



Learning Style Preferences and Achievement in Biology of Higher Secondary School Students

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Abstract: The level of learning achieved by a learner is one of the most important factors which indicate the success of a learning environment. As teachers become more aware of their students' learning style preferences, they are more likely to apply efforts to accommodate their differences. The study intends to find out the learning style preferences of higher secondary school students in Kerala and to compare the mean scores of achievement in biology of different learning style groups within the framework of lecture method. Survey method is used in this research work and the sample consisted of hundred higher secondary school students. The investigator administered Kolb's Learning Style Inventory to find out the learning style preferences of higher secondary school students. The investigator prepared and standardized an achievement test to measure the achievement in biology of students. The scores thus obtained were analyzed by using statistical techniques such as Mean, Standard Deviation, Analysis of Variance, and Scheffe test of Post hoc. The results showed that among the higher secondary school students, the most frequently occurring learning style is Accommodator and it is followed by Assimilator, Convergent, and Divergent and lecture method is more effective on the achievement in biology of secondary school students having Assimilating learning style than higher secondary school students having diverging, accommodating and converging learning styles.

Key words: Learning Style, Divergers, Assimilators, Accommodators, Convergers

Introduction

Science has occupied almost all spheres of human life and living and the society is completely drawn into the scientific environment. The wonderful achievements of science have glorified the modern world, transformed the modern civilization into a scientific civilization and illuminated the human creative potential. It is essential that the emphasis of science education should be on the development of abilities and disposition of mind rather than merely the transfer of dead subject matter. Thus, science education, if properly conceived, should primarily be concerned with the education of the mind rather than acquisition of isolated pieces of knowledge.

The level of learning achieved by a learner is one of the most important factors which indicate the success of a learning environment. In order to ensure the effectiveness of teaching environments, it is important to take account of characteristics, abilities and experience of learners as individuals or as a group when beginning to plan a learning environment (Kemp, Morrison, Ross, 1998). Students have different learning styles—characteristic strengths and preferences in the ways they take in and process information. If teachers teach exclusively in a manner that favors their students' less preferred learning style modes, the students' discomfort level may be great enough to interfere with their learning. On the other hand, if teachers teach exclusively in their students' preferred modes, the students may not develop the mental dexterity they need to reach their potential for achievement in school. As teachers become more aware of their students' learning style preferences, they are more likely to apply efforts to accommodate their differences (Beck, 2001). Therefore, it is necessary for teachers to not only employ learning styles assessments, but to understand the results and to apply them to their instructional methods in the classroom.

In literature there exist numerous learning styles and learning style models. The differences among definitions and models result from the fact that learning is achieved at different dimensions and that theorists define learning styles by focusing on different aspects. According to Shuell (1986) the different ways used by individuals to process and organize information or to respond to environmental stimuli refer to their learning styles. Jensen (1998) defines learning style as a sort of way of thinking, comprehending and processing information. Reid (1987) described learning styles, as “cognitive, affective, and physiological traits that are relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (p. 87).

According to Dunn, Dunn and Perrin (1994) Learning styles is “the way in which each learner begins to concentrate on, process, and retain new and difficult information - that interaction occurs differently for each individual” (p. 2). Felder et al. (2002), suggest that people have different learning styles that are reflected in different academic strengths, weaknesses, skills, and interests. Understanding learning style differences is thus an important step in designing balanced instruction that is effective for all students.

Kolb's Learning Style Model

Kolb (1984) based his theory of experiential learning on peoples' different approaches of perceiving and processing information classifies students as having a preference for 1) concrete experience or abstract conceptualization (how they take information in), and 2) active experimentation or reflective observation (how they internalize information). Kolb (1984) defined four learning styles for explaining individuals. These are Diverger, Assimilator, Converger and Accommodator.

In his model, learning is described as a four-stage interactive process that involves four distinct learning modes, which represent different types of learning: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). The combinations of the learning modes form four learning styles: the accommodative (AE/CE), the divergent (CE/RO), the assimilative (RO/AC), and the convergent (AC/AE). Every individual utilizes each of the four learning modes to some extent, but he/she has also a preferred learning style for grasping and transforming the information. In particular, the accommodator would rely on concrete experiences mixed with active experimentation in a hands-on experience. The diverger would start from concrete experience and would combine it with reflective observation in order to come up frequently with a creative solution. The assimilator would be concerned mainly with reflective observation in order to develop models and abstract theories for explaining reality. Finally, the converger would grasp information through abstract understanding of the immediate experience and puts into practice her/his ideas in a deductive fashion.

1. Divergers (Concrete experienter/Reflective observer)

Divergers make use of Concrete Experience in perceiving and Reflective Observation in organizing. Individuals who own this learning style like to look at things from many perspectives and hence diverging from a single experience to multiple possibilities in terms of what this might mean. They are very open-minded and prefer to work with people. Watching and feeling are essential for divergers.

2. Convergers (Abstract conceptualization/Active experimentation)

Covergers make use of Abstract Conceptualization in perceiving and Active Experimentation in organizing. Individuals who own this learning style learn best through active experimentation and abstract conceptualization. They like to work themselves, solve problems and find practical solutions.

3. Accommodators (Concrete experienter/Active experimenter)

Accommodators make use of Concrete Experience in perceiving and Active Experimentation in organizing. They have the most hands-on approach, with a strong preference for doing rather than thinking and involving oneself in the experience. They prefer acting on the basis of their feelings rather than mental analyses and acquiring information through dialogues with people rather than technical analyses. (Kolb, 1993).

4. Assimilators (Abstract conceptualizer/Reflective observer)

Assimilators make use of Abstract Conceptualization in perceiving and Reflective Observation in organizing. They have the most cognitive approach, preferring to think than to act. They prefer instructional methods for their learning, for example, lecture method and lab demonstrations. (Litzinger & Osif, 1993). Individuals having this learning style are able to comprehend and transform comprehensive information in a

large interval into a meaningful whole. They prefer dealing with abstract concepts and topics rather than tackling people. They generally attach more importance to logical validity of theories than their practical value. (Kolb, 1993).

Statement of the Problem

The aim of the present study was to investigate the learning style preferences of higher secondary school students in Kerala and to determine, the level of achievement in biology of different learning style groups within the framework of lecture method. A learning style inventory, Kolb's Learning Style Inventory, was administered to determine learning style preferences. An achievement test in biology prepared and standardized by the investigator was used to measure the achievement in biology.

Hence the topic selected for this purpose is entitled as A Study on Learning Style Preferences and Achievement in Biology of Higher Secondary School Students.

Objectives of the study

1. To find out the learning style preferences of higher secondary school students in Kerala
2. To compare the mean scores of achievement in biology of different learning style groups within the framework of lecture method

Hypothesis of the study

The hypotheses formulated for the present study were;

1. There are differences in the learning style preferences of higher secondary school students in Kerala
2. There is no significant difference in the mean scores of achievement in biology of different learning style groups within the framework of lecture method.

Methodology of the study

Survey method is used in this research work. The sample consisted of hundred higher secondary school students. The investigator administered Kolb's Learning Style Inventory to find out the learning style preferences of higher secondary school students. The investigator prepared and standardized an achievement test to measure the achievement in biology of students. The scores thus obtained were then analyzed by using statistical techniques and the comparison was done.

Tools Used in the Study

Kolb's Learning Style Inventory

David A. Kolb's Learning Style Inventory consists of 12 questions about the ways in which one learns best. Each question has four answers, which are ranked by an individual in terms of best fit on a scale of 1 – 4 (being best). Responses are organized into two bipolar concepts: Concrete Experience vs. Reflective Observation and Abstract Conceptualization vs. Active Experimentation. The numbers are summed to give scores for CE, AC, RO and AE. Then $(AE - RO)$ and $(AC - CE)$ are calculated and used abscissa and ordinate, respectively, on a graph that determines one's ultimate learning styles. Kolb's Learning Style Inventory (LSI, 1985), purports to categorize individuals on the basis of their self-reported preferred learning style.

Procedure

Kolb Learning Style Inventory (LSI) was administered to higher secondary school students to collect data. Students were asked to respond their learning style to 12 items in the Learning Style Inventory (LSI) by using four-point Likert Scale. There are four statements in each 12 items. The first one is Concrete Experience (CE), the second one is Reflective Observation (RO), the third one is Abstract Conceptualization (AC) and the last one is Active Experimentation (AE). The scores to be taken from LSI are between 12 and 48 in each part. After this process by subtracting each student's CE scores from AC scores and RO scores from AE scores, the learning style of each participant was classified either as 'accommodating', 'diverging', 'assimilating' or 'converging'. The scores of AE-RO and AC-CE vary between -36 and +36. While, the positive score obtained from AC-CE shows that the learning is abstract, the negative score indicate that learning is concrete. Similarly, the positive score obtained from AE-RO indicate that the learning is active and the negative score shows that the learning is reflective.

The scores obtained from the inventory indicate the coordinates related with organization (Active Experimentation – Reflective Observation) and perception (Abstract Conceptualization – Concrete Experience); and the interaction of these two points indicate the learning style. The learning styles on this system of coordinates are Accommodator, Diverger, Assimilator and Converger.

Statistical Analysis Used

The different statistical techniques employed in this study were Mean, Standard Deviation, Analysis of Variance, and Scheffe test of Post hoc.

Analysis of Data

In order to find higher secondary school students' learning styles, frequencies and percentage distributions of different learning style groups were calculated and presented at Table 1.

Table 1: Frequency distributions of Higher Secondary School Students' Learning Style

Learning styles	Frequency	Percent
Divergers	20	20
Assimilators	23	23
Accommodators	36	36
Convergers	21	21
Total	100	100

According to Table 1, among the higher secondary school students, the most frequently occurring learning style is Accommodator (36%) and it is followed by Assimilator (23%), Convergent (21%), and Divergent (20%).

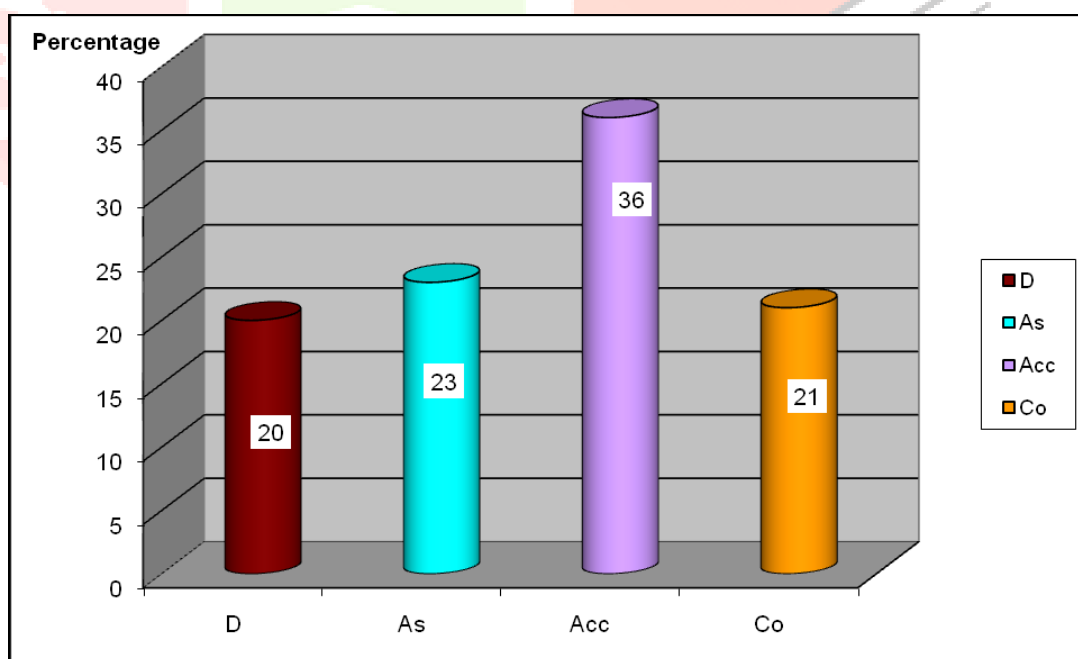


Figure 1: Frequency Distribution of Higher Secondary School Students' Learning Style

Comparison of Achievement test Scores in Biology of Higher Secondary School Students in Various Learning Style Groups

The Achievement test scores obtained by students were condensed into frequency tables and then calculated the various measures of central tendency and dispersion. The values of statistics calculated are given in Table 2.

Table 2: Mean and Standard Deviation of Achievement Test Scores of Various Learning Style Groups

Learning styles	Mean	N	Std. Deviation
Divergers	27.67	20	4.29
Assimilators	35.04	23	3.93
Accommodators	26.90	36	4.26
Convergers	28.95	21	5.53

The test carried a maximum weightage of 40 marks. The arithmetic mean scores obtained for the various learning style groups such as Divergers, Assimilators, Accommodators, Convergers are 27.67, 35.04, 26.90 and 28.95 respectively.

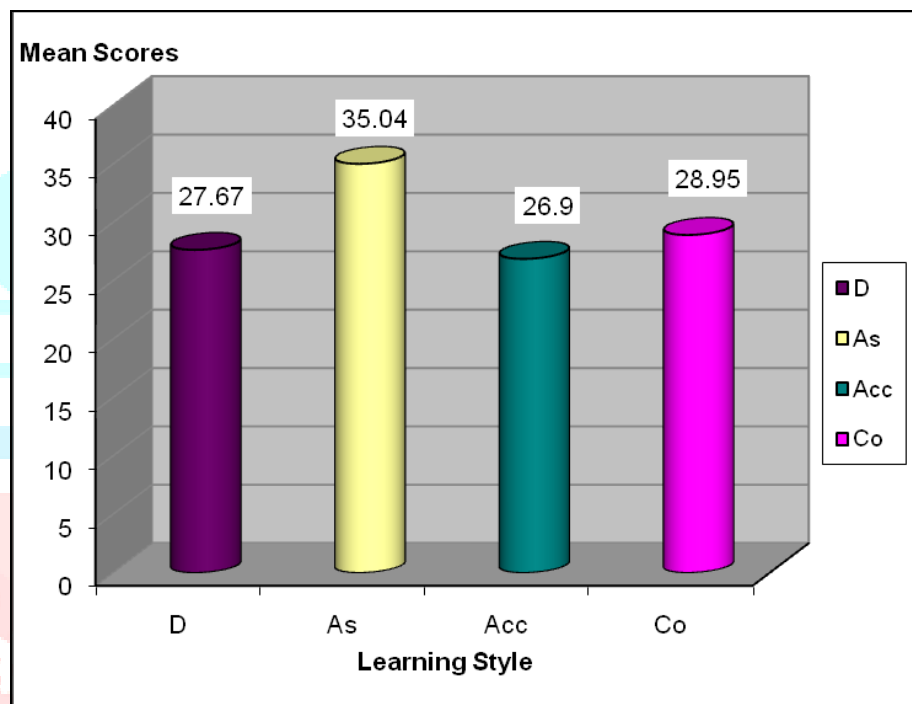


Figure 2: Achievement Test Scores in Biology of Higher Secondary School Students in Various Learning Style Groups

Comparison of Achievement in Biology of Higher Secondary School Students in Various Learning Style Groups

Analysis of Variance

To compare the achievement in biology of higher secondary school students having different learning styles, achievement test scores of students having different learning styles were subjected to the statistical analysis of variance. The summary of analysis of variance of achievement test scores of students having different learning styles, taken separately is given in Table 3.

Table 3: Summary of Analysis of Variance of Achievement Test Scores of Students Having Different Learning Styles, Taken Separately

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	969.251	3	323.084	16.023	.000
Within Groups	1935.709	96	20.164		
Total	2904.960	99			

The table value of F ratio for df 3/96 is 4.01 at 0.01 level. So the obtained F value is highly significant ($F = 16.023$; $P < 0.01$). Since the F test applied to the final scores (F value) falls far beyond the 0.01 level of significance, it can be tentatively interpreted that there is significant difference among the achievement test means of the four different Learning style groups.

This indicates that there is significant difference in the means of achievement test scores among the four different Learning style groups. However, it does not necessarily imply that all the means are significantly different from each other. Here visual inspection of the Figure 2 may suggest that they are all significantly different. Since visual inspection is not scientific, the Post hoc test (Scheffe Test) was applied.

Table 4: Summary of the Scheffe Test Analysis of the means of Achievement Test Scores of Students Having Different Learning Styles, Taken Separately

LS (I)	LS (J)	Mean Difference (I-J)	Sig.
Divergers	Assimilators	-8.14*	.000
	Accommodators	-.77	.575
	Convergers	-2.05	.371
Assimilators	Divergers	8.14*	.000
	Accommodators	7.38*	.000
	Convergers	6.09*	.001
Accommodators	Divergers	.77	.575
	Assimilators	-7.38*	.000
	Convergers	-1.29	.992
Convergers	Divergers	2.05	.371
	Assimilators	-6.09*	.001
	Accommodators	1.29	.992

* The mean difference is significant at the .01 level.

Comparison of Achievement in Biology of Higher Secondary School Students in Various Learning Style Groups

The table value of F ratio for df 3/96 is 4.01 at 0.01 level. The calculated F values of Assimilating learning style group in comparison with Diverging, Accommodating and Converging learning style groups are 8.14, 7.38, 6.09 respectively and are significant at 0.01 level. The obtained values of F of all other group comparisons are not significant even at 0.05 level ($P > 0.05$). This indicates that the other groups are more or less equivalent on their achievement in biology.

The significantly greater adjusted achievement test means of the Assimilating learning style group than other learning style groups in higher secondary school students indicates that Assimilating learning style group is superior to other learning style groups on the achievement in biology. It may therefore be

inferred that the students having Assimilating learning style taught through Lecture method have better achievement in biology than other three learning style groups such as converging diverging and accommodating groups who were also taught through lecture method.

Conclusions Based on Findings

The major conclusions based on the statistical analysis of data, obtained from the comparison of achievement in biology of higher secondary school students in various learning style groups was formulated under the following heads.

1. There are differences in the learning style preferences of higher secondary school students

This conclusion is substantiated by the following findings of the study

Among the higher secondary school students, the most frequently occurring learning style is Accommodator (36%) and it is followed by Assimilator (23%), Convergent (21%), and Divergent (20%).

2. There is significant difference in the mean scores of achievement in biology of different learning style groups within the framework of lecture method. Lecture method is more effective on the achievement in biology of higher secondary school students having assimilating learning style

This conclusion is substantiated by the following findings of the study

A. The analysis of variance of achievement test scores of students having different learning styles in the higher secondary school students shows that there is significant difference among the four learning style groups ($F = 16.023$; $P < 0.01$). This also vouches for the difference in the degree of effectiveness of lecture method on the achievement in biology of higher secondary school students having different Learning styles.

B. The Scheffe test analysis of the means of achievement test scores of students having different Learning styles in higher secondary school students shows that there is significant difference between the means of the achievement test scores of the two groups, Assimilating and Diverging ($F = 8.14$; $P < 0.01$), Assimilating and Accommodating ($F = 7.38$; $P < 0.01$) and Assimilating and Converging ($F = 6.09$; $P < 0.01$). This indicates that the higher secondary school students having Assimilating learning style taught through lecture method excels higher secondary school students having Divergent, Accommodating and Converging learning styles taught through lecture method on the achievement in biology. This confirms that lecture method is more effective on the achievement in biology of secondary school students having Assimilating learning style than higher secondary school students having diverging, accommodating and converging learning styles.

Educational Implications of the Study

Traditional classroom instruction focuses almost exclusively on formal presentation of material (lecturing), a style comfortable for only Assimilating learning style learners. To reach all types of learners, a teacher should explain the relevance of each new topic (concrete, reflective), present the basic information and methods associated with the topic (abstract, reflective), provide opportunities for practice in the methods (abstract, active), and encourage exploration of applications (concrete, active). The term 'teaching around the cycle' was originally coined to describe this instructional approach.

Identification of the Learning style preference will be useful for a teacher to design everyday classroom activities. If the materials to be learned are reached to the learner through the preferred styles for which the learner is predisposed, learning will be highly effective.

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