

**EFFECTIVENESS OF PROJECT BASED LEARNING (PBL)  
FOR UNDERGRADUATE - BACHELOR'S CIVIL  
ENGINEERING EDUCATION**

A

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## **Chapter VI**

### **SUMMARY, MAJOR FINDINGS, DISCUSSION AND SUGGESTIONS**

#### **6.0 Introduction**

Global advancement in technology had contributed towards the economic development of nations. Communication and internet are bringing out changes in learning system around the world. The new era of online learning, teaching had changed the definition of traditional classrooms.

Learning in 21st century is quite challenging and different from the past times. Presently teaching and learning focusses on the overall development of the learners which identified the need of improvising and reforming the traditional education system for future generation. Educators focus on implementing teaching methodologies which prepares present generation to successfully compete with the tough and rigorous competition in global industry. The need to incorporate the out of classroom or field experiences for Engineering and Technology undergraduate program curriculums is becoming a part of course curriculum as to provide them industry exposure along with the theoretical and practical knowledge about their professional course work.

Globalization and liberalization of the industry opens vast number of opportunities for E and T Professionals. The growth and demand for the skilled engineering and technical graduates has increased to a substantial number as compared to the past times. The knowledge, skills and training of E and T professionals has been receiving lot of attention as had demonstrated their contribution in benefitting the economic process and prosperity which leads to nurturing and stabilizing economy of the developing nations.

#### **6.2 Study report on employability of fresh graduates in India**

In reference to AICTE'S India skills report 2019, page 12 only 40% of engineering students are employable. The government is putting an effort to bring the number

from 40 to 60% in next five years. (Source: Statista Research Department) The job industry reveals that 60% of our graduates are not fully career prepared so they need further training, and these 60% students won't also get compensated in terms of salary as compared to 40% of their peers. Despite Technical Education Curriculum by AICTE which includes professional core courses, practical's related to professional course work, class projects and other promotional programs for technical education as it still lacks to keep up with the job Industry.

As per the Planning Commission's 12th year plan 2012-2017 of India, government is proposing curriculum to include an appropriate mix of academic and vocational skills, and which will be aligned to national occupational standards determined by employer-led sector skill councils to make Indian youth more employable. by viewing skill building as an instrument to improve the effectiveness and contribution of labor to the overall production. <https://www.education.gov.in>

Industry revealed that the fresh technical graduates also face challenges while preparing detailed reports for the civil engineering projects as they are unable to identify some areas of construction engineering and management which can be the shortcomings in their work abilities. To be career ready, technical students need to get engaged in outside classroom project practicum and work on the construction sites, design offices and project management areas. It becomes the requirement to acquire the development of key skills required by industry such as teamwork, time management, problem solving along with the required technical competence or field knowledge skills. (Source: Statista Research Department)

### **6.3 Project Based learning (PBL), internship and constructivism**

Constructionism is a process of constructing knowledge step by step. Individuals learn best when (Harel and Papert, 1991) (Kafai and Resnick, 1996) they seek the problem and construct a solution, shared with others for their reflection.

Constructivism (Perkins, 1991 Piaget, 1996, Vygotsky, 1978) knowledge constructed by individuals in interactional environment and the observance and knowledge gain is different for everyone. The new knowledge can be constructed

by interacting, investigating, and involving in the activities based on their current knowledge. In 1900's John Dewey expressed 'learning by doing.' Similar learning profile is reflected in constructionism and constructivism. Another essential element of constructionism is engaged learning as individuals construct their own project or experience to gain knowledge.

Project based learning pedagogy is an engaging instructional method to actively construct the knowledge. Project based learning and construction of new knowledge enable the learners to grasp on the abilities and skills experienced during the process. Hence, the constructionism, PBL and collaborative learning or internship program goes together in successful achievement of learning.

#### **6.4 PBL and engineering education**

Engineering education accomplished throughout the history are examples of individuals striving to solve problems that are often considered untenable at the time. PBL presents an opportunity to reintroduce the breadth into engineering curriculum by participation in real projects as practical implementation of knowledge-based education approach. Project based Learning is an important pedagogical tool of the engineering education. PBL challenges students to connect theory with real life problems. Students are required to solve project scenarios with technical and non-technical skills. PBL is also an adequate approach for engineering education, as it resembles the professional behavior of the engineering discipline.

#### **6.5 Need for PBL approach as an internship program in Civil engineering discipline**

PBL is the critical component in the applied or authentic internship program's settings. Project based internship program branch out from similar profiles such as learner-centered, inquisitive environment, problem solving and communicative approaches. A learning aspect of project-based learning (PBL) that can be achieved in form of internship or field experience in industry where learner will be able to learn how to strategically tackle real life work scenarios. The internship programs

gave the learners an opportunity to experience the corporate structure, processes and gain authentic learning and practice in respective disciplines (Johari, Bradshaw, Augilar, 2002). Internship is the experience of learning by observing, monitoring, and performing project or onsite activities with the field professionals. Internships are designed or structured in a way to provide students practical work experience and exposure to the field challenges. The interns get an opportunity to explore various areas of its professional education, and which provides them an insight to explore, choose and focus on the career path in their professional area. Focusing attention on PBL, theoretical and practical framework of subject matter and learner-centered environment can make internships successful and worthy.

## **6.6 Review of related literature**

The reviewed studies have identified the benefits of using PBL pedagogy at various levels of education. Creghan, Casey and Adair-Creghan, Kathleen. (2015) Avitz, Jason (2008) worked towards engaging high school students through PBL related activities and elevated their interest in collaboration and learning. A similar result was reported by Mioduser David, Betzer Nadav (2007), Kartika Arum Sari, Zuhdan Kun Prasetyo, and Widodo Setiyo Wibowo (2017) had identified that PBL pedagogy contributed in bringing positive attitude and improvement in learners problem solving abilities, collaboration and communication skills with project based learning (PBL) approach. Shi-Jer Lou, Yung-Chieh Chou, Ru-Chu Shih, Chih-Chao Chung (2016) studies reports that PBL STEM experience learning influenced the creativity of high school learners. PBL involved learners in the repeated process of preparing, implementing, evaluating, and presenting their work and resulted in gaining knowledge, positive attitude, creativity, problem solving and communication skills.

Asan, Askin and Haliloglu, Zeynep (2005) and Panasas Mookdaporn Nuangchalerm Prasart (2010) revealed that PBL incorporation in course class had improved student's collaboration and communication skills. Hence, the Problem based learning approach was reasonable and the implementation of it for

elementary, middle, and high school learners improved problem solving abilities, collaboration, and communication skills.

The reviewed studies conducted in different areas of higher education at undergraduate level, graduate level and preservice teacher education showed the contribution of PBL in gaining knowledge, improving technical competence or field knowledge, soft skills such as teamwork, problem solving, time management, critical thinking, decision making and communication skills. Pee, S. H. and Leong, Helene (2005), Hashim, Roslan, Azizi Mohd Din, Mokhtar (2009), Musthak Ahmed Syed, G. Madhuri, Reddy M. Sampath, Condoor Sridhar S. (2018) had implemented PBL in various ways and identified PBL's contribution in learning and development of soft skills. Study result showed that students had appreciated the curriculum structure where they can interact with industry experts and work on real world problems. Engineering course with PBL pedagogy had proved effective improvement in skill development, soft skills, critical thinking, problem solving and creativity among students. Lee, Peiyu (2010) Yam, Lee Hong Sharon and Rossini, Peter (2010), Mergendoller John R., Maxwell, Nan L., Bellisimo, Yolanda (2006), identified the positive impact of introducing PBL with different courses and PBL participants learned to collaborate effectively with multidisciplinary teams, taking responsibilities, to be accountable for decisions taken and their usefulness and applicability in professional environments

The reviewed studies reported the benefits of internship program at various levels and fields of professional education. Results of the studies revealed that participants of internship program got the opportunity to explore and experience the work environment which prepares them as professional and skilled individuals.

Bee croft, Pauline C., Faan; Kunzman, Lucy MS; Krozek, Charles MN. Skledar Susan J., Martinelli Barbara, Wasicek Kelley, Mark Scott, Weber Robert J. (2009) study's findings revealed that the participants of the internship program had improved personal skills, contributed in creating interest and recognizing the professional opportunities.

Matthew, S. M., Taylor, R. M. and Ellis, R. A. (2012) Lam Terry, Ching Larry, (2007). Abell, Sandra K. Dillon, Deborah R., Hopkins Carol J., McInerney William

D., O'Brien, David G. (1995) study's findings shed the light on the positive responses and results for the implementation of internship program. The results reported that interns' soft skills, communication skills, decision making abilities, problem solving and understanding the work environment that had been enhanced. The present study focused on developing and implementing PBL-Internship Program for third year undergraduate civil engineering students.

## **6.7 Rationale of the study**

Due to education importance of technology scientists and engineers are getting the international attention in the current economy. Globalization of technical ideas and overall development brings the focus on the education and availability of technical skilled professionals. The research done in technology and engineering programs brought immense improvements in teaching and learning environments which brings digital sources of knowledge that can be accessed by all. Learners can learn the subject content theoretically in classrooms and from the e-sources but lacks in experiencing field work scenarios. Despite Technical Education Curriculum by AICTE which includes professional core courses, laboratory practical work related to Course work at institutes, class projects and other promotional programs for technical education, technical society still lacks to keep up with the job Industry. More than 60% of the engineering graduates every year remain unemployed and this is the potential loss of 20 lakh man days annually ("Times of India" Report 07-27-2017). The response to above concern by 'Anil Sahasrabuddhe', Chairman, AICTE that fresh graduates are under employable and lacked in industry needed skills. The job Industry reveals that 60% of our graduates are not fully career prepared so they need further training, and these 60% students won't also get compensated in terms of salary as compared to 40% of their peers. Thus, there was a felt need of incorporating the method or a program of Project Based Learning for individual or small groups of students to engage them in the field practicum which will let students reflect their course work learning and understanding.

As the researcher has the education background in Civil Engineering and had experienced this gap and had faced challenges for the path from fresh graduate to career ready skilled individual while looking for job after graduating. The researcher had personally experienced the incapability of linking academic theory to civil engineering professional practice and her inability in reflecting the relating learned professional course content to it. So, this remained Gap has initiated the research process in researcher's mind to find out what aspects of our technical education or curriculum are missing which limits the fresh graduates as unskilled individuals not the career ready skilled individuals of which there is shortage in the job industry.

In reference to Times of India Report 07-27-2017, researcher felt that engineering students need the exposure to the real field challenges and onsite work scenarios along with their theory and practical course work content to get a better knowledge of their professional field.

Reality is constructed as communication happens, in two ways. First order reality and second order reality (Oxford University Press, 2017). A first order reality in context with the classroom learning is what students or learners are observing, listening during the lecture hours. Second order realities involve of attaching meaning to the classroom learning (first order reality) by getting linked with outside world with PBL conception (second order) for better understanding and knowledge. Researcher felt that a strong bridge between first order to second order reality can help to cover the gap from fresh graduate to career ready professional. In context to it researcher reviewed the instructional principles of Constructionism as per Seymour Papert which are viewed as the reconstruction of knowledge and learning by connecting it with the real-life projects. Constructionist theory, Seymour Papert, Idit Harel (1991), David L. (2014) involves learning-by-making or emphasizes on student centered learning by incorporating PBL methodology in the learning courses to make connections between theory and real-world scenarios which can benefit the professional career of students.

Researcher has reviewed the Literature and found out that the studies had been done by (Asan, Askin and Halilogl, Zeynep (2005) and Panasan Mookdaporn,



Nuangchalerm, Prasart (2010)) by incorporating (PBL) Project based learning methodology in curriculum at various levels of education such as elementary, middle, high school, polytechnic, undergraduate and graduate level. Researchers had identified the benefits of using PBL in terms of enhancing academic skills and soft skills. Some studies revealed the students' satisfaction with the PBL process, and they recognized the key skills required by industry such as group work, time management and development of technical competence were enhanced.

Related studies Lee, Peiyu (2010) Yam, Lee Hong Sharon and Rossini, Peter (2010), had inclined towards the benefit of incorporating PBL in classroom and outside classroom activities. Literature indicated that the studies conducted by (Lee, S.H. and Leong, Helene (2005), Hashim, Roslan, Azizi Mohd Din, Mokhtar (2009), Musthak Ahmed Syed, G. Madhuri, Reddy M. Sampath, Condoor Sridhar S. (2018)) for incorporating PBL in design course for Civil engineering students and a field engineering surveying camp of two weeks revealed positive results in developing critical thinking and professional skills in addition to improved academic skills. Students or learners show more reflectiveness for the learning experience to course content.

The benefits of studies conducted for Civil Engineering students convince researcher's mind and increase researcher's confidence in working towards research process of how to fill the gap and trace the path from fresh graduate or unskilled individuals to career ready or technically skilled individuals. As per AICTE's norms for Civil Engineering curriculum for 2017, the students' study most of their professional core courses during first three years of total four-year B. Tech program. The exposure to practical study is done in a controlled way and only in the institution which blocks their exposure to real field challenges and problems. The field knowledge and experience can be obtained by joining respective industry operations as an intern or attending internship programs.

As per AICTE's 2017 curriculum, the Internship Program or field experience has not been made mandatory in all engineering institutes, even the institutes which does have Internship program does not count towards its credibility or has been given no credits in the undergraduate course curriculum.

Hence, a need was felt for incorporating the method or a program of Project Based Learning for individuals or group of students to engage them in field work activities which will give the students an opportunity to reflect their course work learning and understanding. Field work assignments or internship programs incorporate and emphasize on reflecting the lessons learned in the classroom into real world experience which are set in a professional oriented environment. It offers students the opportunity and exposure to develop professional skills such as teamwork, effective communication, social interaction and professional networking, an understanding of corporate procedure, leadership, and critical thinking skills along with enhancing academic skills.

Considering the benefits of PBL and internship for previous done studies and reviewing the related literature, Researcher was convinced, move forward, and had proposed a PBL based three-week field internship program for third year civil engineering students. Researcher believed that the learners would get an opportunity to explore the different branches of civil and construction engineering and the associated field challenges to them. For the proposed curriculum PBL based Internship program students or interns performed project-based learning field practicum assignments for Site survey and ground investigation, construction site excavation, understanding soil testing Reports, foundation design and construction, RCC foundation construction, building construction, coordination of construction plans, Precast structures, construction management, and industry administrative practices. It also provided an exposure to understand the business procedures, budget aspects and time management skills. Students experienced and identified the challenges of transition process from construction design plans or drawings to actual construction and building practices. However, as far as the best of researcher's knowledge while reviewing the related studies, no research has been reported to find the impact or effectiveness of incorporating PBL approach in the form of Internship Program for Undergraduate Civil Engineering Students. Hence the researcher proposed this study to measure the effectiveness of employed PBL approach in the form of internship program in the present Civil Engineering Curriculum for B. Tech Civil Engineering students.

## **6.8 Research questions**

- When applied to internship is the PBL approach in curriculum effective for Civil Engineering students?
- Can the developed curriculum (field practice/ internship) incorporating PBL for Civil Engineering students make learning effective?
- Can the implementation of the developed curriculum for field practice incorporating PBL for Civil Engineering students make learning effective?

## **1.9 Statement of the study**

“Developing, implementing, and studying the effectiveness of internship curriculum based on Project Based Learning (PBL) for third year sixth semester students of civil engineering for construction field preparedness”

## **6.10 Objectives of the study**

- To assess the need and scope for implementing Project based Learning for internship program at bachelor’s level of Civil Engineering.
- To develop the Project based Learning curriculum for internship program at bachelor’s level of Civil Engineering.
- To implement the Project Based Learning curriculum for internship program at bachelor’s level of Civil Engineering.
- To study the effectiveness of the developed Project based Learning curriculum for internship program at bachelor’s level of Civil Engineering program.
- To study the improvement in technical competence/gained field knowledge for the conducted Project based learning curriculum at the bachelor’s level of Civil engineering program.
- To study the development and improvement in soft skills for the conducted Project based learning curriculum at the bachelor’s level of Civil engineering program.

## **6.11 Operational definition of the terms**

**Effectiveness** in the present study was seen in terms of the gained academic knowledge or improvement in technical competence (improvement in scores for pre-test and post-test), development and improvement in problem solving and other soft skills like technical writing, communications, and teamwork.

### **6.11.1 Explanation of terms:**

**Project Based learning (PBL)** - PBL is a student-centered educational approach.

To fill the gap from fresh graduates to technically skilled or career ready individuals the bridge needs to be incorporated in the curriculum for the students by involving them in the outside classroom field practicum which may help in developing the needed professional and soft skills such as teamwork, problem solving along with improvement in the academic knowledge.

**Curriculum:** Per the present study, the designed field Curriculum for the internship program incorporates the method or a program of experiential learning in the form of PBL based Internship program for individuals or small group of students to engage in the field practicum which gives an opportunity to the students to reflect their course work learning and understanding during project practicum activities.

**Implementation :** In this present study, project based learning internship program curriculum was implemented for the third year Civil engineering students. Students were divided into groups with six to seven students in each group. All the groups were engaged in field practicum activities as per researcher designed field practicum assignments for four to five hours a day for a period of fifteen days on the on the respective site/ field at construction site under the supervision of civil engineering site supervisors and the researcher. Students monitored, identified, and collected the information for the assigned practicum and submitted daily reports, weekly reports, final project reports and delivered project presentations along with appearing for Pre-test, post-test for the attended PBL based Internship program. Delayed Post-test was also conducted after three months to review the retention level of students for the gained knowledge during internship program.

**Technical Competency:** It is the skill or technical knowledge of area in the specific industry. Technical competence or field knowledge is the gained field or technical knowledge while getting engaged in field or site civil and construction engineering activities. It is measured as the understanding skills (improvement in understanding skills specific to internship practicum activities), confidence (professionalism, knowledge of field practicum, challenges, or strategic planning for finishing projects before designated deadlines), gained field knowledge (administered test scores) and classroom discussions. Technical competences were measured by the difference in the scores obtained by the interns or students for pre-test and post-test, observations made by the researcher and feedback analyses from the evaluation forms duly filled by students and site supervisors at the end of Field practicum for this designed PBL internship program or present study. Technical competence or gained field knowledge for this study was measured by comparing the mean achievement scores of pre-tests and post-tests of program participants, retention of gained knowledge by comparing mean achievement scores of pre-tests, post-test and delayed post-test and post site visit questionnaire performance.

**Soft Skills:** are subtle behavior and communication styles that help make work environment or interaction with team members and supervisors comfortable. Soft skills were measured in terms of teamwork, time management, problem solving, technical report writing and communication and presentation skills.

**Problem solving Skills:** It is the process of conceptualizing, applying, analyzing, and evaluating the information to reach an answer or a conclusion. Learners' ability to define, analyze and evaluate the challenges or problems during the construction practicum activities showed the improvement in solution seeking skills for learners while experiencing practicum activities compared to the foreseen theoretical challenges. The feedback analysis from student and supervisor evaluation/feedback forms provided an insight about the development and improvement in the problem-solving skills of the students.

**Teamwork Skills:** was measured in the terms of behavior of students in rapport (building relationship, demonstrate respect), openness (work productively in diverse perspectives), effort (does fair share of group work), synthesis (drawing

conclusions with other team members) while participating in their respective teams for the assigned internship group practicum of field internship program. The researcher's observation during practicum activities and analysis of students and supervisors evaluation/feedback forms gave an insight about the development and improvement of teamwork skills in the learners.

**Technical Report Writing and Presentation** : was measured in the terms clarity (clear and understandable expression of technical information), relevance (synchronizing the relevant material), organization (logically organize the structure with reasonable approach) of technical writing for daily reports, weekly reports, final project report of field practicum assignments and delivering as final internship project presentations for the designed practicum activities for PBL based Internship program of this present study.

## **6.12 Delimitation of the study**

This study was delimited to the third year Civil Engineering undergraduate students who had attended and conducted the PBL based Internship program's project practicums for three weeks as per researcher's developed curriculum.

## **6.13 Hypothesis**

The null hypothesis was as follows:

- There will be no significant difference between the mean achievement scores of Pre-tests and Post-tests of third year civil engineering students at 0.05 level.
- There will be no significant improvement in technical competence level or gained field knowledge of third year civil engineering students at 0.05 level.
- There will be no significant development and improvement in the soft skills of third year civil engineering students at 0.05 level.
- There will be no significant retention observed in mean achievement scores of Delayed Post-test of third year civil engineering students at 0.05 level.

## **6.14 Nature and source of data**

The objectives of the study suggested the data to be collected through various sources as well as numerous ways. The achievement mean scores of pre-tests and post-tests were taken for measuring the achievement in gaining knowledge. The development in soft skills and other intellectual abilities were evaluated from the designed feedback forms. The effectiveness of internship program was assessed and evaluated qualitatively and quantitatively with the following designed tools of data collection.

- Pre-test
- Post-test
- Daily reports
- Weekly reports
- Project Report and Presentations
- Student Evaluation form
- Field Supervisor Evaluation form
- Delayed post-test
- Delayed Post site visit questionnaire

## **6.15 Research Methodology and design of present study**

The research methodology proposed for this study was Experimental.

The design employed for the study is One Group Pre-test, Post-test.

$O_1 - X - O_2 \dots\dots O_3$

X = Group of sample students of third year Civil Engineering undergraduate program for PBL based Internship Program.

$O_1$  - are scores of the students in the researcher designed made achievement Pre-test, administered before implementing the PBL based internship Program.

$O_2$  - are scores of the students in the researcher designed made achievement Post-test, administered after implementing the PBL based internship Program.

$O_3$  - are scores of the students in the researcher designed made achievement delayed Post-test, administered after three months of conducted of PBL based internship Program.

Researcher conducted the delayed post-test after three months of implementation of PBL based internship program. The mean achievement scores of pre-tests and post-tests of the students were compared to calculate the t values which were compared with t-table critical values for the findings of the study. The mean achievement scores of pre-tests, post-tests and delayed post-tests were compared to identify the retention of the gained knowledge for the present study.

### **6.16 Population**

The population of the present study consisted of all the third year, or sixth semester students of Undergraduate Civil Engineering program affiliated to All India Council of Technical Education (AICTE) for the year 2017-2018.

### **6.17 Sample and Sampling Technique**

**Sample:** The research study was conducted with thirty-three sixth semester undergraduate civil engineering students. The sample of students was selected from one of the technical institutes located at Vadodara City, Gujarat which offers four-year undergraduate degree program in civil engineering. Owing to growing economy, researcher identified the abundance of improvement or development projects in civil engineering were happening in Vadodara City, which gave researcher an opportunity to locate and finalize the internship/project practicums site for civil engineering construction activities required to implement the developed curriculum for PBL based Internship program in Vadodara City itself for the present study. Researcher had conducted PILOT study and present/main study with group of participants from different institutes who are third year students of bachelor's in civil engineering program. The sample for both studies was categorized large as number of study participants was more than 30. The sample size represents large population because the population sample represents does follow the same curriculum guidelines of AICTE's curriculum for bachelor's in civil engineering program.

#### **Sampling technique**



Vadodara is the city in Gujarat, India which has number of institutions which provide a great platform for higher education in the field of engineering, arts and social science. Some of the institutes which offered Bachelor of Civil Engineering program at the in Vadodara, Gujarat are:

Babaria institute of Technology

KJ Institute of Engineering and Technology

Maharaja Sayaji Rao University of Baroda

Parul Institute of Engineering and Technology

Orion Institute of Management and Technology

School of Engineering and Technology, Navrachana University

Researcher had approached couple of technical institutes affiliated to AICTE, offering undergraduate degree program in civil engineering in Vadodara city, Gujarat. Researcher interacted with the management, faculty members and students and present the objectives and implementation plan of the present study or designed PBL curriculum for the internship program. After the approval from the technical institute authorities, interested civil engineering undergraduate students had filled up the consent form to attend the present study or PBL internship program.

### **6.18 Tools of Data Collection**

- Pre-test - researcher constructed pre-test to evaluate the students present field knowledge of the construction site practicum for the same topics (Site Survey and Ground Investigation, Construction Site Excavation Activities, RCC Foundation Construction, Building Construction Activities, Precast Structures, Construction Management and Administrative practices) as the similar post-test will be administered from. Pre-test was administered before the implementation of the PBL based internship program and the format of the pre-test included the short questions and multiple-choice questions for all the designed sections or topics of the present study's curriculum. The pre-test is enclosed in Appendix 5.
- Post-test - researcher constructed the post-test to evaluate the improvement and gain in the technical field knowledge for the construction site practicum of the students for the PBL based internship program. The evaluation was done by

conducting the post-test after the completion of PBL based internship program. The post-test's format and test questions were similar to the designed and conducted pre-test. The post-test is enclosed in Appendix 7.

- Delayed post-test - was constructed to assess the retention of gained field knowledge by the students of the PBL based internship program after the period gap of three months. The retention evaluation for the students was conducted after the time gap of three months by administering the delayed post-test. The format and questions delayed post-test was similar to the previously conducted pre-test and post-test. The delayed post-test is enclosed in Appendix 12.
- Daily Reports - was constructed to assess each group's learning and clarity for the assigned and conducted field practicum in technical field knowledge and technical report writing on the daily basis. The assessment was measured in the terms of gained field knowledge and technical writing format reported in the daily reports and the effort and contribution of all team members as a teamwork while preparing the technical daily reports of PBL based internship program.
- Student Evaluation form: this form was constructed to evaluate the students clarity on the level of technical competency and learned and improved soft skills like communication skills, problem solving skills, teamwork skills attained after participating in the designed PBL based internship program. Students provided self-evaluation feedback on Likert scale, responded to the open-ended questionnaire for the level of skills attained in the communication, problem solving, technical competence, teamwork, and their overall learning experience for participating and attending the present study or PBL based internship program. The student evaluation /feedback form is enclosed in Appendix 8.
- Site Supervisor Evaluation form: tool was constructed to assess and evaluate by the site supervisors for the gained field practicum knowledge or technical competence and the soft skills like communication, problem solving, technical competence, teamwork of the PBL based internship program students. From their observances and experiences while working with the students during the implementation of PBL based internship program, site supervisors provided the feedback for the open-ended questions and on the Likert scale for improvement

and the level of skill attained in the communication, problem solving and technical competence after attending the PBL based internship program. The site supervisor evaluation/feedback form is enclosed in Appendix 9.

- Weekly progress report: this tool was constructed to assess students' progress in gained technical knowledge and describing it in technical writing in the form of report on the weekly basis. It was made mandatory for all the students to individually submit the weekly progress reports. The assessment was measured on how well the students had followed the format of the technical report writing by including graphics, explaining technical terms, organizing content, and also reporting on the field practicum procedures and queries for the assigned and conducted field practicum assignments for PBL based internship program.
- Project Report - this tool was constructed to assess and measure the progress in the improvement of organizing the content, format, clarity, and precision in technical writing skills of PBL based internship program students. The assessment of project report writing of students was assessed by evaluating the organization of the technical content, flow, and the clarity of the technical writing as per the provided format and designed rubric. The project report format and rubric are enclosed in Appendix 10.
- Project Presentation: this tool was constructed to measure the format, organization, clarity, and delivery of the prepared project presentation content in a professional and in the confident way of PBL based internship program students. Each student advocates the learning about the acquired experience and knowledge during conducting field practicum activities and the evaluation of delivered project presentation was based on the students' and team's performance as per the provided presentation format and the designed rubric. The project presentation format and rubric are enclosed in Appendix 11.
- Delayed Post Site visit questionnaire was constructed to assess the retention of gained field knowledge by the students of PBL based internship program after the time gap of three months. The reflectiveness and the retained field knowledge attained during the conducted PBL based internship program was measured and assessed by the delayed post site visit questionnaire duly filled by the students

during the post site visits. The project report format and rubric is enclosed in Appendix 13.

Designed tools of the study were reviewed and validated by the five experts. Two experts from civil engineering education reviewed the course work to be covered, designed achievement tests, developed daily field practicums. Third expert was from civil and construction engineering and had reviewed the developed daily field practicum for this PBL based internship program. Fourth expert was from education area and had reviewed the language and educational/pedagogical tools of the PBL based internship program. The fifth expert was from an engineering education field and had reviewed the theory and field practicum activities for the desired learning outcomes of proposed PBL based internship program. The list of experts is enclosed in Appendix 1

Researcher had involved Expert 1 from the initial planning phase of field activities to final design of curriculum phase of field work activities for students. As additional supervision for students on Construction site, field expert suggested to involve a Civil Engineering instructor or tutor along with the researcher to monitor and supervise the students while conducting project practicums for PBL based internship practicum.

Expert 2 suggested for AUTO CAD technical drawings to be incorporated instead of internet or printable images for better clarity and authenticity and to incorporate project practicums for concrete testing facility for more practical knowledge in building construction.

Expert 3 had suggested that the learning objectives need to be revised for more clarity, to include testing of materials and incorporate about reinforcement bars grade testing. in addition to the bar bending schedules and construction practices for other building components.

Expert 4 suggested for couple of long sentences in learning objectives to make short and clear, project activity time to be mentioned as hours and minutes (2hours and 30 mins) instead of only hours (2.5 hours), to incorporate examination style common format and general instructions for Pre-test and Post-test.

Expert 5 suggested that students to give feedback, in addition to a quantified scale for learning about the specific outcomes about each area of developed curriculum. Expert advised on putting a request to field supervisors during internships program for their feedback regarding learning progress or improvement in field knowledge of students for each section of developed curriculum. He suggested during data analyzing the supervisor's feedback comments can be utilized to categorize the improvement in field knowledge or soft skills for the developed sections of PBL based internship program.

Experts' suggestions had been incorporated in the tools, technique, and design of study by doing amendments to learning objectives, theory material diagrams, assigning more time for construction/project site project practicums, testing of materials and incorporating sections in student and supervisor feedback /evaluation forms.

### **6.19 Components of the developed curriculum for proposed PBL based Internship Program**

The AICTE curriculum chart showed that core professional courses like Surveying, Geotechnical, Foundation and Building design structures and Hydraulics had been covered till third year or six semester of undergraduate Civil Engineering course. Precast and construction management were included for their relatedness to construction field activities to provide overall knowledge of field scenarios and learning other skills. Researcher had proposed the following areas to be covered in three-week Field Internship program offered after the completion of sixth semester or third year of undergraduate civil engineering program.

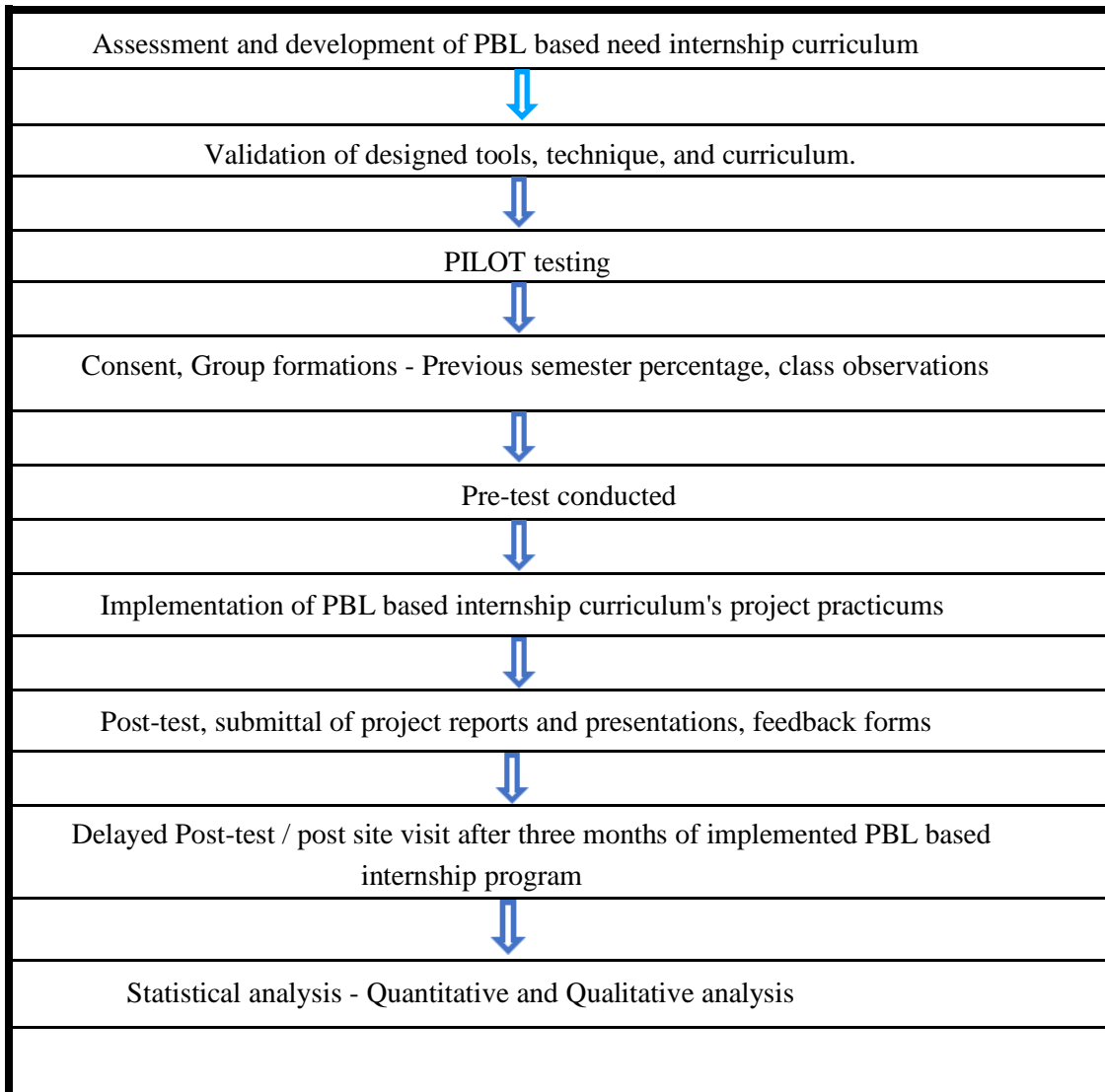
1. Site Survey and Ground Investigation
2. Construction Site Excavation Activities
3. Soil Testing Reports, Foundation Design, Coordination of construction plans
4. RCC Foundation Construction
5. Building Construction Activities
6. Precast Structures
7. Construction Management and administrative practices

## 6.20 Process of data collection

The process of data collection was done in separate phases. The phase diagram below shows the data collection process of PBL based Internship program's implementation flow

**Table 6.1**

*Flow chart for process of data collection for the present study.*



## **Phase I: Need Assessment and Development of Internship Curriculum**

In perspective of civil engineering, internship program is viewed as an effective platform for engineering students for experiencing about the corporate world. Internships are designed or structured in a way to provide students practical work experience and exposure to the field challenges. The interns get an opportunity to explore various areas of its professional education and provides them an insight to explore, choose and focus on the career path in their professional area.

Internship curriculum was developed to improve the technical competence or knowledge of subject matter while observing and participating in the field practicum. The objectives of present study or developed curriculum for PBL based internship program was:

- Students will be able to perform topographic survey and ground investigation of the site.
- Students will be able to monitor excavation site activities as per site building plans.
- Students will be able to analyze the soil testing report for load bearing capacity of proposed building.
- Students will be able to reflect the classroom learning for site building foundation design and construction.
- Students will be able to examine the (BBS) bar bending schedules and concrete mix design grade for foundation construction as per foundation design drawings.
- Students will be able to identify the concrete mix pouring methodology as per standards and regulations.
- Students will be able to monitor the construction practices of building components such as beams, lintels, slabs, columns etc. as per site building design drawings.
- Students will be able to identify the advantages and disadvantages of Pre-cast concrete components in civil engineering construction practices.
- Observance of work hours, the importance of punctuality virtue of the individuals and its implementation in an organization.

- Observance of time management skills as preparing and submitting the reports on scheduled time and meeting deadlines of the projects.
- Enhancing presentation skills which includes appropriate expression, presentation, oral and written communication, and self-confidence.
- Lifelong learning skills like ability to adapt, decision making and teamwork.

### **Phase II: Field testing of developed PBL based internship curriculum as PILOT program**

The PILOT program is the field trial out of the main designed study. The field try out represents the prepared curriculum and allows to observe the learning experiences and desired outcomes of planned internship field practicum for students. It also helped to identify the challenges come across during the implementation of designed Internship program such as interaction between team members and with field supervisor.

PBL implementation in the form of PILOT program was conducted on sample students of 6th semester, third year civil engineering undergraduate course students. and had attained the technical competence for civil engineering core professional courses. Based on their completed professional course work, researcher had developed the field experience curriculum for 40 hours for the pilot program. This program includes reviewing theoretical material related to site activities, onsite and field work activities and expert lectures related to field or site activities. Researcher had approached the local civil engineering companies for the site project activities, expert lecture for the developed PILOT program.

#### **Approaching technical institutes and local construction company:**

Researcher approached, interacted with local construction company and couple of technical institutes management and faculty which are affiliated to AICTE and offers undergraduate degree program in civil engineering in Vadodara City, Gujarat and got the approval to implement and conduct the developed PBL based Internship as PILOT program.

**Pre-test and Project Based grouping:** Researcher administered Pre-test, conducted class observations and group formation of sample of thirty students was done as per the class observations, faculty suggestions and previous semester's



percentage attained. Each group had average, below average and bright students and fluency in English language. Groups were instructed to choose a group leader for each group to lead the group in field practicum assignments.

**Implementation of PBL program curriculum:** Students reviewed the background theory of related topic as forwarded by the researcher before conducting project practicums. PILOT program students were given instructions, teaching and discussion sessions daily with each group for the background theory related for the scheduled field practicums. Students had observed, monitored, and inquired for the scheduled and assigned practicum to be conducted on the sites in their respective groups as per developed PBL based internship program curriculum. Students kept the logbook for noting or reporting down the discussions done with the site supervisors for the observed construction site procedures and the field challenges. Students prepared the daily project practicum reports, final group project reports and deliver group project presentations.

**Assessment of PBL based Internship program as PILOT program:** The learning outcomes of the PILOT program were assessed by conducting quantitative analysis by comparing the mean achievement scores of pre-tests, post-test, and delayed post-test for the students. Qualitative analysis was done for the Project reports, Project presentations and the evaluation and feedback forms received from the students.

### **Phase III: Implementing of PBL based Internship program's curriculum**

PBL implementation in the form of internship program was conducted with thirty-three third year or sixth semester civil engineering undergraduate students. The students had acquired the required competences of core civil engineering undergraduate courses and the PBL based internship program was developed to reflect their classroom learning in the field/project practicums to develop, refine and improve the technical competence or field knowledge and soft skills.

**Approaching civil construction companies and technical institutes:** Researcher had approached the local civil engineering company and couple of technical institutes affiliated to AICTE, offering undergraduate degree program in

civil engineering in Vadodara City, Gujarat. for the present developed PBL based internship program. After observing, locating and identifying few construction sites, researcher finalized the internship site and started meeting and getting approvals from project engineers, site supervisors, institutes management and faculty members, on coordinating and synchronizing the upcoming schedule of ongoing construction with the PBL based internship program's field/project practicum curriculum and students' available schedule. Project practicums for PBL based internship program was conducted for 3 weeks, 15 days on construction site from Monday through Saturday from 9 am to 1 pm

**Pre-test and Project based grouping:** Researcher began with the class observations and interactions with the interested students. After interaction and class observations of students, pre-test was conducted, and the group formation was done with six-seven students in each group. Grouping of students was based on the percentage attained by the students in the previous semester of undergraduate civil engineering course, class observations and personality and the fluency in language. Each group had bright, average, and below average students and all groups were instructed to choose a group leader for each group.

**Implementation of PBL based Internship program field practicums:** The implementation of PBL based Internship field practicum began with construction site orientation to the program participants. The groups were instructed about the internship location, schedule of field practicum, internship timings, safety precautions and construction site discipline to be maintained. The program participants introduced themselves in groups and get familiarized with internship Site, construction manager, project engineer and site supervisors. For each group of students' researchers forwarded the schedule for field practicums and related theory material a day before to review and refresh the background knowledge of related topic before conducting field activities on the site. Before conducting field practicum, program participants were given instructions, teaching and discussion sessions daily for the background theory related to scheduled field practicum with each group of internship program participants. Participant groups were instructed to meet the assigned site supervisor to discuss, review and conduct the assigned

field practicum. Researcher arranged the site visits to GERI (Gujarat Engineering Research Institute) and Precast Manufacturing Plants for envisioning them about other related aspects of construction engineering. Civil engineering Field Expert lecture and class discussion was also arranged to give the learners or interns an insight about the field experience and skills needed in professional career progression.

**Assessment of PBL based internship program:** The learning outcomes of the PBL based internship program were assessed by conducting quantitative analysis by comparing the mean achievement scores of researcher administered pre-test, post-test, and delayed post-test of the students. Qualitative analysis was done for the self-evaluation and feedback forms received from the students, site supervisors, submitted final project reports, delivered project presentations and researcher's onsite observations during PBL based Internship program.

Researcher had observed and monitored the students and their curiosity to learn during the PBL based internship program period while they conduct field practicum in their respective groups. Students were instructed to explore and understand the construction site related information on the internet along with the related theoretical material (provided by researcher) for the field practicum assignments and be knowledgeable about the construction practices so they can clarify their topic related doubts or queries with the construction site supervisors during PBL based Internship program's field practicum assignment.

**Phase IV: Determination of effectiveness of PBL based internship program's curriculum.**

The effectiveness of implemented PBL based internship program was determined by administering the tools of data collection.

**Achievement tests (Pre-test, Post-test, and Delayed post-test):** Researcher designed the achievement tests Pre-test, Post-test, and delayed Post-Test as tools of data collection. The sample of students was single large group that appeared for the initial test (pre-test) and followed by field internship (PBL) and re-administration of similar test as final test (post-test) and then later as delayed post-test or retention test (after 3 months). Since, the initial and final tests were responded by the same

group of individuals, so the data collected was correlated. The achievement tests comprise of short answer and multiple-choice questions related to the sections or topics of PBL based internship program's curriculum. The difference in the mean achievement scores of administered pre-test and post-test measured the improvement and gain in technical field knowledge of the sample students for the conducted construction site group project practicum.

Delayed post-test administered after the time period gap of three months from conducted PBL based internship program assessed the retention of gained field knowledge by the students after the time gap of three months.

**Student self-evaluation and supervisor feedback forms:** Student evaluation form (Appendix 8 - template) was filled by the students (Appendix 21 filled by a student participants) after the completion of the PBL based internship program. Students provided the self-evaluation feedback on Likert scale and responded to the open-ended questionnaire. This form measured the effectiveness of PBL based internship program with the feedback provided by the students for the improvement in technical knowledge and the level of soft skills attained for their future career plans and goals. Researcher requested the site supervisors for their evaluation and feedback for the students' performance from the beginning of the program through the end. Site Supervisor evaluation form provided the feedback (Appendix 22 filled by internship site supervisors) for the gain in field knowledge and the level of soft skills attained in the communication, problem solving and technical competence in the students after attending the PBL based internship program. Researcher's observation and monitoring the student groups on the site, students' queries, engagement, interest, exploring and reflecting background knowledge with the ongoing field practicum, gained field knowledge, group leaders and team members suggestions were summarized under relevant topics in next chapters.

**Daily Report and Weekly Report:** Daily (Appendix 15) and weekly reports (Appendix 16) measured each student's and group's learning and clarity for the assigned and conducted field practicum in technical field knowledge and technical report writing on the daily basis and weekly basis. The assessment was measured

in the terms of gained field knowledge reported in the daily and weekly report and the effort and contribution of all team members while preparing the report as a group

**Project Report and Project Presentation:** The effectiveness of the project report (Appendix 17) was assessed and measured with the progress and improvement in organizing the content, format, clarity, and precision in technical writing skills. Project presentation (Appendix 18) was evaluated based on the format, organization, clarity and delivery of the prepared project presentation content in a professional or confident way. All the groups had submitted the project report and Project presentation for the PBL based Internship program for their respective teams and the effectiveness was measured based on designed rubric for project report and project presentation.

**Delayed post-test and post site visit questionnaire:** The effectiveness of the implemented PBL based Internship program was measured by conducting the delayed post-test similar to administered pre-test and post-test after the gap of three months from the implementation. The scores of the delayed post-test were compared with the pre-test and post-test scores and students' responses to the post-site visit questionnaire to measure the reflectiveness and retention of the gained knowledge or technical competence during the implemented and attended PBL based internship program.

**Researcher's observations:** Researcher observed and identified the soft skills that students had developed while working as a team, team members individual efforts and the fair share of work distribution among team members while conducting field practicum assignments and preparing project reports. Researcher regularly observed, discussed, inquired about the queries and their understandability with the students and with the site supervisors to get an insight about their perspective for improvement in the technical competence or field knowledge and soft skills after attending PBL based internship program.

## **6.21 Data analysis**

The data of the present study was analyzed qualitatively and quantitatively. The effectiveness of PBL based internship program and improvement in technical

competence was measured by comparing the mean achievement scores of Pre-tests and Post-tests. The development in soft skills and other industry needed skills such as teamwork, problem solving, time management, technical writing, project presentation was determined by researcher's observation and monitoring during the implementation of PBL based internship program. The evaluation and feedback forms filled by students and field supervisors, project reports and project presentations submitted and presented by the students for the conducted PBL based internship program.

#### **6.21.1 Quantitative analysis**

Technical competence or gain in field knowledge was measured and analyzed by comparing the mean achievement scores of conducted pre-test and post-test and by calculating and comparing calculated critical t values with t-table critical values (Appendix 19) for significant and insignificant gain in technical knowledge. Delayed post-test was conducted to analyze the retention of the gained field knowledge after three-month period from conducted project practicums.

The sample of study was single large group that appeared for initial test (pre-test), followed by experimental treatment and implementation, re-administration of similar test as final test (post-test) and then later as delayed post-test (after 3 months). The difference in mean scores, standard deviation and calculated t values identifies the significant or insignificant gain for measuring the improvement in field knowledge learning and improving technical competence of the students.

#### **6.21.2 Qualitative analysis**

Soft skills such as teamwork, problem solving, time management, technical project report writing, project presentation was qualitatively measured and analyzed from the feedback/evaluations from the field supervisors, students' self-evaluation/feedback, daily, weekly and final project reports and project presentations for the attended PBL based internship program.

PBL based internship program site supervisors had evaluated the performance of students from the beginning to the end of the internship program in the evaluation

form. Students had also provided their feedback and reported on developing and improving communication skills, teamwork skills and time management skills. Project reports and project presentations were submitted by the students during internship program and the descriptive analysis of submitted project reports and project presentations were based on the designed rubric for assessing the improvement in soft skills.

### **6.21.3 Researcher's observation of students during the PBL based internship program's implementation**

Researcher observed the students coordinating, collaborating, and performing assigned field practicum as a teamwork and submitted daily reports, weekly reports for the assigned field practicum conducted for the developed PBL based internship program. The daily discussion sessions with students before and after the field practicums gave the researcher an insight of the students' progress in gaining field knowledge, development, and improvement in soft skills

## **6.22 Major findings of the study**

Based on data obtained, the following are the main findings of the present study:

1. It was found that the difference in the mean achievement scores of researcher's conducted pre-test (42,64) and post-test (57.76) was significantly higher. The students had scored higher for similar questions in post-test after conducting project practicums of PBL based internship program than the pretest which was conducted before conducting project practicums of PBL based internship program. Hence the implementation of the developed curriculum of PBL based internship program was effective and there is significant increase in scores. T-test was found to be statistically significant at 0.05 level thus hypothesis no 1 (will be no significant difference in mean scores of pre-tests, post-test) was rejected. Therefore, development Project Based Learning curriculum for field-based practicum was found to be effective.
2. It was found that there is significant difference in scores attained by students for researcher's conducted pre-test and post-test. The significant increase in

post-test scores showed that the students had gained field knowledge and improved their technical competence at the bachelor's level of civil engineering program after conducting the project practicums.

3. It was found from the qualitative analysis of submitted project reports, project presentations, supervisor evaluation/feedback forms, student evaluation/feedback forms and delayed post site questionnaire that there is development and improvement of soft skills in students after conducting project practicums of PBL based internship program. Hence the implementation of PBL based internship curriculum was effective and had developed and improved the communication skills, teamwork skills, time management skills in the students at the bachelor's level of civil engineering program.
4. It was found by comparing mean achievement scores of researcher's conducted pre-test (42.64), post-test (57.76) and delayed-post-test (50.27). The mean scores for delayed post-test were higher than the pre-test scores which showed that there is retention of gained field knowledge attained during project practicums and students were able to retain their improvement in technical competence level. Hence the implementation of PBL based internship program's curriculum was proved effective as students retained the improved level of technical competence even after the time of three months from the conducted project practicums of PBL based internship program.
5. It was found through observations and site supervisors' feedback that students had developed and improved the teamwork skills conducting project practicums in a team and learned to work as a team member by sharing responsibilities and contribute towards getting project work done.
6. There was improvement in technical writing skills by learning standard formats and technical terminology while preparing daily reports, weekly reports, and final project reports for the conducted project practicums for PBL based internship program.
7. It was found out from the researcher's observations and site supervisor's feedback that students had developed and improved problem-solving skills as students learned about the unforeseen construction site challenges and figure



solutions for field scenarios while conducting and monitoring project practicums under the supervision of construction site supervisors.

8. It was found out from the researcher's observations and site supervisor's feedback that students had developed and improved time management skills by finishing the assigned field practicums and by submitting daily, weekly, final project reports and project presentations in the scheduled time frames.

### **6.23 Discussion**

It is evident through the findings of the study that the field/project practicums had contributed in terms of student's gain in the field knowledge and was effective with respect to students' achievement scores, developing skills and retention of gained field knowledge. Researcher's observations during implementation of project practicums, student and supervisor's evaluation/feedback form revealed that the students worked as a team, distribute fair share of work in a group member, interact and communicate among each other and were inquisitive for the inquiries with site supervisors.

Students reported in feedback form about the significant improvement in technical writing for project reports, confidence in presenting project presentations, punctuality virtue and time management skills to prepare and for submitting daily and weekly project reports. PBL based internship program site supervisors revealed that they had observed the improvement in technical competence or field knowledge during their interactions with students comparing from the beginning to end of the program. Site supervisors also noted the development in skills like decision making, problem solving, communication and in time management skills in students while conducting project practicums under their supervision.

The reviewed studies also showed that the improvement in the field knowledge or technical competence and in soft skills. Studies conducted by Mioduser David, Betzer Nadav (2007), Kartika Arum Sari, Zuhdan Kun Prasetyo, and Widodo Setiyo Wibowo (2017) results showed PBL pedagogy contribution in bringing positive attitude and improvement in learners problem solving abilities,

collaboration and communication skills which matched with the findings of the present study.

The findings of the Musthak Ahmed Syed, G. Madhuri, Reddy M. Sampath, Condoor Sridhar S. (2018) revealed that the PBL pedagogy provides the opportunity to students to work collaboratively in the groups, for share their knowledge, develop, and improve teamwork, problem solving, communication and other skills. The findings of the present study also matched with Alves Anabela C., Leão Celina P., Moreira Francisco, and Teixeira Senhorinha (2017) where students expressed the development and improvement in teamwork, time management skills and technical writing and oral skills.

The findings of the study by Bee croft, Pauline C., Faan Kunzman, Lucy MS; Krozek, Charles MN. (2001) investigated the benefits of Internship program matched with the findings of present study. The analysis shows that internship program participants were more professionally skilled and confident. The findings of the study Lam Terry, Ching Larry, (2007) investigated the satisfaction level and the expectations students towards their internship program. The findings of the study revealed similar results to the present study results. The analysis of the student feedback questionnaire for the present study revealed that the students felt that the team spirit, involvement, guidance and help from supervisors had motivated them during internship hours.

Studies conducted by Anabela C. Alves, Celina P. Leão, Francisco Moreira, Senhorinha Teixeira (2016 - 2017) Dole, Sharon., Bloom, Lisa., and Doss, Kristy K., Levitt, S., McKeage, A., and Rangachari, P. K. (2013) findings revealed that Project based learning in different areas provided similar benefits as of present study such as developing timelines and present problem / project outcomes in every stage of the learning process which helped in career opportunities.

## **6.24 Implication of the study**

The present study was conducted at the bachelors or undergraduate level of civil engineering program by incorporating PBL based Internship program curriculum. The objective of carrying out this study was to assess the need, develop,

implement, and evaluate the effectiveness of developed PBL based Internship program curriculum at bachelor's level of Civil engineering program.

The present study focused on preparing technical fresh graduates to technically skilled and career ready graduates. The growth and demand for skilled engineering and technical graduates has increased to large number as compared to the past times.

Higher or undergraduate technical education curriculum played a huge role in integrating students and fresh graduates in the industry. The economic viability, quality of life depends upon well-prepared future generation, which depends on well-structured curriculum and focus of learning and teaching on overall development of learners. Therefore, teachers and learners need to improvise their role to sustain in the globalized changing situations. In addition to imparting theoretical knowledge for professional core courses, its much needed to incorporate out of classroom experiences, industry or field visits, an active learning practice like Project based learning in form of internships, field practicum training in the undergraduate or bachelor's in civil engineering program curriculum. This will indeed develop and improve the technical competence or field knowledge, reflectiveness of classroom learning and soft skills along with the academic skills and learners as career ready graduates will be able to demonstrate the competencies, intellectual skills, and knowledge through their productive and satisfying careers.

The results obtained from this present study will inspire the universities, technical institutes, and departments to develop, incorporate and implement similar PBL based internship programs in their offered curriculums so to achieve professional education along with gained technical competencies and develop soft skills that will equip them to contribute to industry and successful professional careers.

### **6.25 Suggestions for future studies**

1. PBL based internship program can be developed and implemented for every year of undergraduate or bachelor's in civil engineering program. It may contribute in gaining field knowledge in understanding and learning theoretical course work.

2. A branch specific PBL based internship program can be developed for all undergraduate or bachelor's in engineering courses. It may contribute in practical learning and experiencing industry needed scenarios in all the other undergraduate engineering streams to gain knowledge in real life /field scenarios.
3. Problem based learning along with Project based learning can be taken up as research in exploring the field-based problems to make engineering students job ready.
4. Other professional undergraduate or bachelors' courses can introduce the PBL based curriculum in the other undergraduate streams such as medical, accounting etc. to gain knowledge in real field scenarios.
5. PBL based internship program can be developed and implemented with incorporation of industries for other professional undergraduate or bachelors' courses. By introducing industry-institute collaboration programs which may contribute in teaching soft skills, problem solving skills while working and learning from industry professionals.
6. A teacher training program could be developed to prepare faculty to develop and implement such PBL based internship programs. It may contribute in developing PBL based courses if faculty has been trained to implement such initiatives.

## **6.26 Conclusion**

The students who had conducted the project practicums for PBL based internship program found this program very effective in terms of improving technical competence by constructing or refining existing subject knowledge and by developing and improving of skills like teamwork, communication skills, technical writing skills and problem-solving skills pertaining to construction site where they were placed for their internship.

The main concluded areas are

- Students refined, improved and gained field knowledge of assigned project practicums which are reflective of classroom theoretical learning during conducted internship program.
- Students learned about the details of construction drawings and monitored the construction activities on site under the supervision of construction site supervisors respectively which gives them exposure on the format and preparing engineering design drawings.
- Students developed and improved the teamwork skills as were conducting project practicums in a group and sharing responsibilities as a team member.
- Students developed and improved communication skills while doing interactions with the team members, researcher, and construction site supervisors. The daily, weekly project practicum discussions and final project presentations by individual team members had played a good role in improving oral communication skills in students.
- Students improved their technical writing skills by preparing daily reports, weekly reports, and final project reports. The students' exposure to construction site activities while conducting project practicums had improved their understanding of writing technical reports, standard formats, and technical terminology about the civil engineering/construction site activities.
- Students were assigned project practicums in different subject areas from survey and site investigation, construction excavation, foundation construction, building construction, Ready to mix concrete batch plants and construction management which provides them the exposure to the different or sub areas of civil engineering which help them in identifying their interest in professional sub areas for their future careers.
- Students learned about the tender documents, bidding processes and safety procedures for workers on the site while conducting project practicums in construction management areas.

Students worked in teams or assigned groups, interacted, investigated, involved as a team member and with site supervisors while conducting PBL based Internship field practicums. The project practicums conducted for PBL based internship

program had contributed in developing and improving teamwork, decision making and problem solving, boosting confidence and communication skills. Students had learned the punctuality virtue and time management skills by finishing the assigned field practicums and submitting daily reports in the scheduled time frame. The clarity, relevance and organization of technical writing, presenting and delivering the content of students was found to be significantly improved. Students had reported that PBL based Internship program had provided them the understanding and clarity in their theoretical knowledge concepts and in their future career and goals. The students had shown the reflectiveness and retention of gained field knowledge or technical competence after the gap of three months while conducting post site visits at the construction/project sites. Hence, students acknowledged that the experience of conducting project practicums for PBL based internship program was highly relevant in learning and then retaining the gained field knowledge.

Thus, present study has paved the way for the students by preparing them how to work as team member, boost their confidence in technical writing and oral communication skills, learned about the construction site challenges and able to reflect the classroom learned theoretical content about civil engineering in the construction site activities.

Students had improved technical competence by gaining field knowledge of the subject area and helped in identifying and clarifying the areas of interest in their future career plans and goals while conducting the project practicums for developed PBL based internship program.