RESEARCH PAPER

THE USE OF INSTRUCTIONAL DESIGN IN EDUCATIONAL TECHNOLOGY FOR EFFECTIVE TEACHING AND LEARNING

By

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ABSTRACT

Educationists are of the opinion that the educational problems relating to quantity and quality could be tackled by the proper utilization of instructional technology. Instructional technology is a systematic way of designing, carrying out and evaluating the teaching learning process. Instructional technology makes instruction more effective, understandable and meaningful. All types of resources are used to make the learning easy. Traditional teacher-centred approach in the classroom has been shifted from teaching to learning. It is called student centred or resource-based approach, the student being the resource. Learning through hearing alone proves to be the least effective means of learning. One learns 11% by hearing as against 83% percent by seeing. As for as retention of hearing is concerned, learning through hearing again stands at the lowest ebb because after three days, we recall only 10% of what we learn through hearing as against 50% of what we learn through both hearing and seeing, and 90% of what we acquire by applying three of our senses i.e. seeing, hearing and doing. The major objectives of the study were, (i) to find the relative effectiveness of instructional technology in teaching biology at secondary level to students of experimental group and control group and (ii) to see the difference of treatment effects between the students of low achievers and high achievers category (iii) to see the difference of treatment effects between the students of the control and experimental groups on the variable of retention. The study is significant because findings identified the effectiveness of instructional technology and weakness of traditional approach at secondary level in teaching biology. The researcher selected the students of 10th class of the Federal government Girls Secondary School No.6 and two groups (experimental and control) were randomly secured from total available group. The equivalence of the groups was determined by equating the students of both groups on the pre-test scores. Four chapters of biology were taught during the experiment of both experimental and control groups by two different teachers almost of the same qualification and experience and were intended to measure the outcomes of learning. The post-test was administered to both groups after twelve weeks. The retention test was administered after twelve weeks of the post-test. In order to secure data, pre-test and retention rest were administered as research instrument. Data were tabulated, analyzed and interpreted in the light of objectives of the study. In order to see the significance of the results, the t-test was applied. The analysis revealed that the application of instructional technology as supplementary strategy in teaching biology was more effective because the use of instructional technology increased interest and enhanced motivation levels. Instructional technology as supplementary strategy was also found to be equally effective for low achievers and high achievers. On the basis of findings, researcher provided workable suggestions/recommendations for enhancing the effective learning of students of biology at secondary level.

INTRODUCTION

At the beginning of last century, children were taught in a rigidly formal and stereotyped way. Education was then conceived as a process of transmission of factual knowledge only. The teacher adopted an authoritarian attitude. The facts learnt by children were tested time to time but such tests were neither concerned with conceptual understanding nor effective performance. The main emphasis was on testing memory. A long time intervened between the child's response and the teacher's reinforcement. The teacher very often used the lecture method, which was not much effective for meaningful learning. The teacher did not use other visual material to supplement his/her oral teaching.

In the present context, teacher does not consider the child as a vessel waiting to be filled up with facts nor as a pliable plastic material, which can be transformed into any shape enabling him/her to project his/her ideas on it. The modern teacher considers each child as akin to a plant and helps the child to grow according to its abilities and aptitudes. He/She helps the children to learn. The modern teacher sees education as a process of interaction between the child and his environment. Children learn by doing and learn how to learn in groups and also individually.

Increase in population and explosion of knowledge are affecting the pattern of human life and also inflicting its full impact on education. The explosion of population and knowledge has raised the serious question of both quantity and quality of education. Educationists are of the opinion that the educational problems relating to the quantity and quality could be tackled by applying systematic approach of instructional technology. Therefore, there has been a rapid development of communication technology in education at all levels with a purpose of extending educational facilities and upgrading instructions. Instructional technology is a field made up of elements of other fields. There is very little content, which is unique. It has taken elements of cognitive psychology, perception psychology, measurement, evaluation, communication, management, media and systems engineering. These elements are arranged synergistically to a point where the whole is greater than sum of its parts. The field has rapidly evolved from audiovisual education through educational communications to instructional technology. There is overlapping of ideas mainly between three terminologies viz, educational technology, instructional technology and communication technology.

The dream of a civilised and developed society remains unfulfilled without providing the necessary means for every individual to be educated (Pantano, Rokou & Rokos, 2004). Till the onset of the last century, a rigidly formal and stereotyped way was used to impart education. Most of the attention was directed towards disseminating the factual knowledge with virtually no scope for imagination. The class was more like a fiefdom with a ruthless commander at the helm of the affairs who wanted his subjects i.e. the students to learn everything through their memory. Intelligence was gauged through the yardstick of recollection of the facts as inculcated by the teacher.

Educationists are of the opinion that the educational problems relating to the quantity and quality could be tackled by applying systematic approach of instructional technology. This opinion collaborates with the ongoing stream of the instructional/educational technology that makes use of the hitherto unheard methods and tools of instruction e.g. the use of information technology, pictures, specimen and demonstration (Mahapatra, 2005).

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These elements are arranged synergistically to a point where the whole is greater than sum of its parts. The field has rapidly evolved from audiovisual education through educational communications to instructional technology. There is overlapping of ideas mainly between three terminologies viz, educational technology, instructional technology and communication technology. Price and Oliver (2007) remark:

"The rapid growth of computing, networks and infrastructure offers not only an increase in available technologies for learning, but also a change in its potential use in education".

Though the term instructional technology is often used interchangeably with educational technology, it presents certain refinements that are not found in the meanings of educational technology. Gentry (1991) describes instructional technology as "the systemic and systematic application of strategies and techniques derived from behaviour and physical science's concepts and other knowledge to the solution of instructional problems". Instructional technology makes an ordinary person capable of performing in a better way by making good use of the printed or electronic material (Venkataiah

1996).

It is quite natural to use instructional technology to teach and learn science in this modern age (Laine, 2003). Before the advent of the instructional technology, science was taught in an authoritarian manner as a 'dogma' of facts, principles and laws that were learnt by heart and were then reproduced during the final assessment. Such a form of training meant that the children did not do any experiments to fully understand the implications inherent in the theoretical lessons. Therefore, there was no use of the laboratory because much of the time was consumed in lecturing.

When a child is helped or guided to discover a generalization imposed upon him/her, he/she is developing his rationale powers, gaining an understanding of content and the process learning. Authoritarian teaching consists of imposing upon the pupils the generalization which are truly their own. Children who learn science by the discovery approach will discover for themselves the true structure of the discipline in complete harmony with modern philosophy of science education.

The teaching method, which is traditionally used, for teaching biology in secondary schools of Pakistan is a combination of lecture method, textbook recitation method and to some extent chalkboard is used. The lecture method is a teaching procedure with one way channel or communication. The instructor makes an oral presentation of information to which student's role is passive. The student is never put into the situation from where he can move to logical reasoning and critical thinking that reduces their learning process.

Instructional technology can enhance learning process. Instructional technology is made up of the things of learning, the devices and the materials, which are used in the process of learning and teaching. Instructional technology emphasizes the interaction between student and his environment, which is the basic requirement of biology syllabus. The teaching of biology is very important because the knowledge of biology helps in improving the quality of life; biology covers all aspects of life, so it goes without saying that biology should be taught in order to succeed in life; Knowledge of biology helps in solving many social problems relating to health, poverty, food shortage and crop production and environmental conservation.

Objectives

The objectives of the study are:

1. To find out the relative effectiveness of instructional technology on the students of experimental group and control group.
2. To see the difference of treatment effects between the students of the control group and experimental group.
3. To find out the difference on pre test, post test and retention test of the control group.
4. To find out the difference on pre test, post test and retention test of the experimental group.

Research Methodology

The study was experimental in nature and used a pre-test post-test single group experimental design.

Population and sampling

Population of the study included those students studying Biology subject at secondary level. As a sample, eighty students of 10^{th} class of the F G Girls Secondary School Islamabad, were selected as sample of the study. Sample students were divided into two groups i.e. control group and experimental group. Both the groups were equated on the basis of their pre-test scores in the selected part of biology. Each group comprised of 40 students.

Contents of the study

Pre-test, post-test and retention tests were developed in order to gauge the performance of the students before and after the treatment. The t-test and ANOVA were used to compare the means of the results of pre-test and the post-test in order to find out whether there was a difference in achievement due to the treatment. The test comprised of 50 items and each item was allocated 1 mark weightage.

Great care had to be taken in the selection of the course

content for the study because it might have had an adverse effect on the end-term performance of the students. This was perhaps the most important ethical issue of this study.

Treatment

Discovery approach combined with discussion was used for teaching both control and experimental groups. In addition, the instructional technology was used as supplementary strategy for experimental group. Lessons of relevant topics were planned according to the type of learning resources. These planned lessons were prepared by the consultation of experts of biology subjects at secondary level. Recorded movies on relevant topics were used to present questions and elicit answers. Students' activities ranged from very passive, as in viewing films to very active as in making field trips to observe and study actual things. Passivity versus activity varied exceedingly according to kind of resource and the purpose in using it as used transparencies during lesson. Duration of films was about 10 minutes and was used in the beginning of lesson, which motivated students to take part in discussion about relevant topic. During this period of forty minutes, teacher engaged the students in the process of problem solving and rational thinking under various degrees of teacher's supervision. Teacher's role was to guide the classroom discussion. Teacher emphasised the development of self-initiated and self-directed pupil learning which placed the students in the role of the inquirer.

Findings:

Hypothesis 1: There is no significant difference between the performance of control and experimental group on pre- test

Table 1 indicates that there is no significant difference between the mean scores of both the groups. Hence, the null hypothesis "There is no significant difference between the performance of control and experimental group" on pre-test is accepted therefore, both the groups could be treated as equal on the variable of pre test scores in biology. Figure 1 shows the mean plots of control and experimental group on pretest.

Groups	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Control	40	40.8000	2.86625	.45319	0.077	0.939
Experimental	40	40.7500	2.91548	.46098		

Table 1. The difference between the mean scores on pre test of control and experimental groups

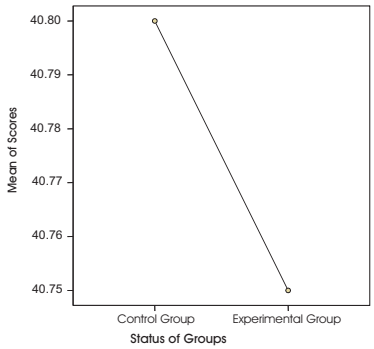

Figure 1. The mean plots of control and experimental group on pre test.

Hypothesis 2: There is no significant difference between the performance of the control and experimental groups on post test

It is apparent from Table 2 that there is a significant difference between the scores of both the groups. The experimental group is significantly better than control group, so the null hypothesis "There is no significant difference between the performance of the control and experimental groups on post test" is rejected and it is concluded that the experimental group is significantly better.

Many studies have shown that the use of audiovisual material promotes learning particularly with respect to factual learning. It was found that film group marked 10 percent and 35 percent increase of knowledge than non film groups. Rulton says that ninth grade science students scored 14.8 percent to 24.1 percent higher than control group, who were not given the advantage of film materials (Kinder, 1959). Figure 2 shows the mean plots of control and experimental groups on post test.

Groups	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Control	40	73.1000	3.12804	.49459		
Experimental	40	88.1500	5.57260	.88111	14.895	0.000

Table 2. The Difference between the mean scores on post test of control and experimental groups

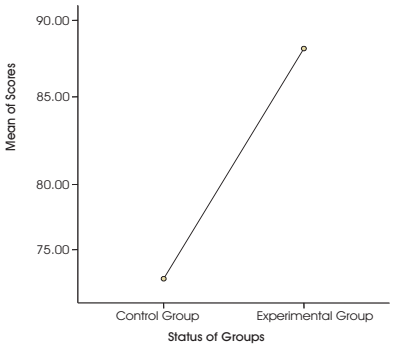

Figure 2. The mean plots of control and experimental groups on post test

Hypothesis 3: There is no significant difference between the scores of pre and post tests of control group

Table 3 shows that there is a significant difference between the pre and post tests of control group, so the null hypothesis "There is no significant difference between the scores of pre and post tests of control group" is rejected and it is concluded that control group performed significantly better on post test.

Hypothesis 4: There is no significant difference between the scores of pre and post tests of experimental group

Table.4 shows that there is a significant difference between the pre and post tests of experimental group, so the null hypothesis "There is no significant difference between the scores of pre and post tests of experimental group" is rejected and it is concluded that experimental group performed significantly better on post test.

Hypothesis 5: There is no significant difference between the performance of the control and experimental groups on retention test

It is apparent from Table 5 that there is a significant difference between the scores of both the groups. The

Test	Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Pre Test	40.8000	40	2.86625	.45319	158.972	0.000
Post Test	73.1000	40	3.12804	.49459		

Table 3. The scores of pre and post tests of control group

	Mean	N	Std. Deviation	Std. Error Mean	t-value	p-value
Pre Test	40.7500	40	2.91548	.46098	99.843	0.000
Post Test	88.1500	40	5.57260	.88111		

Table 4. The scores of pre and post tests of experimental group

Status of Group	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Control Group	40	57.9750	2.88664	.45642	27.706	0.000
Experimental Group	40	84.6500	5.36154	.84773		

Table 5. The scores of retention test of both the groups

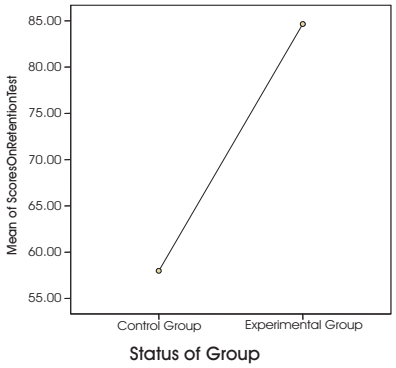

Figure 3. The mean plots of control and experimental groups on retention test

experimental group is significantly better than control group, so the null hypothesis "There is no significant difference between the performance of the control and experimental groups on retention test" is rejected and it is concluded that the experimental group is significantly better. Figure 3 shows the mean plots of control and experimental groups on retention test.

Hypothesis 6: There is no significant difference among the scores of pre, post and retention tests of control group

Table 6 reveals that there is a significant difference on control group among various tests.

It is evident from Table 7 that the scores of post test are significantly better than pre test, post test are significantly better then retention test and retention test is significantly

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20893.817	2	10446.908	1190.183	.000
Within Groups	1026.975	117	8.778		
Total	21920.792	119			

Table 6. ANOVA on pre, post and retention tests of control group

S.No	Pairs	Mean difference	p-value
1	Post test vs Pre test	32.30	.000
2	Post test vs Retention test	15.125	.000
3	Retention test vs Pre test	17.175	.000

Table 7. The multiple comparisons of scores of control group

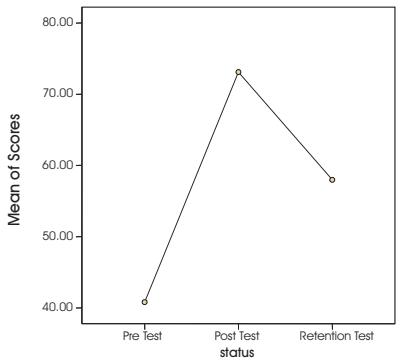

Figure 4. The mean plots of scores of control group on pre, post and retention tests

better than pre test. It can be concluded that control group performed significantly better on post test, and significantly lower on pre test. Figure 4 shows the mean plots of scores of control group on pre, post and retention test.

Hypothesis 7: There is no significant difference among the scores of pre, post and retention tests of experimental group

Table 8 reveals, that there is a significant difference on

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	55816.267	2	27908.133	1225.833	.000
Within Groups	2663.700	117	22.767		
Total	58479.967	119			

Table 8. ANOVA on pre, post and retention tests of experimental group

S.No	Pairs	Mean Difference	p-value
1	Post test vs Pre test	47.400000	0.000
2	Post test vs Retention test	3.500000	0.000
3	Retention vs Pre test	43.900000	0.000

Table 9. The multiple comparisons of scores of experimental group

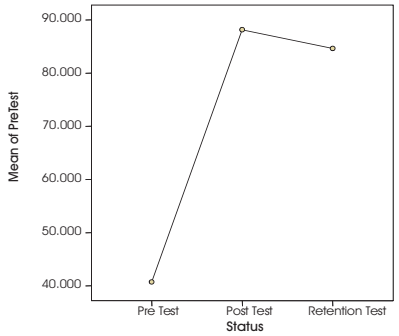

Figure 5. The mean plots of scores of experimental group on pre, post and retention tests

experimental group among various tests.

It is evident from Table 9 that the scores of post test are significantly better than pre test, post test are significantly better than retention test, and retention test is significantly better than pre test. It can be concluded that experimental group performed significantly better on post test, and significantly lower on pre test. Figure 5 shows the mean plots of scores of experimental group on pre, post and retention test.

Discussion

Both the groups control and experimental were compared on the variable of pre test score. The results obtained from the statistical analysis showed that no significant difference existed between the two groups regarding pre test scores in biology as the t-value obtained was not statistically significant at 0.05 level (Table1). Therefore, the null hypothesis, " There is no significant difference between the performance of control group and experimental group on pre test" was accepted and both the groups could be treated as equal.

The performance of the experimental group was significantly different from that of the control group on post test. The difference between the two means was statistically significant at 0.05 level (Table 2). Thus the null hypothesis " There is no significant difference between the performance of the control and experimental groups on post test" was rejected at 0.05 level and it is concluded that experimental group is significantly better than control group.

The performance of the control group on pre test and post test was compared and it was found that the performance of control group was significantly better in post test than pre test. The difference between the two means was statistically significant at 0.05 level (Table 3). Thus the null hypothesis " There is no significant difference between the performance of the control group on pre test and post test" was rejected at 0.05 level and it is concluded that control group is significantly better at post test than pre test.

The performance of the experimental group on pre test

and post test was compared and it was found that the performance of experimental group was significantly better in post test than pre test. The difference between the two means was statistically significant at 0.05 level (Table 4). Thus the null hypothesis " There is no significant difference between the performance of the experimental group on pre test and post test" was rejected at 0.05 level and it is concluded that experimental group is significantly better at post test than pre test.

Both the groups control and experimental were compared on the variable of retention test score. The results obtained from the statistical analysis showed that significant difference existed between the two groups regarding retention test scores in biology as the t-value obtained was statistically significant at 0.05 level (Table 5). Therefore, the null hypothesis, " There is no significant difference between the performance of control group and experimental group on retention test" was rejected at 0.05 level and it is concluded that experimental group is significantly better at retention test.

ANOVA is applied on the variable of scores in pre, post and retention test to compare control group. The results obtained from the statistical analysis showed that significant difference existed on the scores of three tests as the F value obtained was statistically significant at 0.05 level (Table 6&7). Therefore the null hypothesis "There is no significant difference among the scores of pre, post and retention tests of control group" was rejected at 0.05 level, and it is concluded that post test is significantly better than pre test and retention test, retention test is significantly better than pre test, so post test is significantly better and pre test is significantly lower among the groups.

Applying the ANOVA on the variable of scores in pre, post and retention test, the experimental group has been compared. The results obtained from the statistical analysis showed that significant difference existed on the scores of three tests as the F value obtained was statistically significant at 0.05 level (Table 8 & 9). Therefore the null hypothesis "There is no significant difference among the scores of pre, post and retention tests of experimental group" was rejected at 0.05 level, and it is concluded that post test is significantly better than pre test and retention test, retention test is significantly better than pre test, so post test is significantly better and pre test is significantly lower among the groups.

Conclusion

The application of instructional technology as supplementary strategy in teaching of biology was found to be more effective because the instructional technology increased and enhanced the motivation level of the students.

During the treatment, the students of the experimental group were found to be more attentive because the concepts were explained with the help of concrete examples and instructional technology played a significant role in teaching - learning process.

Instructional technology as supplementary strategy was found to be more effective as compared to traditional teaching regarding retention of learning. Retention of the students of experimental group was found to be significantly better than that of the students of control group.

Both the groups had significant difference between the scores of post test and pre test as well as between the retention test and pre test, but there is no significant difference between the scores of retention test and post test.

Recommendations

In the light of findings revealed and conclusions drawn from the study, the following recommendations are made:

1. Since the use of instructional technology proved to have significant positive effect on the achievement of students, the teachers have to be provided proper training on the use of instructional technology and be motivated to use it in the classroom regularly.
2. The head of the institutions must regularly arrange field trips and ensure the provision of films so that the students may be able to study nature very closely and in original manner.
3. Since the video films were not available according to

needs of teaching units, video films were prepared by the institutes. So the institutes of instructional technology can be approached for the production of video films for other units of biology at secondary level.

References

[1]. **Gentry, C.G. (1991).** Educational technology: A question of meaning. In G.J. Anglin (Ed.), Instructional *Technology: Past, Present, and Future* (pp. 1-10). Englewood, CO: Libraries Unlimited

[2]. **Laine, P. (2003).** Use of instructional technology as an integral part of a non-major science laboratory course: A new design. *The Journal of Interactive Online Learning,* 1 (4), Retrieved January 2, 2008 from http://www.ncolr.org/jiol/ Issues/ getfile.cfm? VolID=1& IssueID=5&ArticleID=46.

[3]. **Mahapatra, B.C. (2005).** *Information Technology and Education*. New Delhi: Sarup.

[4]. **Pantano Rokou, F., Rokou, E., & Rokos, Y. (2004).** Modeling web-based educational systems: Process design teaching model. *Educational Technology & Society,* 7 (1), 42-50.

[5]. **Venkataiah,N.(1996).** Educational Technology, APH Publishing Corporation. New Delhi.pp.9-338.

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