Active Learning Strategies for Technological Courses

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Abstract: Almighty created human beings with countless endeavors among that learning plays a vigorous role. Learning can be systematized set of principles which acquires, stores, disseminates, process or understand and recall the various knowledge domains. Quenching the thirst of knowledge is conceivable by either Traditional Learning or Active Learning and both strategies or mechanisms. In this study we discuss on how Traditional Learning strategies continuous from years to gather in importing the knowledge by using chalk and board with numerous pros and cons. This learning focuses on memorization techniques but partially succeed in developing creative thinking strategies. Other limitation of this traditional teaching is due to participation of "only teacher interaction with the student "could not able to achieve outcome of the entire courses. To create interactive environment between the teacher and student we focus on active learning strategies. Active learning is super engaged strategy for cultivating creating thinking power of learners. This strategy is ongoing best suited and result oriented for mainly experimental and applied courses. In this paper we discuss how effective these strategies could be a productive means of achieving course outcomes for modern technological courses. Active Learning strategies will bridge the gap between traditional teaching strategies and modern technological courses outcomes. The various Active Learning strategies which are encountered are perception learning (listening & speaking), Thinking & Reasoning, Class room discussions, Think pair & share; Problem based learning, Solution Based Learning, Shared brain storming and Experimental learning. These strategies can be applied to technological, management, Engineering, medical courses which exhibit the active learning strategies.

Keywords: Active Learning (AL), Traditional Learning (TL), Problem Based Learning (PBL), Solution Based Learning (SBL), NCAAA (National Commission for Academic Accreditation and Assessment (NCAAA), National Qualification Framework (NQF)

I.   INTRODUCTION

Proficient teaching always proves to be an indispensable component in delivering the knowledge [5]. Knowledge and learning are interrelated with each other and derived from experiences [3]. These two have strong influential effect to explore dynamism, talent, knowledge skills, cognitive skills, Interpersonal & responsibility skills and communication IT skills [1]. Numerous teaching strategies widely used in delivering the knowledge but most common among them using chalk & board or traditional teaching [3]. The main disadvantage of student-centered learning is just importing the knowledge i.e. teacher to student relationship but not vice versa.

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Recent advancements pertaining to technology & research demands an immense need of learning which comprises of both AL & TL strategies [4]. As the decades passed still lots of research required to apply type of justifiable learning according to their courses. In the below topic 2 we list the detail pros and cons related to TL. The non-effectiveness of TL can be achieved by AL which is used to explore class room thinking. Due to limited functionality of TL strategies cannot be applied for the wide variety of courses specially the practically oriented. The main objective of active learning is to "give & get" "to and from" the student [2]. AL involves will incorporates the student ability of learning themselves by means both active and passive role in class rooms [3]. AL strategies includes Content delivery from learning & experience, fruitful discussions among students, broad thinking & analysis of problems, improve presentation skills be debates, exploring innovative ideas, practical approach of problem solving, Interaction the students by online, developing cognitive approach and many more[1,3]. Most of the courses related to modern techno development such as Information technology, modern science, medical advancements, personality development, current recent trends and many more need both AL & TL teaching strategies. In the below section we listed complete steps of how AL can be effective to teach technological courses specially computer programming paradigm and software engineering.

II.   METHEDOLOGY

The type of research we had in this paper to promote active learning strategies to be applied on various courses specially which contains applications, technologies, experimental proofs, case studies, project implementations, research activities and problem based & solution based learning. Primarily This courses comes in engineering, medicine, applied sciences, technological innovations, management and others. Over many decades these courses demonstrated by using passive or traditional learning methods which does not unveil complete potential of the learners due to only memorization and teacher centric activities. To strengthen these traditional methods researchers and educationalists had come up with active learning which aims to develop creative thinking, self-potentiality, and performance of the students or learners [1].To explore the learner abilities we had chosen NCAAA and its standards which mainly focus on NQF frame work such as knowledge skills, cognitive skills, interpersonal & responsibility skills and communication, numerical and Information technology skills [13, 14]. All these skills leads to improve and promote the active learning skills of the learner on various application oriented courses.

The active learning skills focus on abilities such as traditional learning or passive learning, perceptron learning, thinking & reasoning, class room discussions, shared brainstorming, thinking abilities, cognitive learning approaches, sharing information, experimental learning, problem based and solution based approaches [1,2,3,6,7,12]. In our study we applied this active learning techniques on the courses of computer science mainly software engineering and programming languages which involves all the active learning strategies at college of arts & sciences, Prince Sattam Bin Abdul Aziz university, Wadi Al Dawassir region. Most of the universities in Kingdom of Saudi Arabia is accredited with NCAAA or ABET accreditation. During our work we found that applying active learning strategies on these course are very much effective to gain the objectives or outcomes of the course. Each active learning strategies with its appropriate assessment methods strives to be profound influence on attaining university objectives and strategic goals.

III. TRADITIONAL TEACHING

Traditional teaching strategies are widely known as teacher centric strategies or passive learning [4].This passive teaching method focuses on interaction from teacher to a student but not vice versa. Due to this limited interaction of the student to a teacher only listening skills being developed within a student. Malawi institute of education presents a complete study of class room activities which is very much mandatory like learning by doing, class room participation, discussions, questioning & answering, buzz groups, thinking, case studies, field experience, industry visits and many more[5].To quench these attributes of learning given rise to active learning [2]. As the modern world technologies are rapidly growing it demands the students or learners to involve completely in gaining the knowledge of their respective courses by means of both Active & passive learning [2]. In the below section we will focus on how these AL strategies can fulfill to achieve the outcomes of the technological courses specially programming paradigm and software engineering. Let's analyze few pros and cons of TL strategies which demands to opt for AL strategies for above modern technological courses.

A. Pros of Passive learning or TL strategies on technological course

As per suggested studies [2, 3, 4, 5] following pros of passive teaching are listed with respect to technological courses.

- **Focus on content** : Passive learning focus on content delivery by means of audio & visual presentations, lectures, giving notes and so on
- **Knowledge acquisition** can be done by listening, visual power points and video presentations
- **Traditional or passive teaching methods** will be very much effective in the beginning stage of the course content delivery.
- **Comprehensive governing** of the class depends on teacher. So maximum likelihood for vast content delivery.
- **Conceptual learning** makes student to put less efforts to gain teachers rich experiences.
- Student evaluation can be easier due to traditional assessment methods based on knowledge skills.

- **Maximum probability** of achieving course outcomes as framed by the course instructor.
- Students are completely guided by the faculty and prescribed materials.
- Classes and assessment methods will be carried as per schedule.
- **Complete control** over class rooms and assessment methods.

B. Cons of Passive learning on modern technological courses

As per the studies prescribed [12, 3, 4,7] the following below are cons listed for TL with respect to technological courses.

- **Much emphasis on the faculty** rater then learner like designing course plans, content delivery, scheduling classes, assessments, evaluations and many more.
- As TL focus on student centric teaching which means **only interaction** from the faculty to student but not from other side.
- Students able to **develop their knowledge skills** but fail to improve their cognitive skills, Interpersonal & responsibility skills, communication IT & numerical skills.
- **Fails to develop thinking,** analyzing, discussions, debates, creating interactive environment and creative thinking with in classroom, which is very much required for modern technological courses.
- **Synchronization** of various maturity levels of all the students can't be possible due to same traditional teaching methods applied.
- **No mechanism** applied to assess or concentrate on poor students even though max of them is inactive in the class room.
- **No regular feedback** will be collected from the students in order to ensure quality in education
- TL strategies or methods **do not promote** higher education especially in the field of computers, I.T, medical, engineering and so on.
- Same understanding level being developed among students though their **intellectuality demands** underneath knowledge.
- **No much emphasis on lab evaluations**, executions, exercises and critical thinking which develops practical oriented knowledge.
- Concentrate on only **listening skills** without developing oral or presentation skills.
- **Short time** to clarify doubts of the students, discussions, doubt clarifications, follow up lectures and so on.
- Difficult to maintain and retain the **student's attention** though they are unable to cope up with current lectures.
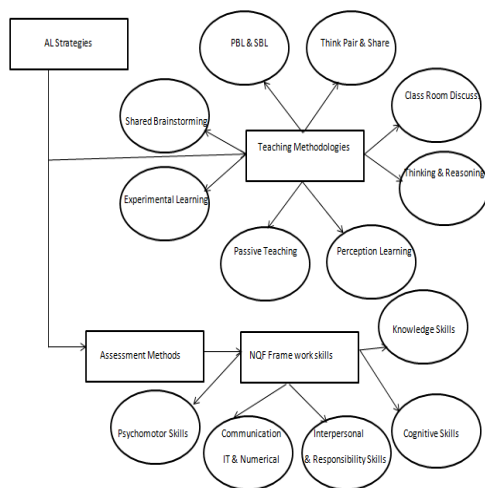
IV. ACTIVE LEARNING

Active learning is a mechanism to provide interactive environment between the teacher and student [2]. AL wills enhances student abilities by various approaches inside & outside of class room [3].Since many decades much research carried out to provide effective learning methods out of which AL proves to be the best one bases on the following below objectives [1][7].

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- Create a **constructive learning environment** where situation demands to beneath the knowledge with in students
- Healthy **relationship** must be developed student and faculty
- **Improve learning** capabilities & Enhance cognitive learning
- **Develop self-efficiency** by building positive interactive environment
- **Replace traditional approaches** by modern active learnings.
- **Develop** various problem **solving approaches**
- **Formative & summative assessments** and class activities carried out to achieve complete outcomes of the course
- **Identify the strengths and weakness** of each student in order to apply well suited method and assessment methods.

A. Active Learning (Al) Strategies

As per suggested studies [1, 2, 3, 6, 7, 12] Numerous AL strategies or methods have been proposed in various researches which is suitable for various courses. In this paper we tried to focus on few learning strategies or parameters which are suitable for modern technological courses. Active Learning strategies are consists of many teaching methodologies and assessment methods to apply on technological courses. The key idea behind various AL teaching methodologies is to achieve maximum outcomes of these technological and research courses. Each Active Teaching method applied on these above courses will leads to achieve outcomes of NQF domain skills knowledge skills, Cognitive skills, Interpersonal & Responsibility skills, I.T Numerical & Communication skill and psychomotor skills. Active learning skills can be applied to all courses like technological, medical, engineering, management and applied courses which exhibits the NQF domain skills. The main objective of applying active skills to develop thinking & reasoning of the students by interactive environment. These environment of interaction leads the student to attain all NQF skills [13, 14].

Fig1: Active Learning Strategies and their Assessment Methods

As shown in the above fig 1 this can be performed by appropriate selection of teaching methodology from AL strategy and apply on the technological courses like programming paradigm & software engineering.

B. Passive teaching

As we discussed above passive teaching is a process where the teacher to student relationship is formed but not vice versa. Due to the deficiencies encountered in TL strategies which given rise to AL strategies. Any how the passive teaching is treated well for acquiring and delivering the knowledge through audio, video and presentations

C. Perception learning

As per paper [8] Student acquires the knowledge by perception techniques like speaking, listening, watching, storing, seeing, motions and many more. As these two courses comprises of knowledge which includes algorithms, concepts, theories, procedures, programming, process models and many more. To deliver knowledge we need to be compulsorily relay on only passive teaching. The key idea behind this learning technique is to develop cognitive skills like listed below with in a student

D. Thinking & reasoning

Critical thinking & reasoning are AL methods which plays a dominant role with in a class room. These AL methods create a positive impact on all students with respect to their maturity level. Following below are the positive effects of developing thinking & reasoning techniques within students especially for modern techno world courses like programming.

E. Class room Discussions

This learning strategy plays a vital role in developing student's ability of understanding. The concepts of programming & software engineering like pointers, structures, encapsulations, constructors, inheritances, polymorphism, templates, virtual functions, collecting requirements, complete analysis, carrying out modeling, designing solutions, testing and others needs considerable discussions. Discussions can be followed with execution of programs, removing errors, finding or guessing output, analyzing problems, designing solutions. There are more assessments can be done to evaluate class room discussion like day to day lab evaluations, presenting seminars, oral discussion, class room exercises and many more class activities. Impact of these class room discussions creates productive influence on student's learning ability

F. Think Pair and share:

As per paper [3] suggest this strategy creates collaborative & cooperative environment with in class. The Course like software engineering deals with development of projects, case studies, assignments and so on due to this strategy helps to assign project/case study/Assignments/Advance topics to a group of students. This Cooperative working of the students in form of teams leads to achieve course outcomes

G. Problem based and Solution based learning

Problem Based Learning (PBL) as the name suggest PBL deals with straight forward technique where student does not have correct answer to a problem. He/she starts of working with a given problem and ends up with a solution. The solution which obtained may differ from student to student. This learning is mostly used to develop the ability of learning from real time problems. Most technological courses like computer programming & software engineering deals with offline or real time projects. To implement these projects we need to acquire knowledge, understand the problems, doing complete analysis, design solutions, writing code, testing and applying to research problems. For doing these operations problem based learning can be beneficial. Solution based learning (SBL) as the name suggests it follows bottom-up approach rather than straight forward. The main objective of both PBL & SBL is same i.e educating the student in particular domain and apply the acquired knowledge to any research problem or real time problem.

H. Shared brainstorming

This AL method is treated as best learning strategy which can be widely used to initiate the cognitive skills with in group of students. It is not necessarily all the students within a group need to be experienced or well versed with knowledge domain. The key idea behind this technique is to give a task or topic or project or module to a group of students. Collect their ideas and suggestion pertaining to that particular topic. Outline the derived idea from existing collected ideas. Compare the idea if (present idea) any with derived one and helps us to conclude with best idea which can be applied to achieve possible outcome. In the next chapter 2 we illustrate how shared brain storming approach can be useful to gain modern technological courses [10].

I. Experimental Learning

As per the studies [11] suggest this strategy is considered to be as learning by doing. Experimental learning strategy makes the student to strengthen practical skills. It bridges the gap between what has learned and real time practical experimentations. Maximum or all courses of modern technological courses needs practical learning or experimental approach.

V. RESULTS AND OBSERVATIONS

With reference to NQF skills of NCAAA standards under the umbrella of Active learning strategies on modern technological courses like programming paradigm for problem solving and Software engineering for product development following below observations are noticed as stated in [1, 2, 3, 6,7,11 and 12].

Table I: Active Learning skill with appropriate assessment method on technological courses

Active Learning skill	Parameters of Learning	Assessment Methods	Observations
Active Learning Strategies	Group Discussion, case studies, Visual presentations, Individual	Projects, Case studies, Assignments and Oral presentations / Assignments and others	Collect information from various sources, Develop interpersonal skills, and Emphasize on creative thinking
Passive Learning or traditional teaching	Delivering information	Mid – term tests, Final Assessment tests,	Develop ability of listening, reading and watching videos.
Perception Learning	Sensory interaction with environment	Quizzes, mid tests and final assessment tests	Learn through sensor organs (Eyes, ears and sense) from environment
Think ,Reason and share	Problem based & solution based learning	Assignments, Oral presentations, class room discussion, group discussions, Project development, Lab Experiments and Final Exams	Develop creative thinking Accentuate maturity level Develop competitive skills Be Economical Analysis of problem to obtain solution Interactive environment Develop cooperative skills
Class room discussions	Presentations	Seminars, projects and case studies	
brainstorming	Group setting	Group seminars, workshops and presentations	Create limited learners with more innovative ideas
Experimental Learning	Lab performance	Day to Day lab evaluations	Technological learners, Deployment skills on research ideas

As discussed in the above table 1 active learning strategies applied on technological courses like programming languages and software engineering is beneficial in obtaining the course outcomes. Hence it is recommended for every institution to apply active learning skills on all engineering, medical, technological, research, management and applied science courses.

VI. CONCLUSION AND FUTURE DISCUSSION

Over the decades there is a myth that acquiring the knowledge can be fulfilled by learning. Learning directly correlates with improving Intellectuality of learners. Intelligence can be developed by systematized learning and modern technological resources. In cooperating learning with technology give rise to develop the learners with NQF framework skills. This paper explains how active learning bridge the gap of achieving NQF outcome's to modern technological courses.

AL has the ability to improve relationship between learners and technological courses. It is mandatory to the tutors to implement AL strategies to grow their potentiality. Numerous courses of medicine, engineering, business, sciences, mathematics, law and others can't achieve maximum outcomes when restricted to TL strategies. In this chapter we present a detailed explanation of how the passive teaching can be replaced by modern active learning strategies. AL strategies are mandatory to incorporate an AL strategy which uses technology to improve the course outcomes. Major aim of the active learning is to teach technological courses using AL strategies like collaborative learning, practice on hands on, think , pair & share activities, demonstrations, group discussions, error identification exercises, interactive lectures, brain storming, case studies, project implementations and ,any more In the chapter 2 we present a detailed explanation on how modern technological courses like computer programming & software engineering can achieve maximum outcomes using experimental approach.

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