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"Effect of Using Lab Rotation Method (LRM) on the Academic Achievement of Grade IX Students in the Subject of Physics"

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Lab Rotation Method (LRM), Blended Learning (BL), Academic Achievement

ABSTRACT

The study was conducted to empirically verify the effect of using Lab Rotation Method on the academic achievement of the students, at Grade IX, in Physics. Lab Rotation Method is basically one of the sub-models of Blended Learning. We conducted a quantitative study on True- Experimental Design. The Randomized Pre-test-Post-test Control Group Design was used. The research tools were Pre-test and Post-test, designed with Proper Tables of Specification (TOS). Validity and reliability of the tools were ensured. The population of the study was all the male students at Secondary level, in Public Sector Schools of District Chakwal, in Province of Punjab. We selected a sample of 40 students and matched them in pairs on the scores of Pre-test, followed by their random assignment, to Control and Experimental Groups. The intervention was the use of OERs, on educational Apps "Prep by PGC", "Taleem Ghar" and "e-Learn. Punjab", through Lab Rotation Method. Inferential Statistics were applied to achieve the objectives of the study. The findings of the study highlighted the positive effect of Lab Rotation Method on the academic achievement of the students, with better score then Traditional Method. On the basis of findings, it is suggested that Lab Rotation Method (LRM) may be used in all Public Schools, to use OERs, for teaching at Secondary Level, to cope with the challenges of shortage of Subject Specialist Staff, unavailability of Science Labs and to train the students to use such OERs at home for compensating the loss of study, in school closure days.

INTRODUTION

Public Sector Schools, at Secondary level education, face certain major problems i.e. shortage of subject specialist teachers for Science and English (Arain, Khatoon & Samson, 2021), missing or non- functional science laboratories for practical (Shahzadi, Hassan, & Zahid, 2023), less number of schools to cater more number of students (Arain, et al. , 2021) and least focus on formative assessment (Anila, Mahmood, & Ullah, 2022); (Shehzadi & Afridi, 2021). Resultantly, low academic achievement is observed, at this crucial stage which is the terminating stage for most of the students in developing countries like Pakistan.

In view of the above mentioned situation, the present research focused on the use of Lab Rotation Method (LRM), to utilize Open Educational Resources (OERs) as one possible solution for Public sector schools as the use of OERs is also recommended by UNESCO as Future of Education in 21st Century (Lima & Biazi, 2022).

Even though, well-equipped ICT labs are available in most of the Public Secondary Schools, yet the use of these ICT labs is limited to meet practicals for the subject of Computer only. Ironically, the objective use of these ICT labs, for learning of the subjects other than Computer, to enhance academic achievement, by using Open Educational Resources (OER), through Lab Rotation Method (LRM) of Blended Learning (BL), couldn't be focused till date. Lab Rotation Method (LRM) can be an appropriate solution to cater the problems of Public secondary Schools as cited in preceding paragraphs.

LITERATURE REVIEW

International Commission on Future of Education by United Nations (UN) recommends ensuring the availability of Open Educational Resources (OER), technologies and digital tools for learners and teachers, by promoting Blended Learning as future of education, across the globe (UNESCO, 2020). But developing countries are yet unable even to utilize the OERs, Apps and online educational infrastructure, already available for online and Blended Learning for schools (Akram, 2021).

The scenario cited above highlights that promoting the use of technology, in online and Blended learning, as an effective learning strategy, has become indispensible, for better academic achievement in 21st century (Dangwal, 2017). But, it can only be implemented if use of technology for learning, either in distant learning or using on line learning resources as add-on to physical classroom in Blended Learning environment, is studied through empirical and evidence based research (Xu, 2023).

Blended-Learning programs comprise one or combining from following four models: i) Rotation, ii) Flex, iii) A La Carte and iv) Enriched Virtual.

Rotation Model has further four sub-models or methods:

a) Station Rotation, b) Lab Rotation, c) Flip Classroom d) Individual Rotation. (Banyen, 2016)

Our focus in present study is only Lab Rotation Method (LRM), one of the four sub-type of The Rotation model. The idea behind Lab Rotation Method of Blended Learning is that learners initially participate in offline activities, in the traditional brick-and-mortar classroom setting. Later on, they are moved/ rotated to online activities/ use of OERs (Videos, Animations, Simulations, Apps and educational websites etc.) in the computer lab of the school (Syarif, 2020).

Learning needs the theories to describe learning principles and processes, reflecting the underlying social environments. Behaviorism (Yusra, Neviyarni, & Erianjoni, 2022), Cognitivism (Malik, 2021) and Constructivism (Al-

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Shammari, Faulkner & Forlin, 2019) are the three main learning theories (Muhajirah, 2020), most often utilized in the creation of instructional environments. These theories, however, were developed in a time when learning was not impacted through technology. Over more than the last twenty years, technology has reorganized how we live, how we communicate and how we learn (Corbett & Spinello, 2020).

The way people work and interact is altered when new tools are utilized (Baidoo & Ansah, 2023). The field of education has been slow to recognize and reorganize for both the impact of new learning tools and the environmental changes, indispensible as effective means for learning (Cai, Wang & Liang, 2021). Ultimately, Connectivism Learning Theory by George Siemen and Stephen Downes gradually emerged as future of education, to cater the needs of content, classroom, teacher and learner of Education 4.0, in digital era of 21st Century (Downes, 2012); (Corbett & Spinello, 2020).

The term 'Connectivism' was coined by George Siemens, to describe learning networks which was later on formally propounded as an educational theory by Stephen Downes in his book "Connectivism and Connective Knowledge" (Siemens, Rudolph & Tan, 2020). Connectivism addresses three key areas i.e. knowledge, learning and community (Baque, Cevallos, Natasha & Lino, 2020).

Adiwisastra (2020) conducted a survey study to see students' perceptions at lower secondary level, to implement the Lab Rotation Method. The results of research showed a positive response with a value of 65% Agree by the students. It revealed that perceptions of learning using the Lab Rotation Method provided motivation to students for studies (Adiwisastra, 2020).

Zulraudah (2019) analyzed the needs of Grade VII students for Lab Rotation Method to improve writing skills in English. He found Lab Rotation Method (LRM) as most influential to support the learning process and to produce good results. The results of the need analysis showed 80% students in need of innovative learning methods, using computers or other technology tools (Zulraudah, 2019).

Sandra, Razi, Jonuarti, & Sari (2022) studied the use of Lab Rotation for Physics in Senior High School as a solution to cope with the challenges of Education 4.0. Using ADDIE (Analysis, Design, Development, Implementation and Evaluation) model, the researchers validated the Lab Rotation Method (LRM) for Physics, through the available variety of OERs in form of learning instructions and materials, competencies, supporting information, worksheets, exercises and evaluations. They found the usefulness of technology-based learning resources, in the teaching and learning process, to increase students' independence and literacy. It can be an answer to the challenges of industrial revolution 4.0 (Sandra, Razi, Jonuarti & Sari, 2022).

Krasnova & Shurygin (2020) studied the use LRM for the professional development of Physics teachers through a survey research. The use of MOODLE (Modular Object-Oriented Dynamic Learning Environment), to enable the teachers for teaching Physics through different methods and to improve his/her general competence of using OERs in classroom, was found useful for the teachers' professional development (Krasnova & Shurygin, 2020).

To improve Critical Thinking of Students, the Impact of STEM Education Approach for High School Physics, was studied by Ardianti et al. (2020). They used certain apps from Google Play Store for Blended Learning. Their findings endorsed the technology to promote improvement in learning performance of students, not only in

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urban but in rural areas also (Ardianti, Sulisworo, Pramudya & Raharjo, 2020).

Syafril et al., (2021) highlighted the significance of combining networks and technology, for assisting the students, in Physics learning. They concluded with the need of combining technology with face to face learning. They further highlighted the need of teacher training for such teaching during routine and unusual schools closure like pandemic of COVID-19 (Syafril, Latifah, Engkizar, Damri, Asril & Yaumas, 2021).

The researcher found the gap in available literature on Lab Rotation Method (LRM) of Blended Learning (BL) as very few studies and material on implementation of Lab Rotation Method (LRM) in classroom were found. With different key words, specifically, the theme of the "Effect of Lab Rotation Method on achievement score of the students", was also searched on different major search engines i.e. Google, Google Scholar, Springer, Academic Search Elite (EBSCO), ERIC(ProQuest), MEDLINE(Ovid), PsycINFO (ProQuest) and SPORTDiscuss etc. Ironically, very few studies were found on implementation and effects of Lab Rotation Method (LRM) specifically, in contrast to a bulk of literature on defining Blended Learning (BL) and its all model generically. Same gap is highlighted by systematic reviews by Adiwisastra et al., (2020) and Ashraf et al. (2021) on BL. Comparatively, Rotation Model was studied as a whole, with few studies specifying Station Rotation (Ayob, 2020).

We can also conclude from our literature review that the challenges of 21st century demand quality education which is now only possible with Blended Learning (BL), by using latest technologies, for combination of face to face and online learning (Iyer, 2021). In developing countries like Pakistan, mostly stakeholders in education are reluctant to switch from traditional physical classroom to Online learning either Distant or Blended, for different concerns (Khan, 2019). However present study is aimed to examine the relationship of using Lab Rotation Method (LRM), not only to remove such concerns but also to improve academic achievement at Secondary level in Public sector schools, by using the infrastructure of IT labs, Multimedia, laptop, tablet and PCs, already available in Public Sector schools.

RESEARCH OBJECTIVES

Present study has following objectives for conducting the research:

i) To examine the effect of using Lab Rotation Method on the academic achievement of Grade IX students, in the subject of Physics.

ii) To compare the academic achievement of students taught by traditional method and Lab Rotation Method, in the subject of Physics at Grade IX.

HYPOTHESES

Ho.1. There is no significant difference in academic achievement level of the students, taught by Lab Rotation Method (LRM) and traditional Method, in the subject of Physics at Grade IX.

Ho.2. There is no significant difference in the pretest and posttest of academic achievement level of the students, taught by Traditional Method and Lab Rotation Method, in the subject of Physics at Grade IX.

METHODOLOGY

The study is quantitative in nature. The Randomized Pre-test-Post-test Control Group Design (using Matched Subjects) of

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True- Experimental Research Design was used.

This design uses two groups of subjects, with both groups being measured or observed twice. The first measurement serves as the Pre-test, the second as the Post-test. The study participants were randomly assigned to the treatment and the control group after the Pre-test. Both groups were initially taught with in same conditions i.e. traditional lecture method. Later on after the Pre-test, the treatment group received the intervention, whereas the control group did not. The outcome was measured simultaneously for both groups at 2 points in time — the Pre-test and the Post-test.

All the male students at Secondary level, in Public Sector Schools of District Chakwal, in Province of Punjab, were population of the study. The number of this population was 16229, as per Government of Punjab official portal (SIS.Punjab), studying in total 1141 schools including both Secondary and Higher Secondary level schools (SIS, 2023).

As a sample, total 40 students of Grade IX, Science group, from Government High School Dhaular (EMIS Code 37420022), a school located in rural area of District Chakwal, was selected. Random Assignment for experimental group and control group was made, in the light of scores, obtained from Pre-test.

During the six weeks experiment, the teacher divided the students in groups, for rotation from classroom to computer lab, on a set timetable. This method enabled schools to utilize already-existing computer labs and permit flexible scheduling.

The research instrument for data collection was the score of achievement tests, in the subject of Physics of Grade IX, on Pre-test (T1) and Post-test (T2), both designed according to proper table of specifications (TOS), for specified content. The Pre-test (T1) covered first two Chapters of Physics Grade IX, already taught to whole sample of 40 students before their random assignment to experimental and control groups.

Both Pre-test and Post-test were designed on the pattern of study scheme, given by Board of Intermediate and Secondary Education, Rawalpindi. 12 MCQs, 15 short questions, 02 long questions and 02 numerical, were designed, separately for Pre-test and Post-test to assess their level of Knowledge, Comprehension and Application, according to Bloom Taxonomy, in the subject of Physics of Grade IX. The Post-test (T2) covered Chapter 3 and 4 of Physics of Grade IX, on same pattern.

ITEM ANALYSIS

Table 1

Item wise Difficulty Index (p- value) and Discrimination Index (D-value)

Item Number	H/L	A	B	C	D	Not Attempt	Difficulty Index (DIF)	Discrimination Index (DI)
1	H	2	16	3	4	0	0.4	0.48
	L	6	4	10	5	0		
2	H	2	3	17	3	0	0.44	0.48
	L	3	10	5	7	0		
3	H	16	4	2	3	0	0.44	0.4
	L	6	7	8	4	0		
4	H	3	18	2	2	0	0.44	0.56
	L	12	4	3	6	0		
5	H	1	2	0	22	0	0.7	0.36
	L	7	4	1	13	0		
6	H	2	1	21	1	0	0.6	0.48
	L	4	5	9	7	0		
7	H	2	21	1	1	0	0.7	0.28
	L	3	14	2	6	0		
8	H	2	1	4	18	0	0.52	0.4
	L	3	5	9	8	0		
9	H	1	2	0	22	0	0.64	0.48
	L	4	6	5	10	0		
10	H	2	1	20	2	0	0.62	0.36
	L	3	7	11	4	0		
11	H	19	2	1	3	0	0.58	0.36
	L	10	6	4	5	0		
12	H	2	1	18	4	0	0.52	0.4
	L	7	3	8	7	0		

Validity of the Instrument

The instruments for the research were Pre-test (T1) and Post-test (T2), both designed according to proper Table of

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Specifications (TOS). These were validated by three different experts/ Subject Specialists.

Reliability of the Instrument

Kuder Richardson's Formula (KR-21) was used to determine the reliability of the tool. For the purpose of estimating the value of KR-21, pilot testing was conducted on the students other than the sample but from same population of Grade IX from another school. The value of KR-21 was calculated and found 0.736 which is considered appropriate by the experts. After certain necessary changes, the tools were used for the research.

RESULTS

Independent Samples t-test was performed to examine the effect of using Lab Rotation Method (LRM) on the academic achievement of Grade IX students. Following Null hypothesis was tested, followed by its data presentation and interpretation. The details are as follow:

Table 2

Independent Samples t-test Statistics of overall Academic Achievement

	Group	N	M	S.D	T	df	p
Pre-Test Total (LOTS)	Experimental	20	27.30	15.393	.020	38	.984
	Control	20	27.20	15.592			
Post-Test Total (LOTS)	Experimental	20	37.90	15.904	2.159	38	**.037**
	Control	20	27.95	13.105			

Independent Samples t-test was performed to compare the mean score of academic achievement. In our study, it was limited to only Lower Order Thinking Skills (LOTS), being total overall of Knowledge, Comprehension and Application Levels, as reported on Pre-test and Post-test by Experimental Group and Control Group. The mean score value in table 4.1 revealed that Lower Order Thinking Skills (LOTS) mean score reported by experimental group was found better than control group in Post-test, despite it was almost same in Pre-test . In addition to this, it was found that reported mean score of Experimental Group (M= 37.90) on the overall scale of Academic Achievement was significantly better (p=.037) than the mean score of Control Group (M= 27.95). It revealed that this Null Hypothesis was rejected.

Paired Samples t-test was performed to compare the Lab Rotation Method (LRM) and Traditional Method on the academic achievement of Grade IX students. Following Null hypothesis was tested, followed by its data presentation and interpretation. The details are as follow:

Table 3

Paired Samples t-test Statistics of overall Academic Achievement Level Skills of the students

Group	Level	M	N	SD	T	Df	p
Total Score- Experimental	Pre-test Total	27.30	20	15.393	-9.732	19	**.000**
	Post-test Total	37.90	20	15.904			
Total Score- Control	Pre-test Total	27.20	20	15.592	-.529	19	.603
	Post-test Total	27.95	20	13.105			

Paired Samples t-test was performed to compare the mean score of Lower Order Thinking Skills (LOTS) as measure of academic achievement in our study, being total overall score of Knowledge, Comprehension and Application Levels as reported on Pre-test and Post-test by Experimental Group and Control Group. The mean score values in table 4.5 revealed that overall Academic Achievement Level mean score reported by Experimental group (M= 37.90) was found better than control group (M= 27.95) in Post-test, despite it was almost same in Pre-test. In addition to this, it was found that reported mean score of Experimental Group on the overall scale of Academic Achievement was significantly better (p=.000) than the mean score of

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Control Group. From the p-value being less than 0.05, we can conclude that this Null Hypothesis was rejected.

DISCUSSION

It was found on the basis of data analysis in Table 2 that reported mean score of Experimental Group (M= 37.90) on the overall scale of Academic Achievement was significantly better (p=.037) than the mean score of Control Group (M= 27.95). So, it revealed that the students taught through Lab Rotation Method (LRM) have overall better score in their Academic Achievement as compared to the students who were taught through Traditional Method.

The study is aligned with the findings of Adiwisastra et.al (2020) which also supported the implementation of Lab Rotation Method with the students' perspective and found it positive on the basis of data analysis (Adiwisastra et.al, 2020).

The findings of our study also support to answer the challenges of Public Sector Schools, at Secondary level education as mentioned in our statement of the problem. The shortage of subject specialist teachers for Science and English as highlighted by Arain et.al (2021) can be addressed as the researcher in our study is personally an English teacher but supposed to teach Physics, due to shortage of Science teachers (Arain et.al, 2021).

It was found on the basis of data analysis in Table 3 that reported mean score of Experimental Group on the overall scale of Academic Achievement was significantly better (p=.000) than the mean score of Control Group. So, it can be inferred that the students taught through Lab Rotation Method (LRM) have overall better Lower Order Thinking Skills (LOTS) in their Academic Achievement as compared to the students who were taught through Traditional Method.

The outcomes of the study offers the possible and effective solution, for the problem of public schools, regarding less number of schools and teachers, to cater more number of students, highlighted by Arain et. al (2021). The training on use of OERs and their display on multimedia projector, not only can address the issues in large number of classes but can also provide the teacher with time and focus on formative assessment which was otherwise least focused in public sector schools as highlighted by Anila et.al (2022) and Shehzadi & Afridi (2021).

Finally, the finding of this study, in terms of better achievement score by the students, through Lab Rotation Method (LRM) can prevent the drop out, due to low academic achievement or even low attendance, at this crucial stage of Secondary School Certificate Examination which is the terminating stage for most of the students, in developing countries like Pakistan (Mohsin, Aslam & Bashir, 2003).

The proceedings and findings of present research focused on the use of Open Educational Resources (OERs) through technology. Its findings are also aligned with recommendation by UNESCO as suggesting OERs through use of technology as Future of Education in 21st Century (Lima & Biazi, 2022).

CONCLUSIONS

It was concluded through overall significantly better mean score of experimental group than control group, on the Post-test (T-2) that Lab Rotation Method (LRM) has significant effect to improve the academic achievement of the students, in Physics, at Grade IX.

It was found on the basis of data analysis that reported mean score of Experimental Group was significantly better (p=.000) than the mean score of Control Group, on the overall scale of Academic Achievement. So, it can be inferred that the

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students taught through Lab Rotation Method (LRM) have overall better in their Academic Achievement as compared to the students who were taught through Traditional Method.

RECOMMENDATIONS

Following recommendations were made on the basis of main conclusions of this research:

Guidelines for Subject Specialist Teachers

- The subject specialist teachers may use Lab Rotation Method (LRM) for making their teaching more innovative, effective and concrete, through using videos, animations and simulation, available as Open educational resources (OERs).
- The lack of science lab or science practical apparatus can be compensated through available OERs, for practicals, in virtual form which can be used during Lab Rotation of the students to IT Lab.
- Many abstract concepts of Science i.e. Voltage, Current etc. can be materialized through animations and simulations which are otherwise not possible to be visualized, in manually performed practicals.

Guidelines for Head Teachers

- The issues of shortage of Subject Specialist Teachers, Science Lab Room, Science Lab apparatus and lack of time available for practical of science subjects, due to other academic or administrative limitations can be addressed by capacity building of teachers, through their orientation with Lab Rotation Method (LRM).
- The orientation of head teacher, him/ herself, with Lab Rotation Method, can help to monitor the performance of teachers.

Guidelines for IT Teachers

- Government rules hold the IT teacher responsible for IT literacy of the students and the teachers in the school and keep the IT Lab functional and available, for the task even in long vacation. He may not only use Lab Rotation Method (LRM), him/herself, for teaching the subject of Computer but may also train other teachers, for using Lab Rotation, for the academic and administrative good of the institution.

Guidelines for Students

- Regular students may utilize the facility of Lab Rotation in Computer Lab, not only for the topics assigned by the teacher but also to get them trained to use same OERs at home on the PC, Tablet or Mobile available at their homes, to get them free from the heavy cost of tuition. They may even use it for their off days from school in vacations, unscheduled closures of the school, in their higher and/ or professional education, either being as regular or private students.

Guidelines for Parents

- In the age of technology, we cannot restrict the children from using digital gadgets but can regulate them, through time table and parental control on their devices. So, the parents should themselves learn to use the OERs through Apps and web sources, to guide and supervise their wards in education. It will reduce their financial and administrative burden of the high cost of tuition and provide them the capacity to monitor the academic progress and activities on the internet as well.

7.2 Implications of the Research

Guidelines for District Education Authorities

- Despite following research ethics and research procedures, the researcher faced a lot of administrative issues during research, to get the Computer Lab available and functional, for the student, even at their own school, during experiment. The District Education Authorities should devise mechanism for the functionality, availability and practical use of Computer Lab, for the purpose of, not only for the subject of Computer but also for digital literacy of the students, teachers and Head teachers, thus to

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enable them all, to use OERs of other their own subjects, at school and also at home.

- As the science Labs/ apparatus, for practicals of Science subjects, are either not available or not being utilized due to different reasons, authorities may devise SOPs to compensate this loss through virtual simulations, animations and animated videos, using Lab Rotation Method.

Guidelines for District Monitoring Authorities

- It has been observed during the research and monthly District Monitoring visits of Public Schools by the MEAs that the availability and functionality for use of Computer Lab, for activities like Lab Rotation, for the students and teachers, is not included in their monitoring indicators. It should be included in main indicators, to get the already Computer Labs utilized, to meet the challenges of education, due lack of Subject Specialist teachers and Science Labs/ Apparatus, through Lab Rotation to Computer Labs.

Guidelines for Provincial Education Authorities

- The orientation/ digital literacy for use of OERs, through Lab Rotation Method (LRM) may be included in Curriculum and Syllabus of the students and teacher training programs.
- The use of Lab Rotation Method (LRM) can enhance the skills of the students at Secondary level in Higher Order Thinking Skills (HOTS) of their academic achievement which will be included in Board examination at SSC and HSSC level since 2024 Annual examination, as per new Assessment Policy of the government.
- Currently, most of the teacher training courses are limited to Primary or Elementary teachers, in Punjab Public Sector schools. After initial Induction training, the SSTs (Secondary School Teachers) of all subjects have no training program, for their capacity building and Continuous Professional Development (CPD). The focus of the government teachers training body in Punjab is through the body of Quaid e Azam Educational Academy (QAED) which has no professional development/ capacity building training program, through using OERs for Secondary School teachers. It should be focused in future, through and for teaching, using Lab Rotation Method (LRM).

Guidelines for Federal Education Authorities

- The orientation/ digital literacy for use of OERs, through Lab Rotation Method (LRM), may be included in Curriculum and Syllabus of the students.
- Federal schools are comparatively better privileged in terms of teachers' ability and Computer Lab facilities. The use of Lab Rotation Method (LRM) can enhance the skills of the students at Secondary level in Higher Order Thinking Skills (HOTS) of their academic achievement which will be included in Board examination at SSC and HSSC level since 2024 Annual examination, as per new Assessment Policy of the government.

Guidelines for IT Experts and OERs/ Apps Developers

- Due to limited time available to teachers, for supplementing their teaching in Brick and Mortar classroom, with the use of OERs, through Lab Rotation Methods, the Apps with appropriate animated videos, simulations and animations, on every topic, according to Grade level, with choice of the English and Urdu language, may be developed. Such Apps can save the time of teachers which is to be spent for collection of OERs for use of Lab Rotation Method (LRM), at their own time, ability and devotion.

Guidelines for Future Researches

- The present research has empirically found that Lab Rotation Method (LRM) is effective for teaching Physics, at Secondary Level. The future researches may focus the

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same for other subjects at Secondary and other levels as well

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