EFFECT OF PROGRAMMED INSTRUCTION ON ACHIEVEMENT OF SECONDARY SCHOOL CHILDREN IN LIFE SCIENCE

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Introduction

Science and Technology have created a phenomenal impact in shaping the lifestyle of human beings all over the world. Now-a-days all disciplines are becoming more scientific. Our method of observation becomes more symbolic, graphical and linguistic models in every discipline. Speaking on our dependence on science **Sandave (1963)** says:

Our Environment to a great extent is influenced by science. The clothing we wear, the houses in which we live, the agricultural method which produced our food and necessities, our automobiles, our telephones, our radios, the electrical appliances which are used in the home, all are based upon scientific information.

Science in its various forms and shapes helps us to understand ourselves and the environment around us. However, this task to understand ourselves and the environment is not so simple as it appears otherwise. To facilitate and serve the purpose in a better way, attempts are made to divide the subject matter and knowledge of the science into some distinctive branches. The study of physical science helps us to understand the material aspect of life and helps us to harness the physical forces and material world for the benefit and progress of man; the life science or the biological science help us to understand the life in all its aspects. We study of our plant kingdom and life of animals—terrestrial, aerial and aquatic. Such knowledge helps us to understand our own life and utilise this knowledge for healthy living in healthy environment.

As the child of today is more advanced and ahead of his father and forefathers in scientific advancement, proper care should be taken to see that the child develops in a systematic way to fit herself/himself to the modern world. Today each child must gain some fundamental knowledge of

science to develop acquisitiveness about varieties of things in a better way. He needs to be well informed about the developments taking place in the field of science. For this, it has become necessary to recognise and improve teaching and learning of science right from the school stage.

Aims of life science education at secondary level

The advantages that can be drawn by the study that subject generally become the aims for its study. The following are aims of teaching Life science at the lower secondary stage:

- To provide the students deep insight (more than the previous classes) with the facts and principles of life science.
- To develop their ability to perform experiments more skillfully and to help them to have better insight about the applications of science.
- To provide appropriate opportunities for the development of the inventive and creative faculties of the students
- To provide essential base for the higher specialised studies in the areas and fields of life science and technology.
- To equip the students with all the basic scientific knowledge and skills of life science which are helpful in day-to-day life.
- To help them in adopting and learning some useful scientific activities as hobbies and leisure hours purposeful activities.
- To create in them proper attitude and faith regarding the values and contribution of Life science.

Instructional materials in life science education

Effective instruction in life science can be attributed to the meaningful organisation of women/men, material, method and machine employed in the instructional situation. With the invention and use of modern scientific gadgets like computer, television, overhead projector etc., learning has been simplified and made faster and productive. In addition to this, innovative techniques like programmed instructional materials, interactive video and various forms of print materials have minimised the teacher's effort and increased self-instructional habit among the learners.

In this context there is a need for production of self-instructional modules for dealing with large amount of subject contents. There is lack of adequate materials in life science education programmes. Chalk and talk method is still prevalent in majority of schools. Use of modern instructional techniques among teachers for teaching life science has not reached its expectations. This is because the educational authorities have not been successful in equipping the teachers with the modern technology for developing self-instructional materials to meet the needs of large number of learners. With this end in view, the researcher makes an attempt to bring out an innovative programmed learning materials for students' uses. This may help in providing support for fulfilling the objectives for which textbooks are in uses.

Programmed instruction

Programmed instruction or programmed learning is one of the important innovations in the teaching-learning process. Programmed instruction is a carefully specified, systematically planned, empirically established, skillfully arranged and effectively controlled self-instructional technique for providing individualised instruction or learning experiences to the learner. It is an application of the principles of behavioural sciences and technology in the field of education. Following are some characteristics of programmed instruction:

- The programmed instruction is a process of constructing sequences of instructional material in a way that the rate and depth of learning are maximised, understanding is fostered and the motivation of the student is enhanced.
- The subject matter of the programme is presented by breaking into small steps in a logical sequence. The small steps stress the gradual nature of the increase in complexity and the smoothness of the transition from one item to the next, information grows in depth, changes occur in quality and quantity.
- In programmed learning situation, the learner progresses at its own pace.
- Programmed learning provides for constant evaluation through the record of learner's responses. The quality of the programme can be improved through checking the number of errors at each step and the learner's programme can be evaluated by looking into various types of responses produced by the learners.
- Programmed learning is based strictly on the behaviouristic principles of psychology. A fair amount of stress is laid on the examination and development of understanding through the handling of various cases in learning process.

Principles of programmed instruction

The principles on which programmed learning is based were discovered in psychological laboratories, which were discussed below:

- **Principles of small steps:** It is experimentally verified that a dullest student can learn as effectively as the brightest student, if the subject matter is presented to them in suitable small steps. The steps are so small that the students can easily go through it and give answers without any mistake. Thus the students will be able to go through the task or steps and sequentially learn all the steps.
- **Principle of active responding:** The second psychological principle is that the students learn better and faster when they are actively participating in the teaching-learning process. Programmed materials provide opportunity to every learner to respond at every small step.
- **Principle of reinforcement:** The third principle from the psychological laboratory is that the students learn best when they can confirm their answer immediately. It is one type of reinforcement to work on the programme or to learn. A student who must wait two weeks for the test results probably

will not learn as well as a student whose test is scored immediately.

- **Principle of self-pacing:** The programmed instruction is based on the basic assumption that learning take place effectively if the learner is allowed to learn at his own pace. Therefore, a good programme of the material always takes care of the principle of self-pacing. A learner moves from one frame to another according to his own speed of learning.

- **Principle of student evaluation or student testing:** Continuous evaluation of the student and learning process leads to better teaching-learning. In the programmed instruction, the learner has to leave the record of his responses because he is required to write a response for each frame on response sheet. This detailed record helps in revising the programme.

Types of programmed instruction

Among various programming, linear and branching programmings are most important. They are discussed below:

- **Linear programming:** B.F. Skinner of Harvard University and his associates are the originators of the linear type of programming. This is also known as the Skinnerian programming or Extrinsic programming and based on the principle that the learner's original response should be gradually attained or shaped until he meets some standard or acceptable performance. In this programming the best way to teach students is to break the subject matter into meaningful segments of information and write small steps in such a way that only the correct responses are likely to occur. Students learn better when they are successful. The student should be provided immediate knowledge of the result of his performance. He should actively participate in the learning process by constructing responses. In short, linear programming is based on the theory of the stimulus response reinforcement sequence of operant conditioning.

- **Branching programming:** Branching programming was developed by Norman A. Crowder (1954), an American technician. This is also known as Intrinsic programming. The programming is developed to overcome the limitation as reflected under linear programming. In this type, the learner has several branches before him. The responses to the item determine which of several units he will be directed to attempt. The branching type of programme is found useful in learning problem-solving and various types of analytical abilities.

Need of linear programming

Linear programming is used for solving the following problems of education:

- The individual difference is the major problem of education. Every learner does not get opportunity to proceed according to his own abilities and rate of learning.

- In teaching and learning, main emphasis is given to presentation rather than doing. The students learn better by doing.

- There is no provision for diagnosing the weakness and difficulties of the learners, so that remedial instruction or teaching may be organised to remove learner's difficulties.
- The available textbooks do not provide any reinforcement to learners' behaviours or activities.
- Teaching strategies, textbooks, teaching aids do not provide any opportunity to check his responses immediately so that he could know how successfully he is learning.

In classroom teaching, a teacher tries to pace with the average students and he ignores the bright and poor students of the class. These problems of teaching-learning can be solved effectively by the use of programmed learning strategy. It incorporates the psychological principles of learning.

Role of the teacher in programmed instruction

The teacher occupies a significant position in the teaching-learning process. He is the pivot around which all the educational programme rotate. In this connection, George Temlison has rightly remarked that:

You can do without the ministry, you can do without the civil service. But if there are no teachers the world would be backing the barbarism in two generations.

The role of the teacher in the selection of programmed learning may be stated as under:

- Teacher as an advisor in helping students in the selection of programmed learning material.
- Teacher as a discussion leader for focusing the attention of the learners on important points.
- Teacher as a guide to clarify doubts and elaborate on various points asked by the learner.
- Teacher as an evaluator of the learning outcomes.
- Teacher as a consultant to the various agencies engaged in production of programmed material.

Programmed instruction in India

The concept of programmed instruction was introduced in India in December 1963 with the organisation of three days seminar on programmed instruction at Central Pedagogical Institute, Allahabad. In this seminars 25 educators of training colleges of the country participated. After that, several seminars were organised on programmed instruction in the training colleges of Punjab, Gujarat and Maharashtra. In 1965, NCERT organised a workshop at Psychological Foundation Department for a week to train 25 lecturers of training colleges. In 1966, NCERT organised a workshop on programmed instruction and 40 teachers of sciences, mathematics, statistics, geography, family planning and defence persons were participated. They had prepared programmed instruction material in their discipline. Most of programmed materials were designed on science and mathematics. Council had organised second workshop at Chandigarh. Some persons working in this area formed Indian Association of Programmed Learning (IAPL) during 1966. An annual conference is organised every year as a

new aspect of IAPL and Journal of Educational Technology is published by this organisation. Central Advanced Studies of Education (CASE) Baroda, Meerut University and H.P.University have also introduced a course on programmed instruction at B.Ed, M.Ed and M.Phil (Education) levels. By doing this, they are providing knowledge and skill of programmed instruction strategy. In these Universities, number of programmed instruction materials have been designed and evaluated on different school subjects.

Programmed instruction is still in its infancy in India. As regards to its classroom use, it may be observed that it is almost nil.NCERT has also done some work in this field. Inspite of all these efforts, it may be stated that the application of programmed instruction has not yet made an appreciable impact on our classroom teaching. Our methods of teaching still remain traditional, by and large.

Reveiw of related studies

Leslie and Angell (1964) made a comparative experimental study of programmed instruction and traditional classroom instruction. He found that the results obtained by programmed instruction were in no way inferior to those obtained by traditional methods of teaching. Fieldman (1965) conducted several studies using programmed instructional material and the textbooks used in traditional classroom. He found that his results were inclusive, because some studies showed no significant differences. Chibbar (1973) made a comparative experimental study of programmed instruction and traditional classroom instruction for teaching biology and found no significance between the two methods. Pandey, Abha Km.(1974) conducted an experimental study, which involved the application of two teaching methods. He found no significant difference between the methods. Das Rabindra (1984) conducted his Ph.D. study on "The development and tryout of self-instructional material on health education for high school student with special reference to communicable diseases" his main findings are (a) the self-instructional materials succeeded in enhancing the learning capacities of the student when self-administered by the students as well as administered under the supervision of the teacher, (b) The self-learning techniques were found superior to the other modes of learning, (c) A very proportion of students showed a favourable attitude towards the prepared self-instructional material. Chaudhury, M. (1985) made a study on preparation and evaluation of programmed learning material in geography for the secondary level. His main findings are (a) Students gained significantly in the knowledge of the subject by reading the programme, (b) The mean gains for the different institutions varied to a fair extent but all these gains were highly significant. Mehta, J.M.(1985) conducted a study on the construction of different types of programme in mathematics and the relative efficiency. He found that (a) The different types of learning programme were equally efficient compared to ordinary method, (b) The linearly prepared programme was found efficient, (c) The effect of learning through different programmes upon high achievers and low achievers was equal. Desai, R.M.(1986) conducted a

study on the effectiveness of programmed learning strategy in teaching of physics in the eleventh grade. He found that (a) Pupils took active interest in reading and teaching through programmed material. He found that (b) programmed learning material approach easy and interesting as each pupil had an opportunity to learn at his own speed and capacity.
(c) The programmed learning approach proved better than the lecture method in the study of physics. Kalacherry, K.A . (1987) conducted an experimental study on the preparation and tryout of programmed instructional material on the syllabus of chemistry prescribed for Class VIII in Maharashtra state. He found that,
(a) About 83 per cent learners were able to response correctly to 83 per cent of the frame,
(b) The value of measure of density for the whole programme was found to be 0.36. It was found that a few students who scored usually below 50 per cent in the traditional system, scored above 85 per cent through the use of programmed material. Debi, M. K. (1989) worked on Development and testing the effectiveness of PLM in the syllabus of principles of Education in B.T. course of Gauwhati University. He found that students taught through PLM performed better than students taught through traditional method. Ambli, S. (1992) studies the step, size, extrinsic, intrinsic reinforcement and overt-covert response transformation in reading materials and their interactions on learners' performance. The researcher found that step size was of significance only in the girls' sample with small step materials; girls learnt better but the response mode found to have significant impact both on boys and girls. Sahu, A.R. (2001) conducted his M.Phill study on Development of programmed Text in science for students of Class VII. He found that students taught through PLM performed better than students taught through traditional method.

Rationale of the study

As the world is progressing rapidly, the students' need to be given more knowledge in quick time, now-a-days classroom teaching is very much inadequate in India as it is evident everyday from newspapers, magazines etc. Very often parents also complain that nothing is taught in the school. This type of problem is due to the prevailing traditional method of teaching. In traditional teaching and learning, main emphasis is given for presentation rather than doing. But the students learn better by doing. Self-instructional material can solve this purpose the best. Considering above fact in mind, researcher wants to prepare a linear programmed instructional material in which the subject matter of the programme is presented by breaking into small steps in a logical sequence. The small steps stress the gradual nature of the increase in complexity and smoothness of the transition from one item to the next. Therefore, information grows in depth changes occur in quality and quantity and the individual may get mastery over as many subjects as he likes. So, the researcher is interested to develop a programmed instruction in life science for secondary school children to find out its effect on their achievement.

Objective of the study

- To develop a Programmed Instructional Material in life science for secondary school children.
- To study the effect of Programmed Instruction on achievement in life science.
- To compare the achievement in life science through programmed instruction and traditional approach.
- To analyse the effect of programmed instruction on achievement in life science with reference to sex.
- To study the interaction effect of the method of teaching and sex on achievement in life science.

Hypothesis

- There will be significant difference in the achievement in life science through programmed instruction and traditional approach.
- There will be no significant difference in the achievement in life science through programmed instruction and traditional approach.
- There will be significant difference between achievement in life science of boys and girls learning through programmed instruction.
- There will be no significant difference between achievement in life science of boys and girls learning through programmed instruction.
- There will be significant interaction effect of the method of teaching and sex on achievement of life science.
- There will be no significant interaction effect of the method of teaching and sex on achievement of life science.

Scope and delimitation of the study

As the present study is a pilot project, the study has been delimited to the following aspects:

- The programmed instructional material developed by the researcher is only meant for the children of Cuttack district only.
- Further due to the paucity of time and money, only one topic "The diseases due to over intake of food" will be taken for programmed instruction.
- The programmed material developed by the researcher will be linear in nature.
- The sample of the study consists of eighty students from two schools i.e., one for control group and another for experimental group.

Overview of the design

The design chosen in the present study was pre-test-post-test equivalent groups design. There were two groups, one control group and one experimental group. In this design, experimental and control groups were generally kept as identical as possible with the exception that experimental group exposed to the experimental treatment. Pre-test and post-test were proposed to be administered to both the groups.

Where,

O1 = Pre-test for control group.

O3 = Pre-test for experimental group.

T1 = Teaching through traditional method.

T2 = Treatment for experimental group i.e., teaching through programmed instruction.

Table 1: Design of the Study

Control Group			Experimental Group		
O1	T1	O2	O3	T2	O4

O2 = Post-test for control group.

O4 = Post-test for experimental group.

Sampling

Eighty number of Class IX students of Cuttack district had participated in this study. They were samples from two high schools and were assumed to be equal in all respect. The details of participants are listed below:

Table 2: Sample of the Study

Name of the Group	Control Group		Experimental Group	
Sex	Boys	Girls	Boys	Girls
No. of participants	20	20	20	20

Tools and techniques

- Programmed Instructional Material on the topic 'The diseases due to over intake of food' in Life Science for Class IX.
- Achievement test.

Procedure of the study

To assess the previous knowledge of the student in the topic 'the diseases due to over intake of food' , the pre-test was administered both on control group and experimental group. Then, their scores were recorded separately. After that, the topic 'The diseases due to over intake of food' was taught to the control group through traditional method. This topic was taught in three periods taking three consecutive days. Then, the prepared programmed instructional material on the same topic was given to the experimental group. It also took three periods in three consecutive days. When the subjects were provided with programmed instructional material, the teacher physically present in the class to clarify the doubts arose by the students. After teaching of the same topic to control group and experimental group with two different methods, a post-test was administered to both the groups. Then, their post-test scores were recorded separately. Then the pre-test and post-test performances of the subjects and also the post-test performances of the control group and experimental groups were fed to statistical treatment i.e., ANOVA to find out the effect of programmed instruction.

Results of the study

In the present study all the scores had been collected from 80 students of Class IX. Among these 80 students, 40 students constitute one group known as control group, it contains 20 boys and 20 girls and other 40 students constitute another group known as experimental group, it also contains 20 boys and 20 girls. All the pre-test and post-test scores of both control group and experimental groups were analysed and their mean and standard deviation were calculated. These are given in table 3. From

Table 3: Mean and Standard Deviation of Pre-test and Post-test Scores of both Control and Experimental Group

Name of Test		Pre-test			Post-test		
Name of Groups		Control Group	Exptl. Group	Combined	Control Group	Exptl. Group	Combined
Girls	M	2.5	12.8	12.65	22.4	31.45	26.92
	SD	3.05	2.67	3.19	5.95	4.05	6.81
	M	10.3	10.35	10.32	21.25	28.95	25.1
Boys	SD	2.78	2.67	2.72	3.86	3.58	6.36
	M	11.4	11.57	—	21.82	30.2	—
Combined	(B+G)	SD	3.12	3.25	—	5.05	4.03

Table 3, it is observed that pre-test mean score of control group and experimental groups are 11.4 and 11.57, respectively. It clearly indicates that the scores of both the groups are equal. It is also clearly observed that the standard deviation of pre-test mean score of control group and experimental groups are 3.12 and 3.25, respectively. It also indicates that there are similar scores in both the groups. Table 3 also indicates that the mean score of girls are slightly greater than the mean score of boys.

From the same table, it is clearly observed that during post-test the mean scores obtained for both the groups were higher than the corresponding pre-test mean score i.e., pre-test and post-test mean scores of control group are 11.4 and 21.82, respectively. It indicates that the traditional method had some effect on the achievement of life science. But, the pre-test and post-test mean scores of experimental group are 11.57 and 30.2, respectively, it indicates that the programmed instructional approach had some more positive effect on the achievement of life science than traditional method. The post-test mean score of control group and experimental groups are 21.82 and 30.2, respectively. This clearly indicates that programmed instruction was more effective than traditional approach on the achievement of life science.

Besides this the 2×2 (Equal cell) ANOVA techniques were used for testing the hypothesis. The summary of variance is given in Table 4.

- **Difference in the achievement through programmed instruction and traditional approach**

In terms of independent variable methods of teaching, there exists significance difference, F=66.95 (df=1, 76), where the tabulated value is 7.01 at 0.01 in the achievement of students as shown in Table 4. Students taught through programmed instruction performed significantly better than students taught through traditional approach. In Table 3 instructional material indicates higher mean marks than students taught through traditional approach as their mean scores are 30.2 and 21.82, respectively. The result is in accordance with the first hypothesis that there will be significance difference in the achievement in life science through programmed instruction and traditional approach.

Table 4: Summary of Analysis of Variable (ANOVA)

Sources of Variance	df	SS	MS	F	Significant/ not Significant
Method	1	1402.81	1402.81	66.95	.01
Sex	1	66.61	66.61	3.18	NS
Interaction	1	9.11	9.11	0.434	NS
Within	76	1592.45	20.45	-	-

Findings of present study have been in conformity with a substantial body of literature provided by other researchers. Leslie and Angell (1964) had reported programmed instructions were in no way inferior to those obtained by traditional methods of teaching. Debi, M.K.(1985) also reported that students taught through programmed learning material performed better than the students taught through traditional method. Similarly a number of findings of Fieldman (1965), Das Rabindra (1984), Mehta, J.M. (1985) had reported that programmed instructional approach is more effective than traditional approach in classroom situation.

So, the hypothesis, there is significant difference in the achievement in life science through programmed instructional material and traditional approach is accepted and the null hypothesis, there is no significant difference in the achievement in life science through programmed instructional material and traditional approach is rejected.

- **Difference among achievement of boys and girls**

In terms of independent variables sex, there exist no significant difference, F=3.18 (df=1, 76) in the achievement of boys and girls as shown in Table 4. From Table 3 girls have secured higher marks than the boys as their mean scores are 26.92 and 25.1, respectively. But this mean difference between girls and boys is negligible. The result is in accordance with the second hypothesis that there will be no significance difference exists in the achievement of life science between the boys and girls learning through programmed instructional material.

In this connection several studies had been conducted. Mehta, S.J. (1972) found in his study that the achievement of girls to be superior than boys in experimental as well as in control group. In contrary, Singh, B.P. (1972) reported that achievement of boys was higher than that of girls through the programmed learning performance.

Further, a study conducted by Ambli, S. (1992) found that there exists significance only in the girls sample. With small step materials girls learnt better but the response made was found to be significant impact both on boys and girls.

Thus, regarding the sex variables, no final conclusion can be drawn because results of the studies are inconsistent with regard to sex variable.

- **Interaction effect of the method of teaching and sex on achievement**

There is no significant interaction effect of methods of teaching and sex. The obtained value, F=0.434 (df=1, 76) indicates interaction effect is insignificant as shown in Table 4. From Table 3, students taught through traditional approach exceed very marginally in their achievement as the achievement scores of student, changes from the boys to the girls. Again from Table 3, it is clearly observed that students taught through programmed instruction exceed marginally from boys to the girls. It is evident that methods of teaching and sexes have no influence upon each other. Figure 1 shows the illustration of sex and methods of teaching effect on achievement.

Fig.1 Illustrates sex and methods of teaching effect on achievement, several studies had been

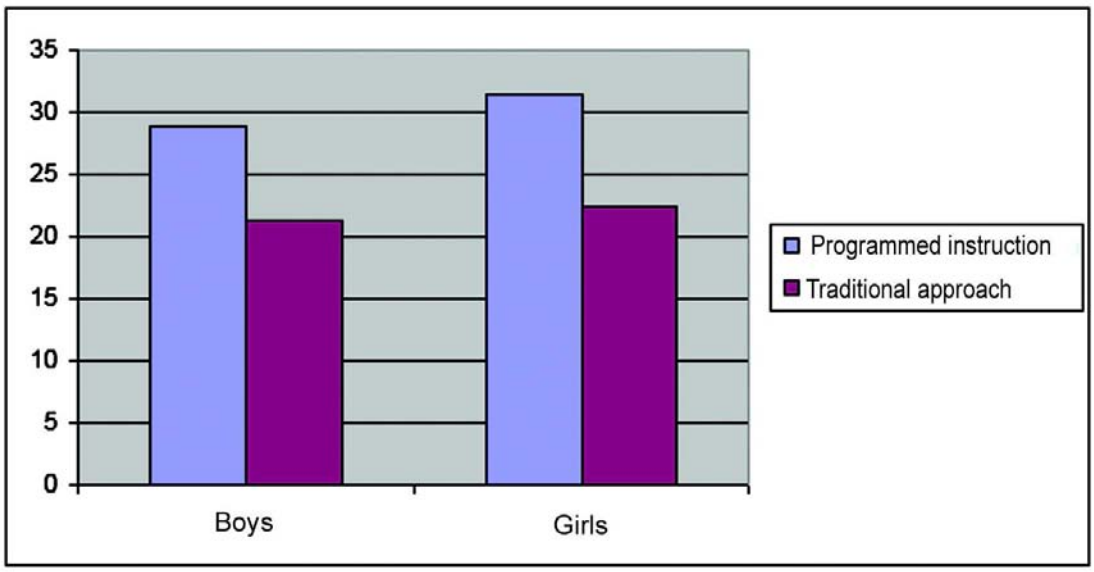

Fig.1 : Difference of achievement among boys and girls

conducted in this direction. Kkrumbottz, J.D. and Weilsman, R.G. (1964) had conducted a study in this direction and found that interaction effect was not significant.

Educational implications

The present study offers a number of implications.

- At elementary level, there is an urgent need to prepare textbooks on linear model. Because, generally there single teacher required to teach all subjects. This strategy will be very helpful to them. It may raise the academic standard of primary education.
- At secondary level, the major feature is the diversified curriculum; the teacher may be assigned a subject other than his interest. The diversity of interest and curriculum necessitates the application of self-instructional strategies. It may be used on remedial teaching. The classroom teaching may be followed by this strategy.
- The implication of programmed instructional approach in correspondence education is beyond imagination. Because it is now necessary to realise that the self-instruction could be made possible if the correspondence lessons are programmed. Again, a large number of school teachers feel frustrated when new courses are introduced in the curriculum, the programmed learning text will equip them with new content and new method of teaching. Further till now,

fifteen Universities have been introduced correspondence education at graduate level and post graduate level. In this context programmed lessons should be brought at par of the regular students and by doing so standard of higher education can be maintained by them.

- The implication of programmed instructional material for language teacher is also beyond consideration. With the present methods of teaching language the task seems to be insurmountable. The programmed material for language learning will be presented in a book format for which it will achieve the objectives of language teaching.
- It may also be noted that science and mathematics are growing rapidly that is becoming harder and harder for school teachers to keep pace with the change. In this regard, the programmed instructional material should develop on new topics which will be helpful to equip themselves with latest content and they will be able to keep pace with time.
- Implication of programmed instructional material in medical and health education is also unbelievable. To cope with the rapid advancement in the field of medical education programmed instructional material may be used by the doctors and medical colleges.
- The strategy of programmed instructional material will also be helpful to solve the problems like, population growth, information growth, demand for higher education and further education, teacher shortage, demand of competent teachers and existing limitations and resources.

Besides all these, there is no significance difference existing between boys and girls in learning programmed instructional material, so programmed instructional material can widely used in the above area irrespective of sex, which is an important variable in learning situation.

Thus, the results of the present study expected to throw light in the field of education and accordingly inspire teachers, educationists and other researchers to build up bright academic accomplishment.

Suggestions for future research

The present investigation identified several ways of possible exploration and numbers of important findings have been reported in the present study.

However, in view of inevitable limitations and constraint of this study following directions are suggested for future research:

- Development of programmed text in branching style and tests its efficacy over traditional approach.
- Development of programmed text in any subjects other than life science and tests its efficacy over traditional approach.
- The present study has been tried out in limited area and sample. So it is recommended to try out in large sample and in different areas of the state for its validation.

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