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RESEARCH ARTICLE

A SCIENTIFIC APPROACH FOR EVALUATING LEARNING EFFECTIVENESS WITH RESPECT TO DIFFERENT PARAMETERS ASSOCIATED WITH A TRAINING PROGRAM

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Abstract

Purpose: The purpose of the study is to evaluate the effectiveness of a five-day Project Management training program by establishing a relationship between the first (reaction) and second (learning) levels of the Kirkpatrick model of Evaluation of Training Results.

Design/Methodology/Approach: The study was conducted with 21 participants who attended the training program, which consisted of six different topics delivered by six faculty members. Pre and Post examinations were conducted for all sessions, and learning indices were calculated for each participant with respect to all faculty members. Factors affecting learning were identified based on participant feedback, and three factors i.e. Faculty Feedback Rating (FFR), Topic Difficulty Factor (TDF), and Optimal Session Time Factor (OSTF) were selected for evaluation. The relationship between the learning index (dependent variable) and the identified factor (independent variables) was established using multivariate linear regression.

Findings: The study demonstrated the effectiveness of using multivariate linear regression to establish a mathematical relationship between the learning index (associated with the second level of Kirkpatrick's model) and the independent variables (FFR, TDF, and OSTF) associated with the first level of Kirkpatrick's model. It was found that FFR, TDF, and OSTF significantly affected relative learning with respect to each session delivered by faculty members.

Research Limitations/Implications: The current research was conducted on a single training programme on a particular subject. More studies conducted with similar approach on other types of programmes on topics of different subjects/duration can be helpful in establishing the validity of approach. In this study, some identified factors from first (reaction) level of Kirkpatrick model were not considered applicable such as course design, background and experience of participants and environment/facilities. Training programmes conducted in different settings with heterogenous group of participants can be useful in studying the impact of these factor.

Originality/Value: The idea of quantifying learning effectiveness by relating it to factors identified from first (reaction) level of Kirkpatrick model is a unique and original approach adopted in this study.

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Moreover, this study contributes to the field by providing a methodological approach to evaluate training effectiveness by linking the reaction and learning levels of the Kirkpatrick model using mathematical and statistical tools.

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Introduction:-

Learning is a continuous process by which the behavior of a learner is expected to change by an addition to previous knowledge & experience. Training programs are designed and delivered with the intention of enhancing the learning of a target group of learners. Learning Effectiveness of a training program can be considered proportional to knowledge gained by participants from it. Though Learning Effectiveness is a qualitative terminology yet it can be quantitatively evaluated by a term called Learning Index (LI). In any training program if the Learning Index calculated is of a higher value, then it can be safely assumed that this trainingprogram delivers more learning effectiveness. If examinations are conducted before (Pre) and after (Post) the training and a participant obtains P_i^e and P_i^fmarks respectively, and maximum marks for examination is P_i^{max} then mathematically, Learning Index of ith participant is defined as $LI_j^i = (P_i^f - P_i^e) / (P_i^{max} - P_i^e)$. It is a non-dimensional quantity which provides quantitative representation of learning effectiveness. However, effective learning in a training program depends on many factors which are explained in subsequent paragraphs.

Faculty/ Trainer Effectiveness & Efficiency:

A trainer plays a crucial role in delivering effective training. They may take on various roles, such as instructional designer, technical trainer, or needs analyst. Their primary responsibility is to guide trainees in modifying their behavior through the learning process. A trainer's teaching skills, techniques, and personal qualities significantly contribute to the success of a training program. In addition to imparting knowledge, trainers inspire and motivate trainees while also establishing performance benchmarks. Trainer competencies fall into two main categories: basic (pedagogical) and specific (including skills, abilities, aptitude, attitude, and attributes). In the training program considered in this research work, an expert committee selected six faculty members, from different institutes and different areas of specialization, who delivered lectures on different topics of Project Management. Faculty Feedback Rating (FFR), received from participants, indicates trainer's effectiveness. Thus, FFR can be considered as one of the independent variables for evaluating the Learning Index.

Teaching Methodologies:

Teaching Methodologies are different ways of knowledge transfer from faculty to training participants. Selecting a suitable teaching methodology for a specific topic plays a vital role in achieving effective knowledge transfer leading to learning effectiveness. Trainers may adopt following teaching methodology depending on the topic (whichever is the best method for specific topic) of training program, for effective learning. As per requirement of topic/content, teaching methodologies are categorized into four groups 1) trainer-centered methods, 2) learner-centered methods, 3) content-focused methods and 4) interactive/ participative methods. Each group includes some teaching methods e.g., Lecture Method, Discussion Method, Programmed Instruction, Study Assignment Method, Tutorial Method, Seminar Method, Demonstration Method, Group Task, Brainstorming, Role Plays, Case Study, Hands on Practice etc. As per requirement of this particular training program under study, lecture method has been adopted by all trainers. Lecture method is a way of relaying factual information which includes principles, concepts, ideas and all theoretical knowledge about a given topic. In a lecture the trainer tells, explains, describes, or relates whatever information the trainees are required to learn through listening and understanding. It is therefore trainer-centered. The trainer is very active, doing all the talking. Trainees on the other hand, are relatively inactive, doing all the listening. In this training program, since all trainers used the lecture method for all participants, hence, teaching methodology did not affect the relative learning effectiveness of the participant with respect to trainers.

Course Design (Suitable Curriculum/Syllabus/Content):

Contents of all topics in training programs are designed by an expert team as per requirement of training participants. Training content typically refers to what is being taught, at what level, and in what quantity. Training becomes more effective when it is directly connected to trainees' current job experiences and assigned tasks, making it more meaningful to them. The transfer of training is maximized when trainees acquire relevant skills that can be applied in their actual work environment and have opportunities to practice them. When the training content closely

resembles real job tasks, it fosters a positive attitude toward the training process. Additionally, content validity plays a crucial role in shaping trainees' reactions and enhancing their self-efficacy in performing tasks. In this training program, an expert committee designed a course curriculum with their experience. They incorporated previous feedback of the participants received in similar courses. Training content of all lectures have been designed by the same expert committee based on particular requirements. Therefore, it did not affect relative learning effectiveness with respect to different faculty for different lecture sessions.

Optimal time for given content:
Learning effectiveness for a particular lecture/session depends on optimal time allotted to the trainer for covering contents of the topic(s) planned in the session. If the trainer spends excessive time for unnecessary elaboration of a topic, then participants may get exhausted after some time, resulting in reduced effectiveness. On the other hand, spending lesser time than required ensures fast delivery but resulting in the possibility of missing out important concepts. So, for deciding on optimal timing of sessions, feedback of participants have been obtained in terms of adequacy of time for a particular lecture session. Optimal time for a session is measured from participant's feedback in terms of Optimal Time Factor (OTF).

Background & experience of participants:
Training has been designed for a homogeneous group of training participants having similar age and skill, experience & qualification. In most of the cases students/participants may assess their own knowledge, skills, and expertise before selecting appropriate training programs to gain maximum knowledge. In this study, this factor has already been considered at the time of selection of training participants. Therefore, this factor does not contribute to deviation in relative learning effectiveness.

Environment/Facilities:
Training environment/facilities affects the process of knowledge, which involves both knowledge transmission by faculty as well as knowledge receipt by participants. All known environmental factors and training facilities for the training program include arrangement of infrastructure and training facilities (like area and layout of classroom including open space, seating layout & arrangement, gap between two rows, display resolution, illumination of the screen of the display board, colour of the board-white/black, marker/chalk position of classroom, etc.) and environmental factors (like classroom temperature and humidity, how effectively temperature is maintained by air-conditioning and/or heater/blower, illumination of classroom, cleanliness, undesirable odour etc.). Since all sessions have been conducted using same infrastructure and facilities, therefore, thisfactor has not affected relative learning effectiveness.

Difficulty Level of Topics:
Topics having different levels of difficulty and delivered by different faculties result in different levels of learning effectiveness. If topic A is more difficult than topic B and is delivered by multiple faculty members with similar ratings, it is likely that topic A having higher level of difficulty may receive slower response from participants compared to topic B, resulting in lesser transfer of knowledge. Thus, this factor has been considered to affect relative learning effectiveness of participants.

In the preceding paragraphs, it has been observed and discussed that learning effectiveness may depend on many factors associated with training, but, in this study, we will be moving forward with the idea that Learning Index of participant primarily depend on three main factors out of seven identified factors namely,Faculty/Trainer Effectiveness &Efficiency (Faculty Feedback Rating), Optimal time for given content (Optimal Time Factor) and Difficulty level of topics.

Literature Review: -

Many relevant literatures in the form of articles from national and international journals, relevant presentations from conferences and symposia and other available write up on the topic were scanned, to study the evaluation of participant training effectiveness for training programs. The effectiveness of learning in training programs were studied in detail, from available literature of research already undertaken, with the aim of incorporating international best practices in the current study.

Tomic, W. (1991), this article argues that research on the effectiveness of teacher behavior should focus more on systematically designing training programs and collecting implementation data on behavior of trainer before integrating the training program into an experimental framework.

Moody, D. L., Sindre, G. (2003) concluded that no standardized instrument exists for evaluating learning effectiveness. While final exams and end-of-semester course evaluations can serve this purpose, they are not specifically designed for it and present inherent limitations. Their study introduces the **Learning Effectiveness Survey**, a tool designed to assess and enhance the effectiveness of learning interventions. This instrument evaluates learning effectiveness in two contexts: **short-term learning**, based on course-specific goals, and **long-term learning**, in relation to the broader educational program and future professional applications. Additionally, the survey provides feedback on learning interventions and suggests areas for improvement. A case study demonstrates its use in assessing peer reviews as a learning activity in a requirements analysis course. While the instrument exhibited relatively high validity, its reliability fell below acceptable levels. Notably, the study found that attitude had no impact on short-term learning but was the primary factor influencing long-term learning.

Clayson, D.E. (2009) investigated the relationship between student evaluations and learning. A review of the literature indicates that establishing a clear nomological relationship has been challenging due to issues related to practice, methodology, and interpretation. The study concludes that the more objectively learning is measured, the weaker its correlation with student evaluations.

Bhanji et al. (2012) highlighted that program evaluation remains a crucial yet underutilized aspect of medical education. Their study compared traditional and retrospective pre–post self-assessment methods against objective learning measures to determine which better correlated with actual learning. Forty-seven medical students participated in a four-hour pediatric resuscitation course, completing both pre- and post-course self-assessments on pediatric resuscitation and two unrelated distracter topics. Additionally, after the course, students retrospectively rated their pre-course understanding (the "retrospective pre" method). Both self-assessment methods showed an increase in scores from 1.9/5 to 3.7/5 ($p < 0.001$). However, individual participants exhibited response shifts, either increasing or decreasing their retrospective pre-scores compared to traditional pre-scores. Objective learning, measured through a 22-item multiple-choice test, also improved, with median scores rising from 13.0 to 18.0 ($p < 0.001$). Despite these gains, there was no significant correlation between changes in self-assessment scores and objective learning outcomes (Spearman correlation: -0.02 for traditional and -0.13 for retrospective pre–post methods). Notably, students reported fewer changes in the distracter topics when using the retrospective pre–post method (11 instances) compared to the traditional method (29 instances). This suggests that while students could recognize learning improvements, they struggled to quantify them accurately. The retrospective pre–post method was found to be more reliable in eliminating perceived changes in understanding for content that was not actually taught.

Zheng, L. Fluang, R., Yu, J. (2013) examined the effectiveness of e-learning for in-service teachers aimed at enhancing instructional skills. A total of 16,264 primary and secondary school teachers participated in the study, which evaluated e-training effectiveness using Kirkpatrick's four-level model. The results indicated a high success rate, with over 80% of participants successfully completing the program.

Chahal, A. (2013) emphasized that training and development play a crucial role in equipping employees with the necessary skills and competencies to enhance organizational performance, particularly in the banking sector. It helps minimize randomness in learning and ensures structured behavioral changes. Training also improves employees' job knowledge, skills, intellectual growth, and overall personality development. The study analyzed need-based training and development practices in Punjab National Bank (PNB) and HDFC Bank, exploring the link between training and employee productivity through a development-based theory. Using statistical techniques such as percentage, mean, standard deviation, standard error, and coefficient of variation, the research found that training effectiveness in PNB and HDFC was average, with room for improvement. Additionally, employees' perceptions of training varied significantly based on gender and designation. The study highlighted the importance of needs assessment in training to enhance its impact and bring measurable benefits to the banking sector.

Borate, N.S., Krishna, and Dr. G. et al. (2014) conducted a study to assess the effectiveness of employee training programs in multinational corporations (MNCs) using Kirkpatrick's four-level evaluation model. Data analysis was performed using SPSS 30, and Cronbach's Alpha ($\alpha = 0.7$) was used to test questionnaire reliability. A paired

sample T-test revealed that the training program was highly effective. The study concluded that all four levels of Kirkpatrick's model had a significant impact on the training program's effectiveness.

Suresh, K.C., Agrawal, M.R., and Rao, R. KVS (2014) evaluated training effectiveness in an automotive component manufacturing organization using five key factors: training objectives and needs, age, gender, training factors, and employee performance. The questionnaire was developed through a literature review, employee interviews, and pilot study feedback. Data analysis was conducted using Percentage method, Chi-Square test, ANOVA, Correlation method, and T-test. Based on the findings, the study provided recommendations to improve training programs.

Borate, N.S., Gopalkrishna, and Borate, S.L. (2014) conducted a case study evaluating training effectiveness in the quality department of an MNC using Kirkpatrick's model. The study surveyed 330 employees using a questionnaire covering attitude (Reaction), learning, behavior, and results. Questionnaire validity was confirmed by university professors, and Cronbach's Alpha exceeded 0.7, ensuring reliability. A paired sample T-test demonstrated that employees perceived the training program as effective. Additionally, the mean of hypotheses was significantly higher than the theoretical mean, confirming the overall effectiveness of the training program.

Bagul, D.B. (2014) highlighted that the primary objective of the research was to analyze changes in employees' skills, attitudes, knowledge, and behavior after training. The study also examined the effectiveness of training at both individual and organizational levels. Additionally, the research provided insights into professional environments, workplace culture, communication, and etiquette. Given that training is a time-consuming and cost-intensive process, it must be carefully designed. To evaluate its effectiveness, a well-structured questionnaire should be used to gather feedback from participants.

Al-Mzary, M.M.M. et. al (2015)) examined the attitudes of administrative leaders and employees toward training programs and their impact on job performance at Yarmouk University in Jordan. Conducted within a Malaysian small and medium enterprise (SME), the study found that training courses were moderately aligned with employees' training needs and that specific criteria were used to determine eligibility for training. The findings also revealed a positive relationship between effective training and employee job performance. Several recommendations were proposed based on the study's results.

Jonny (2016) evaluated the effectiveness of the Kirkpatrick model and the Return on Investment (ROI) of training at PT XYZ. The results revealed key findings: trainees' feedback score (410 out of 462) on reaction, an average final exam score (300 out of 366) on learning, and superiors' feedback score (300 out of 353) on behavior. Additionally, the ROI of training was 58.88%, exceeding the 15% benchmark, indicating that the program was highly effective in developing supervisory leaders within the company.

Salah, M. R. A. (2016) emphasized that the success or failure of modern business organizations depends on the quality of their human resources, with well-trained and highly developed employees serving as the foundation for success. The study aimed to examine the relationship between training, development, and employee performance and productivity in private-sector transportation companies in southern Jordan.The research tested multiple hypotheses: H0s assumed no relationships between variables, while H1-H6 proposed the existence of relationships. A quantitative approach was used, with data collected through a structured questionnaire. The study involved 254 employees (60% of the total population of 420), with 212 questionnaires returned, and 188 valid for statistical analysis. Data analysis was conducted using SPSS version 16, incorporating both descriptive and inferential statistics. Descriptive statistics included frequency tables, percentages, means, and standard deviations, while inferential techniques such as the Pearson product-moment correlation coefficient (r) and linear regression were used to assess relationships between training and development (independent variables) and performance and productivity (dependent variables).The results showed a significant positive correlation between training, development, employee performance, and productivity at a 0.05 level of significance. The study concluded that effective training programs and well-structured development plans are essential for enhancing employee skills and knowledge. It recommended implementing comprehensive training programs and suggested that future research should explore additional variables such as capabilities and employee involvement, which may also impact performance and productivity.

Salah, M. R. A. (2016) highlighted that the success of modern business organizations is largely dependent on the quality of their human resources, with well-trained and highly skilled employees serving as a key factor for success.

The study aimed to examine the relationship between training, development, and employee performance and productivity in private-sector transportation companies in southern Jordan.The research was based on multiple hypotheses: H0 assumed no relationships between variables, while H1-H6 proposed the existence of relationships. A quantitative approach was used, with data collected through a structured questionnaire. The study involved 254 employees (60% of the total population of 420), with 212 responses received, of which 188 were valid for statistical analysis. Data analysis was conducted using SPSS version 16, applying both descriptive and inferential statistics. Descriptive statistics included frequency tables, percentages, means, and standard deviations, while inferential statistics, such as the Pearson product-moment correlation coefficient (r) and linear regression, were used to assess the relationship between training and development (independent variables) and performance and productivity (dependent variables).The findings revealed a statistically significant positive correlation between training, development, and employee performance and productivity, with results analyzed at a 0.05 level of significance. The study concluded that training and development play a crucial role in enhancing employee skills and productivity. It recommended implementing structured training programs and well-defined development plans to continuously improve employee competencies. Additionally, the study suggested that future research could explore other variables, such as employee capabilities and involvement, that may further influence performance and productivity.

Saha, J. (2017), provided a general overview of training effectiveness measurement models, offering a critical evaluation of their applications. Rao, D.S., Vijaya, K.P. (2017) focused on Kirkpatrick's four-level model to assess the difference of opinion and relationships among reaction variables such as the training management process, materials, course structure, and satisfaction with the trainer. Data were collected from 267 respondents out of 2,645 participants and analyzed using SPSS v20. The findings indicated a need for improvements in machinery, equipment, course material quality, and faculty competency. Angela, R.L. (2017) discussed the importance of accurately interpreting student and faculty evaluation data, particularly in the selection of questions for effective research-based assessment. Shivaraju et al. (2017) examined the effectiveness of didactic lectures as a teaching methodology. Due to time constraints and an extensive syllabus, pre- and post-test evaluations were used to assess students' knowledge acquisition. Second-year MBBS students (4th and 5th term) voluntarily participated in the study. They completed a pre-test with 10 questions on antiamoebic drugs before the lecture and the same post-test afterward to measure their learning progress. Results showed a significant improvement in students' knowledge, with 78.21% scoring between 5 and 8 in the post-test compared to 35.90% in the pre-test, and 21.79% scoring above 8. These findings suggest that interactive feedback methods can enhance lecture effectiveness and improve students' cognitive structure.

Sanyal, S., Hisam, M. W. (2018) examined the impact of training and development practices on employee performance in selected Omani public and private sector banking organizations. The study utilized a descriptive research design and incorporated both primary and secondary data. Data were collected using a structured questionnaire with a sample size of 300, selected through convenience sampling. Statistical tools such as Pearson Correlation Analysis, Regression Analysis, and ANOVA were employed to test the proposed hypotheses. The study concluded that training and development practices positively influence employee performance in the Omani banking sector.

Claude Müller et al. (2018) explored the benefits of flexible learning, which provides students with increased access and flexibility in dimensions such as time, place, learning pace, content, and assessment. The Zurich University of Applied Sciences (ZHAW) introduced a blended learning format called FLEX, reducing classroom learning time and incorporating e-learning tools like instructional videos for self-study. A semi-experimental study was conducted to assess its effectiveness. Findings indicated that students perceived the FLEX program positively, and their final test results were comparable to those of students in traditional learning formats, despite a 50% reduction in classroom hours.

Choudhury, G. B., Sharma, V. (2019) conducted a study focused on reviewing various models for training effectiveness evaluation and identifying the most suitable model for research and development (R&D) organizations. Alias, S.A., Mohd Ong, H.A. et. al (2019) explored the relationship between training design factors (training content, training methods, and trainer competency) and training effectiveness in Malaysia’s public service sector. The study involved 215 public service employees and used SEM-PLS analysis to determine that all three training design factors significantly influenced training effectiveness. Among them, trainer competency had the highest impact, followed by training method and training content.Heydari, M. R. et. al (2019) evaluated the impact of a workshop on new teaching and learning methods for healthcare staff using Kirkpatrick’s program evaluation

model. The study found that the workshop significantly improved staff satisfaction, knowledge, and behavior in delivering training sessions. The findings suggested that such workshops should be integrated into educational programs for healthcare workers to enhance teaching and learning methods.Bharthvajan R et. al (2019) examined the effectiveness of training and development in IT solutions in Chennai. The study used a random sampling method with 110 employees out of 195 and gathered feedback via structured questionnaires. Chi-square and percentage analysis were applied to measure the impact of training. The study concluded that training significantly improved employee performance, aligning with the study's objectives and reinforcing the importance of training programs. Kashif, A. R. et. al (2020) explored the impact of training on employee and organizational performance in the education sector of Rawalpindi and Islamabad. The study used a survey questionnaire with 15 questions, sent to 300 participants, with responses collected on paper. The research focused on three independent variables i.e. On-the-job training, Training design and Delivery styleThe dependent variable was organizational performance, which was mediated by employee performance. The data analysis was conducted using SPSS, employing Cronbach's Alpha, descriptive statistics, correlation, regression, and ANOVA. The results indicated a positive and significant relationship between the training variables and organizational performance, highlighting the strong connection between training design, delivery style, and on-the-job training in enhancing both employee and organizational outcomes.

Munna, A. S., &Kalam, M. A. (2021) conducted a study on the enhancement of teaching effectiveness. They define the teaching and learning process as the transfer of knowledge from teachers to students. This process involves multiple elements, including the identification of learning objectives, development of teaching resources, and implementation of effective teaching strategies. On the other hand, learning is a fundamental factor that educators must consider when teaching students. This study evaluated various academic journals, pedagogical approaches, and inclusive practices to assess teaching effectiveness in higher education. The research aimed to analyze teaching effectiveness within a university setting, using experimental methods—primarily reflection—supported by literary analysis and real-world university experiences. The findings suggest that providing positive and constructive formative feedback, as well as incorporating role-play, significantly enhances students' confidence and self-esteem. Additionally, the study revealed that an active learning environment fosters inclusivity and improves both faculty and student academic performance. These insights can help educators design and implement inclusive teaching strategies that enhance student engagement and academic success.

Study by Mehale, K.D., Govender, C.M., & Mabaso, C.M. (2021) explores the impact of training evaluation on employee performance in South Africa's financial sector. Employee performance is a critical factor for organizational success, and training and development are often used as solutions to address poor performance. However, for training to be effective, evaluations before and after training interventions are essential to assess whether employees apply the acquired skills to improve their performance. The study highlights the gap in empirical research on training evaluation tools in South Africa's financial sector, particularly in measuring post-training employee performance improvement. Findings indicate that financial organizations commonly use levels 1–3 of the Kirkpatrick-Phillips training evaluation model (satisfaction, learning, and application), while levels 4–5 (results and ROI) are rarely measured due to a lack of skills, motivation, and resources. This has critical implications for HRD professionals and managers, emphasizing the need for more frequent post-training assessments. The study also proposes a Training Evaluation Framework for Performance Improvement, aimed at helping stakeholders effectively measure and enhance employee performance through training evaluations.

Theobald, M. (2021) conducted a meta-analysis to examine the impact of extended self-regulated learning (SRL) training programs on academic performance, SRL strategies, and student motivation in university settings. The study analyzed 49 studies involving 5,786 participants, using a three-level meta-analysis based on 251 effect sizes. The overall effect size was $g = 0.38$, with the highest impact observed in metacognitive strategies ($g = 0.40$) and resource management strategies ($g = 0.39$), followed by academic performance ($g = 0.37$), motivational outcomes ($g = 0.35$), and cognitive strategies ($g = 0.32$). The effectiveness of training varied across specific SRL strategies, ranging from 0.23 (rehearsal) to 0.61 (attention and concentration). Moderator analyses revealed that course design characteristics influenced training outcomes. Feedback was associated with greater improvements in metacognitive and resource management strategies, as well as motivation. Cooperative learning arrangements enhanced cognitive and metacognitive strategies, while the use of learning protocols improved resource management strategies. Furthermore, training programs based on metacognitive theories demonstrated stronger effects on academic achievement compared to those grounded in cognitive theories. The findings also indicated that training programs targeting older students and those with lower prior academic achievement yielded greater improvements in resource

management strategies. Overall, the study concluded that self-regulated learning training programs significantly enhance academic performance, learning strategies, and student motivation.

Proposed Methodology:-

In this research study, for establishing the relationship between learning index and three identified parameters affecting learning effectiveness, participant'sfeedback has been taken and 'Learning Index' with respect to each session have been calculated. Participants' feedback form was designed on Likert scale and distributed to all participants who attended the course on 'Basic Project Management'. Pre-& Post evaluation of all participants have been carried out with respect to all sessions of faculty to evaluate respective Learning Indices. The research concluded with the multivariate regression analysis between parameters of learning and reaction levels of the well accepted Kirkpatrick model for evaluation of effectiveness training programs. Parameters 'Learning index' was considered to represent learning while reaction was captured by participant's feedback which provided information to evaluate Topic Difficulty Factor, Optimal Session Time Factor and Faculty Feedback Rating.

Details of Tools and their Purpose:

In this study, MS Excel has been used for solving the mathematical equations.

Data Collection:

Feedback data has been collected from course participants who had attended training sessions. Data of Pre and Post Evaluation marks has been used to calculate Learning Index.

There are four sections; each section represents its data and calculation process that is given below:

1. Learning Index (LI) using Pre and Post Evaluation marks
2. Faculty Feedback Rating (FFR)
3. Optimal Session Time Factor (OSTF)
4. Topic Difficulty Factor (TDF)

Learning Index (LI):

In this section, Learning Index has been calculated by Pre-evaluation test and Post evaluation test of training participants. Learning indices have been calculated with respect to each faculty (Questions selected from the content of respective faculty in Pre as well as Post evaluation). Only non-negative real values of learning indices selected with respect to faculties have been considered and other indeterminate as well as negative values have been considered as zeros. Pre and Post evaluation was conducted with 90 questions (number of questions being same in each section) from 6 faculties (delivered in 9 sessions). The questions from different sessions delivered by the same faculty have been clubbed. Number of questions with respect to faculties are F1 = 23, F2 = 15, F3 = 10, F4 = 15, F5 = 10 and F6 = 17.

The Learning Index of the evaluation of the effectiveness for the faculty's sessions as given below:

$LI_j^i = \frac{P_i^f - P_i^e}{P_i^{max} - P_i^e}$ …… (II) Where, $0 \leq LI_j^i \leq 1$

Where, LI_j^i= the learning index of student j with respect to sessions of faculty i (j=1 to 21, i=1 to 6), P_i^f = Post evaluation marks for questions from sessions of faculty i, P_i^e = Pre evaluation marks for questions from sessions of faculty i, P_i^{max} = Maximum marks in the questions from the sessions of faculty i.

While calculating the learning indices, two special cases have been observed where the values of learning indices were obtained either negative or indeterminate. These two types of values are not considered for calculating Overall Learning Index with respect to sessions delivered by a particular faculty. Overall learning indexLI_{F_i} with respect to sessions delivered by particular faculty will be calculated as given below:

$$LI_{F_i} = \frac{\left(\sum_{j=1}^{n} LI_j^i\right)}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (III)$$

(where j=1 to 21, i=1 to 6), n = Total no. of valid learning indices of students (excluding negative and indeterminate values) n≤21.

Calculation process:

$$LI_{F_1} = \frac{(LI_1^1 + LI_2^1 + LI_3^1 + \ldots + LI_{21}^1)}{21}$$

$$LI_{F_1} = \frac{\begin{pmatrix}0.33 + 0.08 + 0.4 + 0.33 + 0.25 + 0.43 + 0.53 + 0.69 + 0.67 + 0.73 + 0.54 + 0.47 + 0.6 + 0.63 \\ +0.44 + 0.45 + 0.56 + 0.57 + 0.69 + 0.67 + 0.08\end{pmatrix}}{21}$$

$$LI_{F_1} = 0.48$$

Following table represents Overall Learning indices of the sessions delivered by six faculties

Table 1:- Learning index of each faculty w. r. t. each participant and the overall learning index of each faculty.

	Learning Index					
No. of Participants	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**
1	0.33	0.71	0.71	0.56	0.1	0.41
2	0.08	0.2	0.6	0.33	0.67	0.4
3	0.4	0.43	0.83	0.33	0.13	0.47
4	0.33	0.67	0	0.67	0.71	0.64
5	0.25	1	0.25	0.18	0.17	0.29
6	0.43	0.5	0.57	0.38	0.5	0.55
7	0.53	0.4	0.5	0.56	0.6	0.36
8	0.69	0.82	0.33	0.42	0.5	0.65
9	0.67	0.43	0.5	0.67	0.17	0.15
10	0.73	0.67	0.25	0.44	0.4	0.59
11	0.54	0.6	0.4	0.11	0.56	0.53
12	0.47	0.5	0.4	0.58	0.75	0.4
13	0.6	0.6	0.75	0.4	-	0.18
14	0.63	0.6	0.6	0.67	0.75	0.5
15	0.44	0.67	-	0.5	0.78	0.71
16	0.45	0.54	0.67	0.6	1	0.5
17	0.56	0.57	0.5	0.6	0.57	0.5
18	0.57	0.25	0.6	0.56	0.4	0.4
19	0.69	0.57	0.67	0.29	0.63	0.63
20	0.67	0.44	0.5	0.45	0.4	0.41
21	0.08	0.82	0.75	0.5	0.7	0.53
Average	0.48	0.57	0.52	0.47	0.52	0.47

Faculty Feedback Rating (FFR):

Faculty members play a key role in the development and enhancement of the quality of learning experience. Participant's feedback is an effective tool for faculty evaluation, resulting in faculty development as well as providing scope for enhancing the effectiveness in future programs. A feedback form for faculty evaluation was developed and validated through peer review/brainstorming. A customized feedback form with specific questions is distributed in the beginning of the training program for evaluating the extent to which faculty of different subjects/topic have been successful in reaching out to the advanced as well as the slow learners in the classroom. It was instructed to the participants in the beginning for providing faculty feedback (reaction) immediately after each session. It was ensured by Course Coordinator.

Feedback form concentrated on the parameters related to training delivery such as coverage of topic by the faculty completely as per Lesson plan [A1], Methodology of session delivery [A2], Interaction between faculty and participants during session [A3], Relevance of contents as per topic [A4], Solution to queries of participants [A5],

and Adequacy of allocated time/duration for topic [A6]. The primary purpose of such feedback is to help training team decide whether faculty can be used in future training program for that topic or not, or whether faculty can be used after feedback to faculty and subsequent improvement. For this study, faculty feedback was also used to measure training effectiveness.

For first five parameters i.e. A1, A2, A3, A4, A5 a well-defined six-point scale (**6:** Excellent, **5:** Very Good, **4:** Good, **3:** Satisfactory, **2:** Poor, **1:** Unsatisfactory) was designated and for sixth parameter i.e A6, a two point (**1:** Yes/Adequate &**0:** No/ Not Adequate) was designated. These parameters are essential for evaluating overall rating for each faculty and lecture duration. Overall feedback has been calculated as the function of rating giving by all participants with respect to above parameters. For calculating population rating, 80/20 criteria was applied instead of averaging the rating of all participants. Criteria is based on the assumption that 20% of outlying responses are random & biased and cannot be relied upon. Remaining 80% selected from the responses with higher frequency are considered as unbiased & reliable. The method has been termed "Representative Response Rating (RRR) and the process followed is discussed in detail below.

Faculties of training program were rated by 21 training participants in respect to above six parameters with defined rating scales. Most of the ratings received were either **Very Good** or **Excellent** level. Duration of session was found adequate in the opinion of most of the training participants.

Table II, represent the weighted average of population with respect to all associated parameters. Though a total of 21 students contributed their opinion in terms of rating, opinion/rating of 80 % of 21 i.e., 16.8 were considered for calculating weighted average population rating. The method,formulated by Ashutosh Bhatnagar, has been briefly described below.

The method has been coined as Ashutosh Bhatnagar's "Representative Response Rating (RRR)'' method. Step wise calculation procedure of the this method is as follows [Kanango, J., Ashutosh Bhatnagar et. al (2023)]:

Arrange responses in different Parameter Rating in descending order of frequency of responses.

1. Calculate the sum of respective frequency of occurrences of all responses.
2. Calculate 80% of the above sum of the frequencies. The categories which add up to this 80% of the total sum are the selected categories.
3. Add till cumulative frequency of responses added reaches at least 80% of the total sum of frequencies calculated in (b) above. This is the desired cumulative value.
4. While desired cumulative value is reached, if the last frequency considered occurs multiple times in the data collected, then all occurrences of that frequency are included in the calculation of RRR.
5. The remaining responses are not considered in calculation of RRR.

Table 2: -Calculation process of weighted average of parameter rating and associated quantification (AQ) for session of faculty 1.

AQ	**A1**	**AQ*A1**	**AQ**	**A2**	**AQ*A2**	**AQ**	**A3**	**AQ*A3**	**AQ**	**A4**	**AQ*A4**	**AQ**	**A5**	**AQ*A5**
6	12	72	6	16	96	6	13	78	6	13	78	6	12	72
5	9	45	5	5	25	5	8	40	5	8	40	5	9	45
4	0	0	4	0	0	4	0	0	4	0	0	4	0	0
3	0	0	3	0	0	3	0	0	3	0	0	3	0	0
2	0	0	2	0	0	2	0	0	2	0	0	2	0	0
1	0	0	1	0	0	1	0	0	1	0	0	1	0	0
Weighted Average		R_{F1}^{A1} = (12*6 + 9*5)/ (12+9) = 5.57	Weighted age Average		R_{F1}^{A2} = (16*6 + 5*5)/ (16+5) = 5.76	Weighted age Average		R_{F1}^{A3} = (13*6 + 8*5)/ (13+8) = 5.62	Weighted age Average		R_{F1}^{A4} = (13*6 + 8*5)/ (13+8) = 5.62	Weighted age Average		R_{F1}^{A5} = (12*6 + 9*5)/ (12+9) = 5.57

In table II, Weighted average has been calculated using six-point rating scale for each parameter (A1, A2, A3, A4, and A5). Opinion or ratings have been contributed by 21 course participants for this research. Faculty Feedback Rating (FFR) for each faculty has been calculated as given below:

$$R_{F_i} = \frac{\left(\sum_{j=1}^{n} R_{F_i}^{A_j}\right)}{totalno\ .of\ A_j} \ldots\ldots\ldots\ldots \text{(I)}$$

Where, R_{Fi} = Overall Faculty Rating for ith Faculty, $R_{F_i}^{A_j}$ =the rating of faculty Fi with respect to parameter A_j where i=1 to 6 and j=1 to 5.

Calculation process:

$$R_{F_1} = \frac{\left(R_{F_1}^{A_1} + R_{F_1}^{A_2} + R_{F_1}^{A_3} + R_{F_1}^{A_4} + R_{F_1}^{A_5}\right)}{5}$$

$$R_{F_1} = \frac{(5.57 + 5.76 + 5.62 + 5.62 + 5.57)}{5}$$

$$R_{F_1} = \frac{(28.14)}{5} = 5.63$$

Table 3:- Comparison Between Mean, Median And Ashutosh Bhatnagar's "Representative Response Rating (RRR)'' methodFor Faculty Feedback Rating For Session of Faculty 1.

Statistical Methods	**[A1]**	**[A2]**	**[A3]**	**[A4]**	**[A5]**	$\mathbf{R_{F1} = (\sum R_{Fi}^{Aj}) / A_j}$
Representative Response Rating	5.57	5.76	5.62	5.62	5.57	5.63
Mean	5.57	5.76	5.62	5.62	5.57	5.63
Median	6	6	6	6	6	6

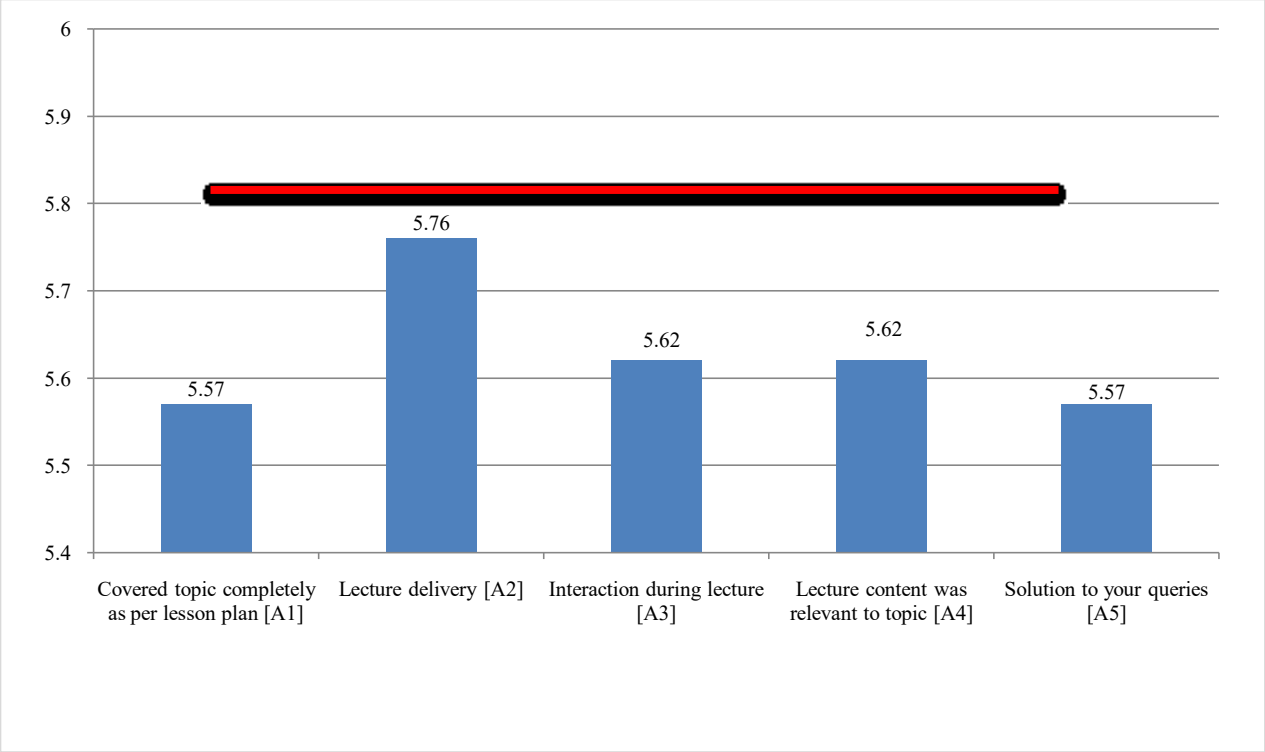

Fig. 1: -Overall rating scale for individual parameters for Faculty Feedback Rating.

Weighted average with 80/20 criteria, mean and median of faculty 1 with respect to all parameters have been calculated and shown in table III. It is found that overall faculty feedback calculated based on weighted average is more reliable than mean and median.

Table 4:-Categorization Of Faculty On The Basis Of Rating Of Faculty.

Rating Condition	**Faculty Category**
Overall faculty rating > 5 and Overall faculty rating < = 6	Excellent Faculty
Overall faculty rating > 4 and Overall faculty rating < = 5	Good Faculty
Overall faculty rating > 3 and Overall faculty rating < = 4	Improvement Required
Overall faculty rating < 3	Not to be used

In above table IV the faculties are categorized in four groups i.e., Excellent, Good, Improvement required and Not to be used.

Table 5:-Summary of Faculty And Their Respective Overall Rating & Categorization.

Faculty Identification	**Faculty Rating**	**Faculty Category**
F 1	5.63	Excellent Faculty
F 2	4.62	**Good Faculty**
F 3	4.74	**Good Faculty**
F 4	4.41	**Good Faculty**
F 5	5.66	Excellent Faculty
F 6	5.55	Excellent Faculty
F 7	5.32	Excellent Faculty
F 8	4.64	**Good Faculty**
F 9	5.86	Excellent Faculty

In above table V all faculties have been categorized based on representative value of Faculty Rating given by the participants.

Optimal Session Time Factor (OSTF): Adequacy of the time duration for the sessions delivered by the faculty have been calculated. Responses from the participants regarding adequacy of time allotted for sessions have been collected through feedback forms in the form of 1 (for adequacy) and 0 (for inadequacy). Optimal Session Time Factor (OSTF) for faculty has been calculated as given below:

$$OSTF_{F_i} = \frac{\left(\sum_{j=1}^{n} A_j^i\right)}{n} \quad \text{..... (IV)}$$

Where, A_j^i = response for sessions i given by participant j for faculty i, where i=1 to 6 and j=1 to 21, n = Total no. of participants

Calculation Process:

$$OSTF_{F_1} = \frac{(A_1^1 + A_2^1 + A_3^1 + \ldots + A_{21}^1)}{21}$$

$$OSTF_{F_1} = \frac{(1 + 1 + 1 + 1 + 0 + 0 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 0 + 1 + 1 + 1 + 1 + 0 + 0)}{21}$$

$$OSTF_{F_1} = \frac{16}{21} = 0.8$$

Optimal Session Time Factors for the sessions delivered by all faculties have been calculated and given in following table:

Table 6: - Summary of values of optimal session time factor for different faculty members.

OSTF	Representative Values
$OSTF_{F_1}$	0.8
$OSTF_{F_2}$	0.73
$OSTF_{F_3}$	0.8
$OSTF_{F_4}$	1
$OSTF_{F_5}$	0.9
$OSTF_{F_6}$	0.9

Topic Difficulty Factor (TDF):
Difficulty level of the topic in each session delivered by respective faculty has been received from feedback of participants in five-point scale i.e. 5 for Very Difficult, 4 for Difficult, 3 for Moderate, 2 for Easy and 1 for Very Easy. Representative values of topic difficulty level for sessions delivered by first faculty is evaluated in table VII.

Table 7:-Calculation process of topic difficulty factor using weighted average w. R. T. Faculty 1.

Ratings of Parameter	Rating Parameters Values (w.r.t ratings of parameters)	Ratings of Parameter * Rating Parameters Values
3	13	39
2	6	12
1	2	2
4	0	0
5	0	0
		TDF_{F_1}= (13*3 + 6*2)/ (13+6) = 2.68

Representative values of Topic Difficulty Factor for the sessions delivered by all faculties have been calculated and presented in following table:

Table 8: -Summary of representative value of topic difficulty factor for different faculty members.

TDF	Representative Values
TDF_{F_1}	2.68
TDF_{F_2}	2.5
TDF_{F_3}	2.67
TDF_{F_4}	2.57
TDF_{F_5}	2.59
TDF_{F_6}	2.9

The following table IX shows the representative learning indices of all sessions delivered by the faculty members along with representative values of all four factors affecting learning indices as calculated in previous sections:

Table 9: -Summary of Topic Wise LI, FFR, OSTF & TDF.

S. No	Session/Topic	Faculty	Learning Index (LI)	Faculty Feedback Rating (FFR)	Optimal Session Time Factor (OSTF)	Topic Difficulty Factor (TDF)
1	Project Planning and Management: An Overview	F1	0.48	5.63	0.8	2.68
2	PPFM & PEARL	F2	0.57	4.59	0.73	2.5
3	Project Quality Management	F3	0.55	4.64	0.8	2.67
4	Team Building	F4	0.47	5.86	1	2.57
5	Network Graphs	F5	0.52	5.66	0.9	2.59
6	Time Estimation	F6	0.47	5.55	0.9	2.9

Data Interpretation, Handling and Analysis

In order to obtain the relation between learning indices with all three factors affecting Learning Index, multivariate regression analysis has been performed as follows:

For simplifying the notations in equations, following variables are considered instead of Learning Index and three factors:

Table 10: -Representatives variables w.r.t. factors & learning index symbols.

S. No.	Factors & Learning Index Symbols	Representatives Variables
1.	Learning Index (LI_{Fi})	X1
2.	Faculty Feedback Rating (R_{Fi})	X2
3.	Optimal Session Time Factor ($OSTF_{Fi}$)	X3
4.	Topic Difficulty Factor (TDF_{Fi})	X4

Multivariate regression equation is given as follows:

$$X1_{\alpha} = b_1 + b_2X2_{\alpha} + b_3X3_{\alpha} + b_4X4_{\alpha}$$

Where, α is the number of faculties (α = 1, 2, 3, 4, 5, 6), b_1, b_2, b_3, and b_4 are unknown variables, X_1, X_2, X_3, and X4 are known variables.

$$ErrorE = \sum_{\alpha=1}^{6}(X1_{\alpha} - b_1 - b_2X2_{\alpha} - b_3X3_{\alpha} - b_4X4_{\alpha})^2 \ldots\ldots\ldots\ldots(1)$$

$$\frac{\partial E}{\partial b_1} = 0$$

$$2\sum_{\alpha=1}^{6}(X1_{\alpha} - b_1 - b_2X2_{\alpha} - b_3X3_{\alpha} - b_4X4_{\alpha})(-1) = 0$$

$$\sum_{\alpha=1}^{6}X1_{\alpha} = 6b_1 + b_2\sum_{\alpha=1}^{6}X2_{\alpha} + b_3\sum_{\alpha=1}^{6}X3_{\alpha} + b_4\sum_{\alpha=1}^{6}X4_{\alpha} \ldots\ldots\ldots\ldots(2)$$

For minimum error

$$\frac{\partial E}{\partial b_2} = 0$$

$$2\sum_{\alpha=1}^{6}(X1_\alpha - b_1 - b_2X2_\alpha - b_3X3_\alpha - b_4X4_\alpha)(-2X_{2\alpha}) = 0$$

$$-4\sum_{\alpha=1}^{6}(X1_\alpha X2_\alpha - b_1X2_\alpha - b_2X2_\alpha^2 - b_3X3_\alpha X2_\alpha - b_4X4_\alpha X2_\alpha) = 0$$

$$\sum_{\alpha=1}^{6}X2_\alpha X1_\alpha = b_1\sum_{\alpha=1}^{6}X2_\alpha + b_2\sum_{\alpha=1}^{6}X2_\alpha^2 + b_3\sum_{\alpha=1}^{6}X2_\alpha X3_\alpha + b_4\sum_{\alpha=1}^{6}X2_\alpha X4_\alpha \ldots\ldots\ldots\ldots(3)$$

Similar putting
$\frac{\partial E}{\partial b_3} = 0, \frac{\partial E}{\partial b_4} = 0$

$$\sum_{\alpha=1}^{6}X3_\alpha X1_\alpha = b_1\sum_{\alpha=1}^{6}X3_\alpha + b_2\sum_{\alpha=1}^{6}X2_\alpha X3_\alpha + b_3\sum_{\alpha=1}^{6}X3_\alpha^2 + b_4\sum_{\alpha=1}^{6}X4_\alpha X3_\alpha \ldots\ldots\ldots\ldots(4)$$

$$\sum_{\alpha=1}^{6}X4_\alpha X1_\alpha = b_1\sum_{\alpha=1}^{6}X4_\alpha + b_2\sum_{\alpha=1}^{6}X2_\alpha X4_\alpha + b_3\sum_{\alpha=1}^{6}X3_\alpha X4_\alpha + b_4\sum_{\alpha=1}^{6}X4_\alpha^2 \ldots\ldots\ldots\ldots(5)$$

Equation (2) can be written as

$$6\overline{X1} = 6b_1 + 6b_2\overline{X2} + 6b_3\overline{X3} + 6b_4\overline{X4}$$

$$\overline{X1} = b_1 + b_2\overline{X2} + b_3\overline{X3} + b_4\overline{X4} \ldots\ldots\ldots\ldots\ldots\ldots(A)$$

From equation (3)

$$\overline{X1X2} = b_1\overline{X2} + b_2\overline{X2^2} + b_3\overline{X2X3} + b_4\overline{X2X4} \ldots\ldots\ldots\ldots\ldots\ldots(B)$$

From equation (4)

$$\overline{X1X3} = b_1\overline{X3} + b_2\overline{X2X3} + b_3\overline{X3^2} + b_4\overline{X3X4} \ldots\ldots\ldots\ldots\ldots\ldots(C)$$

From equation (5)

$$\overline{X1X4} = b_1\overline{X4} + b_2\overline{X2X4} + b_3\overline{X3X4} + b_4\overline{X4^2} \ldots\ldots\ldots\ldots\ldots\ldots(D)$$

Above linear equations can be represented in following matrix form:

$$\begin{bmatrix} 1 & \overline{X2} & \overline{X3} & \overline{X4} \\ \overline{X2} & \overline{X2^2} & \overline{X2X3} & \overline{X2X4} \\ \overline{X3} & \overline{X2X3} & \overline{X3^2} & \overline{X3X4} \\ \overline{X4} & \overline{X2X4} & \overline{X3X4} & \overline{X4^2} \end{bmatrix}\begin{bmatrix} b1 \\ b2 \\ b3 \\ b4 \end{bmatrix} = \begin{bmatrix} \overline{X1} \\ \overline{X1X2} \\ \overline{X1X3} \\ \overline{X1X4} \end{bmatrix}$$

In previous research, mathematical methods like curve fitting, correlation, linear equation have been used by researchers for calculating True Learning. In this study, the above mathematical methods have been employed to find the best correlation. Four Learning Factors are represented by linear equation which have been solved by Gauss Seidel method for calculating True Learning. The matrix provided above is used to solve the equation, the values being displayed in Table XI.

Table 11: - Calculated values for matrix parameters used in correlation.

S. No.	X1	X2	X3	X4	$X2^2$	$X3^2$	$X4^2$	X1X2	X1X3	X1X4	X2X3	X2X4	X3X4	Calculated Learning
1.	0.48	5.63	0.8	2.68	31.7	0.64	7.18	2.7	0.38	1.29	4.5	15.09	2.14	0.52
2.	0.57	4.59	0.73	2.5	21.07	0.53	6.25	2.62	0.42	1.43	3.35	11.48	1.83	0.53
3.	0.52	4.64	0.8	2.67	21.53	0.64	7.13	2.55	0.44	1.47	3.71	12.39	2.14	0.53
4.	0.47	5.86	1	2.57	34.34	1	6.6	2.75	0.47	1.21	5.86	15.06	2.57	0.47
5.	0.52	5.66	0.9	2.59	32.04	0.81	6.71	2.94	0.47	1.35	5.09	14.66	2.33	0.49
6.	0.47	5.55	0.9	2.9	30.8	0.81	8.41	2.61	0.42	1.36	5	16.1	2.61	0.51
Calculated Mean for each factor	0.51	5.32	0.86	2.65	28.58	0.74	7.05	2.7	0.43	1.35	4.59	14.13	2.27	

Representation of the values of True Learning & Calculated Learning and Correlation between them given below in table XII & Fig.3 respectively.

Table 12: - Summary of true and calculated learning indices.

True Learning	Calculated Learning
0.48	0.52
0.57	0.53
0.55	0.53
0.47	0.47
0.52	0.49
0.47	0.51

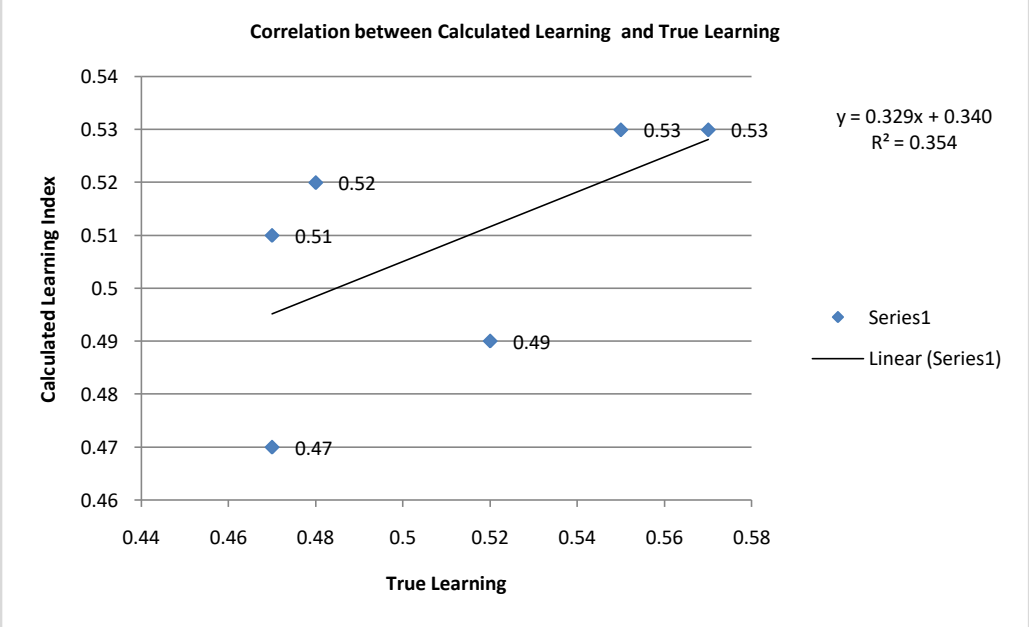

Fig. 2:- Correlation between Calculated Learning Index and True Learning.

Summary and Conclusions:-

This study has been able to establish a relationship between variables captured at the reaction level, from training participants, from which Learning Index can be estimated, and the actual Learning Index calculated at the learning level from performance of training participants at pre and post evaluation stages.

There is a significant amount of correlation noted from the True and Calculated Learning Indices, which implies that, by capturing honest reactions from participants, learning indices of participants can be predicated to a significant degree of accuracy.

Direction for further research

Result may be improved for that training program in which number of lectures are more (as in case of 3- or 4-week training programs) and number of participants are more. Moreover, done faculty should be associated with one lecture session only. Furthermore, for further betterment of results, number of questions in pre and post training evaluation/test should be more with respect to each faculty member.

References:-

1. Alias, S.A., Mohd Ong, H.A. et.al (2019), "The Role of Training Design Factors in influencing Training Effectiveness among Public Service Employees", International of Journal of Academic Research in Business & Social Sciences, Vol. 09, No. 05, May 2019, p.p. 898-913. E-ISSN 2222-6990, @2019 HRMARS.
2. Al-Mzary, M. M. M., Al-rifai, A. D., Al-Momany, M. O. E. (2015), "Training and Its Impact on the Performance of Employees at Jordanian Universities from the Perspective of Employees: The Case of Yarmouk University", Journal of Education and Practice, 6(32), 128-140.
3. Angela, R. L. (2017), "Interpreting and using student rating data: Guidance for faculty serving as administrators and on evaluation committees", AR. Lines/ studies in Educational Evaluation 54 (2017), 94-106. www.elsevier.com/stueduc.
4. Bharthvajan, R., Kavitha, S. F. (2019), "A Research on Effectiveness of Training and Development in its Solutions", training, 12, 11.
5. Bhanji, F., Gottesman, R., de Grave, W., Steinert, Y., Winer, L. R. (2012), "The retrospective pre–post: A practical method to evaluate learning from an educational program. Academic emergency medicine", 19(2), 189-194.
6. Borate, N.S., Krishna, Dr. G., et. al. (2014), "A case study approach for evaluation of Employee Training Effectiveness and Development Program", The International Journal of Business & management, Vol. 02, Issue 06, p.p. 201-210, June 2014, ISSN 2321-8916. www.theijbm.com.
7. Borate, N.S., Gopalkrishna, Borate, S.L. (2014), "A case study approach for evaluation of Employee Training Effectiveness and Development Program", Proceeding of the Second International Conference on Global Business, Economics, Finance and Social Sciences (GB14 Conference), Chennai-India, 11-13 July 2014, Paper ID- C432. www.globalbizresearch.org.
8. Bagul, D.B. (2014), "A Research paper on 'To study the Effectiveness of Employees Training & Development Programs' ", Scholarly research Journal for Humanity Science & English Language, Vol. I, Issue IV, June July 2014, p.g. 596-603. www.srjis.com.
9. Clayson, D.E. (2009), "Student Evaluations of Teaching: Are they related to What student Learn? A Meta-Analysis and Review of the Literature", Journal of Marketing Education, Vol. 31, Number 01, April 2009, p.p. 16-30. @2009 SAGE Publications. http://jmd.sagepub.com.
10. Chahal, A. (2013), "A study of training need analysis-based training and development: Effect of training on performance by adopting development-based strategy", International Journal of Business and Management Invention, 2(4), 41-51.
11. Choudhury, G. B., Sharma, V. (2019), "Review and comparison of various training effectiveness evaluation models for R & D organisation performance", PM World Journal, Vol. 08, Issue 02, February 2019. www.pmworldjournal.net.
12. Heydari, M. R., Taghva, F., Amini, M., Delavari, S. (2019), "Using Kirkpatrick's model to measure the effect of a new teaching and learning methods workshop for health care staff", BMC research notes, 12(1), 1-5.
13. Jonny (2016), "Training Effectiveness at PT XYZ using Kirkpatrick Model and Return on Investment of Training (ROI-Training)", Binus Business Review, Vol. 07, No. 02, p.p. 137-141. http://dx.doi.org/10.21512/bbr.v7i2.1728.

14. Kanango, J., Bhatnagar, A., Gupta, R. and Kashyap, V. (2023), "Designing a short-term training course curriculum using the quality function deployment (QFD)", International Journal of Quality & Reliability Management, Vol. 40 No. 9, pp. 2247-2277. https://doi.org/10.1108/IJQRM-05-2022-0150
15. Kashif, A. R., Shafiq, M., Tahir, A. H., Wahid, S., Ahmed, S. (2020), "Impact of on job training, training design and training delivery style on organizations performance", Foundation University Journal of Business & Economics, 5(2), 40-51.
16. Müller, C., Stahl, M., Alder, M., Müller, M. (2018), "Learning effectiveness and students' perceptions in a flexible learning course", European Journal of Open, Distance and E-Learning, 21(2), 44-52.
17. Moody, D. L., Sindre, G. (2003), "Evaluating the effectiveness of learning interventions: an information systems case study".
18. Munna, A. S., Kalam, M. A. (2021), "Teaching and learning process to enhance teaching effectiveness: a literature review", International Journal of Humanities and Innovation (IJHI), 4(1), 1-4.
19. Mehale, K. D., Govender, C. M., Mabaso, C. M. (2021), "Maximising training evaluation for employee performance improvement", SA Journal of Human Resource Management, 19, 11.
20. Rao, D.S., Vijaya, K.P. (2017), "Evaluating of Training Effectiveness based on Reaction- A case study", International Journal of Business and General Management (IJBGM), Vol. 06, Issue 04, Jun-Jul 2017, p.p. 45-56.
21. Suresh, K.C., Agrawal, M.R., Rao, R. KVS (2014), "Analysis of Effectiveness of Employee's Training in an Automotive Component Manufacturing Organisation", Research Journali's Journal of Management, Vol. 02, Issue 08, September 2014, ISSN 2347-8217.
22. Sal, A., Raja, M. (2016), "The impact of training and development on employees performance and productivity", International Journal of Management Sciences and Business Research, 5(7).
23. Saha, J. (2017), "Comparative study of Training Effectiveness Measurement Models", Global Journal of Engineering Science and Research Management, Vol. 04, Issue 12, p.p. 34-39, December 2017, ISSN 2349-4506. http://www.gjesrm.com.
24. Shivaraju, P. T., Manu, G., Vinaya, M., Savkar, M. K. (2017), "Evaluating the effectiveness of pre-and post-test model of learning in a medical school", National Journal of Physiology, Pharmacy and Pharmacology, 7(9), 947.
25. Sanyal, S., Hisam, M. W. (2018), "Impact of training and development on the performance of employees-A comparative study on select banks in sultanate of Oman", International journal of scientific research and management, 6(03), 191-198.
26. Theobald, M. (2021), "Self-regulated learning training programs enhance university students' academic performance, self-regulated learning strategies, and motivation: A meta-analysis", Contemporary Educational Psychology, 66, 101976.
27. Tomic, W. (1991), "Training Programs in Research into the Effectiveness of Teacher Behavior", Journal of Education for Teaching, Vol. 17, No. 02, 1991, p.p. 181-188.
28. Zheng, L. Fluang, R., Yu, J. (2013), "Evaluation of the Effectiveness of e-Training: A case study on In-service Teacher's Training", 2013 IEEE 13th International Conference on Advance Learning Technologies, IEEE Computer Society, July 2013.