modern schooling systems.

H3: There will be no significant difference in the understanding and implementation of differentiated instruction in the pedagogy used between ancient and modern schooling systems.

The above hypotheses were tested using the following research design.

**Research design**

The research is an exploratory research following the survey research paradigm. The research is conducted in multiple phases. Phase 1 involved an in-depth interview of subject experts across different informal religious education institutions to identify the variables of the study. Based on the interviews, two disciplines were identified as common disciplines to assess learning among the ancient and modern schooling systems; which were mathematics and Sanskrit grammar. Assessment tools in consultation with subject experts to assess learning in maths and Sanskrit grammar were constructed. In phase 2, - A pilot study was conducted that validated the tools constructed and the variables. Keeping in view the objectives of the study the phase 3 was the main study is conducted. 5 institutions under the ancient system and 10 institutions under the modern system of education were identified and approached for conducting the study.
Sample selection

Ancient schooling system:

Inclusion criteria

- Students enrolled in the Gurukulas for a minimum period of 5 years and 3 years under the higher secondary board.
- Students studying in the higher secondary school level - tenth standard under both the systems.
- Students studying under the curriculum prescribed by the state government of Karnataka.

Exclusion criteria

- Non residential students pursuing their studies in Gurukulas.
- Students who refuse to participate in the study.

Modern schooling system

Inclusion criteria

- Students studying in the higher secondary school level - tenth standard under both the systems.
- Students studying under the curriculum prescribed by the state government of Karnataka.

Exclusion criteria

- Students pursuing studies under CBSE, ICSE, IGCSE systems.
• Students studying in a residential schooling system.
• Students who refuse to participate in the study.

Sampling technique

The sampling technique employed was Purposive sampling. The study comprised of an overall sample size of 210 (N = 210). Among them the sample from the ancient schooling system was 95 and modern schooling system was 110. The age range of the sample ranged from 15 years to 19 years in the ancient schooling system and from 15 years to 16 years in the modern schooling system. The ancient schooling system comprised of 75 male and 20 female. In the modern schooling system, 42 were female and 73 were male.

Sample description

Based on the inclusion and exclusion criteria, the sample was drawn from various institutions in Karnataka. The ancient schooling system that was followed in Gurukulas was identified across Karnataka. 5 such institutions were identified and data was obtained from them. These include Sri Shankara Smartha Samskrutha Paathashaala, Ved Vijnana Gurukula, Prabhodhini Gurukula, Maitreyi Gurukula and Om Shanthidhama. The modern schooling system comprised the sample from 10 institutions across Bangalore city that permitted access to the researcher namely Hymanshu Jyothi Kala Peetha, Vidyaniketan Public School, Sri Vidya Mandir High School, Cluny Convent High School, Mother Teresa High School, PoornaPrajna High School, Auden High School, Holy Child English High School, Sri Kumarans Childrens Home and VVS Sardar Patel High School.
The ancient schooling system comprises of 75 male and 20 female. Disparity between the two schooling systems in terms of the age range as well as gender is observed. Uniformity in the age group among the respondents of the modern schooling system is found due to the age of entry being predetermined (5 years 10 months for 1st grade level). Whereas, in the ancient schooling system, the entry level is flexible and also flexibility is given to the students to take up the tenth grade level examinations at their convenience. Also, since educational institutions in the ancient system of education exclusively for females is very few in number in Karnataka, the sample size for females was less in the ancient schooling system.

In order to compare the pedagogical differences, 5 teachers of mathematics and 6 teachers of Sanskrit representing both Gurukulas and modern schools who volunteered were administered the differentiated strategies survey. In addition to the responses to the questionnaire, an unstructured interview was conducted on the teachers in order to obtain information that is specific to their stream of education.
Tools

1. Test of mathematics that consists of 46 items and Test of Sanskrit which consists of 26 items developed by the researcher in consultation with subject experts. The test items measure the dimensions of the revised blooms taxonomy. Corresponding to these dimensions, both multiple choice and open ended questions were framed. The following table depicts the number and the nature of questions for maths and Sanskrit.
Table 3.1

*Depicting the categorisation of the items across the test of learning mathematics*

<table>
<thead>
<tr>
<th>KNOWLEDGE DIMENSION</th>
<th>COGNITIVE PROCESS DIMENSION</th>
<th>Total no of items (Cognitive processes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remem bering</td>
<td>Understanding</td>
</tr>
<tr>
<td>Factual</td>
<td>11, 14, 2</td>
<td>25, 26, 30</td>
</tr>
<tr>
<td>3, 41, 45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conceptual</td>
<td>13, 21</td>
<td>2, 46</td>
</tr>
<tr>
<td>Procedural</td>
<td>4, 18</td>
<td>8, 40</td>
</tr>
<tr>
<td>Metacognitive</td>
<td>44</td>
<td>17</td>
</tr>
<tr>
<td>Total no of items (Knowledge)</td>
<td>10</td>
<td>08</td>
</tr>
</tbody>
</table>

Table 3.2

*Depicting the categorisation of the items across the test of learning Sanskrit grammar*

<table>
<thead>
<tr>
<th>KNOWLEDGE DIMENSION</th>
<th>COGNITIVE PROCESS DIMENSION</th>
<th>Total no of items (Cognitive processes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remem bering</td>
<td>Understanding</td>
</tr>
<tr>
<td>Factual</td>
<td>16, 26</td>
<td>1</td>
</tr>
<tr>
<td>Conceptual</td>
<td>19</td>
<td>14</td>
</tr>
</tbody>
</table>
The psychometric properties of the tests are as follows:

The Cronbach alpha (N=210) for the test of mathematics yielded a value of 0.89 with the item-total correlation ranging from 0 to 0.63. The Cronbach alpha for the test of Sanskrit grammar (N=210) yielded a value of 0.97 with the item-total correlation ranging from 0.16 to 0.83. The validity of the test was established by subject experts of both the systems of schooling.

2. VARK questionnaire was used to assess the preferences of learning styles developed by Fleming (1998) The tool measures four different learning preferences having 16 questions with four alternatives each. The authors have provided open access for its use in research. Subjects preferred learning style is determined by the frequency of the response categories chosen. The psychometric properties of the tests are as follows:

The reliability estimates for the scores of the VARK subscales were .85, .82, .84, and .77 for the visual, aural, read/write, and kinesthetic subscales, respectively, which are considered adequate given that the VARK is not used for high-stakes decisions. Four multitrait-multimethod confirmatory factor
analysis models were compared to evaluate the dimensionality of the VARK. The correlated trait-correlated method model had the best fit to the VARK scores. The estimated reliability coefficients were adequate. The study found preliminary support for the validity of the VARK scores. (Leite, W. L., Svinicki, M. & Shi, Y 2010)

3. Pedagogical differences were measured using the Understanding and Implementation of Differentiated Instruction Survey. (Tomlinson 2001) the tool measures the differences in terms of strategies adopted by the teachers in understanding and implementation of instructional procedures across 6 components - Student interest, Assessment, lesson planning, content, process and product. The tool consists of 26 self report statements to be rated on a 4 point rating scale.

The psychometric properties of the scale are as follows:

According to Hobson (2004), the scale showed a Cronbach Alpha of .97 and two split-half reliability coefficients of .95 and .94. Hobson also got the tool reviewed by a panel of experts on differentiation. Each reviewer on the panel was asked to evaluate the instruments for validity. Results of the review were positive for all items including instrument construction, content validity, construct validity, face validity, item bias, and consequential validity, including internal consistency and potential for consistent responses (Hobson, 2004, pg. 50).

4. Demographic data sheet

5. In order to facilitate students, questions were translated into Kannada with the help of respective teachers.
Procedure

1. Initially, in the phase 1- a study was conducted to determine the techniques of pedagogy followed in teaching respective subjects, methodological differences present between ancient and modern systems of schooling, subjective correlates of the learner, and the criteria of academic performance. The sample comprised of 10 expert tutors spanning across different formal traditional educational institutions. Among them, 5 teachers belonged to the Hindu schools of Veda and related subjects taken from the Bharathiya Samskruthi Vidyapeeta Samskrita Pathashala, Bangalore 3 were teachers of Biblical scriptures who taught in the St. Peter’s Seminary, Bangalore. 1 was a teacher of Quran and related scriptures, from the Darul-Ul-Uloom-Imam-e-Azum, Bangalore, and 1 was a teacher of Pali language and literature in Buddhist traditional school, Mahabadhi Society, Bangalore. The teachers were mostly those who had relevant teaching experience in the subjects they taught, the duration of their experience in teaching was in the range of 10-15 years. They were interviewed personally using a semi-structured interview schedule developed by the researcher. The interview typically lasted 30-60 minutes per teacher.

2. The result of this in-depth interview brought out the fact that these institutions have the primary objective of imparting religion based curriculum which could not be compared across the religions. Further, enrolment of students to some of the religion based institutions did not allow the formal general education. Hence, only those religious institutions that allowed students also to pursue general education was considered. Some of Institutions run by
Hindu Religion often termed as ‘Gurukulas’ that allowed students to pursue the general education that also had common subjects for study under both the streams were identified; like the subjects of mathematics and Sanskrit grammar were found to be learnt in both the systems though the methodologies of teaching as well as learning were distinct to the schooling systems.

3. Based on the review of literature comparing the ancient and modern systems of education differences in the pedagogy of education between the two streams have been recognised. The prevailing higher secondary education in Karnataka has greater emphasis on assessing learning through the rote method. The goal of education as propagated by educationists is beyond rote learning. The foundation a student gets at the primary and higher secondary education paves way for analysing, extending and creating knowledge at a later stage of development. Theories and models have been evolved by educationists that are being put to practice periodically. One such model that has been extensively used is the Revised Bloom’s Taxonomy. Hence a comparison of learning across the two streams was made as per the revised Blooms Taxonomy

4. Phase 2 - Pilot study: Test construction was done to assess learning based on revised blooms taxonomy. A 46 item test of Mathematics as well as a 26 item test of Sanskrit grammar were constructed and were administered on the students group after obtaining the permission from the institutions. A Mann Whitney U test was conducted on the results obtained where it was revealed
that there was a significant difference between the two groups on all dimensions of learning.

5. The obtained differences were validated by the subject matter experts from both the streams. In addition, a reliability measure for the tool was also estimated in terms of Cronbach Alpha. The Cronbach alpha for Sanskrit grammar yielded a value of 0.96 (N=67) with the item-total correlation ranging from 0.08 to 0.92. The Cronbach alpha for the test of mathematics (N=59) yielded a value of 0.84 with the item-total correlation ranging from 0.00 to 0.71.

6. A pilot study was conducted taking 27 subjects from the Gurukulas and 40 from the modern schools. Based on the commonality of the syllabi, a test was developed to assess learning as per the revised blooms taxonomy for mathematics and Sanskrit grammar. Subject experts in the field of teaching at higher secondary level were consulted to frame the questions and were validated for its content.

7. The results of the pilot study supported the rationale for the objectives of the present study.

8. The assessment tools were rectified for the main study. The sample matching the inclusion and exclusion criteria of the main study were identified for the Phase 3 – Main study.

9. The data was collected by group administration by the researcher separately visiting the institutions on different days. On an average, respondents took 60 to 90 minutes to complete answering all the tools.
10. Data from the teachers of the respective schools was also obtained through the use of the Differentiated instruction survey coupled with an informal interview.

11. Scoring was done separately for the correct responses of each dimension of the revised blooms taxonomy of the mathematics and Sanskrit grammar tests. The responses were scored. Each correct response was scored as 1. The raw scores were the total score was the no of correct responses totalled in all the dimensions separately i.e., Remembering, Understanding, Applying, Analysing, Evaluating, Creating, and Factual, Conceptual, Procedural, Metacognitive dimensions.

12. The obtained raw scores on each dimension was cross tabulated and converted to standard scores for the highest score across the cognitive processes and knowledge processes for the test of learning Sanskrit grammar and a similar procedure was followed for the scores on the test of learning mathematics.

13. The obtained data was subjected to appropriate statistical analyses using SPSS version 20 keeping in view the objectives of the study.

14. To test the differences in learning mathematics between the ancient and modern schooling systems; the converted scores on cognitive process dimensions and the converted scores of the knowledge processes were subjected to the non-parametric test of Mann Whitney U test.

15. To test the differences in learning Sanskrit grammar between the ancient and modern schooling systems; the converted scores on cognitive process
dimensions and the converted scores of the knowledge processes were subjected to the non-parametric test of Mann Whitney U test.

16. To test the differences in the preferences of learning styles, a $2 \times 2$ contingency table Chi square test was computed for the learning preferences between the two schooling systems.

17. To examine the differences in the pedagogy - the use of differentiated instruction between the two schooling systems were analysed. Due to lesser number of teachers (who agreed to participate) teaching Sanskrit and mathematics in the modern school and teacher-student ratio in the Gurukulas being different; the pedagogical differences were analysed in detail for each component under the two sections of differentiated instruction.

The obtained results are presented and discussed in the next chapter.