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# Student Learning Improvement using Collaborative Presentations and Knowledge Sharing

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***Abstract*— Academic institutions hold the key responsibility for developing knowledge and skills to produce responsible and qualified engineering graduates. A lot of research has already been done regarding the importance of active learning techniques for engineering education. Active learning techniques help both teachers and students in many ways. Learning by teaching method encourages students to take the role of teacher to enrich their learning experience. This paper addresses the implementation of outcome-based education with Learning by presentation tactics and creating a databank of related subjects for student reference. This method improves a student's communication skills, presentation skills, confidence level and thinking ability. Students were asked to study assigned topics and prepare a detailed presentation. Each student will teach the assigned topic to the whole class and should clear the doubts about the topic asked by peers. All the presentations are well arranged according to the topic and application. The whole bunch of presentations are returned to all the students for their reference and study when they face doubts or difficulties. Students were enthusiastic regarding their topic and presentations. There was healthy competition, and everyone was working hard to prove themselves. Two internal assessment modules are implemented in the same class which are compared using statistical methods. The results were analyzed using Statistical Package for the Social Sciences (SPSS) software and show that the method assists students learning and understanding students' skills and performance..**

***Keywords*— Collaborative Presentations, Knowledge Sharing, Learning, Teaching, SPSS, ANOVA..**

## I. INTRODUCTION

ASSOCIATION for Study of Higher Education (ASHE) states in a report that there are a variety of terminologies for ensuring active learning. The report also suggests that students should do more than just listen to lectures to learn a particular concept, students must read, write, think, and discuss to learn more effectively. This specific process relates to three learning areas - knowledge, skill and attitude (KSA). Students must always try to engage themselves in higher-order thinking for analyzing, synthesizing, and evaluating critical problems (Grady Roberts, 2005).

In 1991 Bonwell and Eison advised that learners work collaboratively to discuss theories while role-playing, doing case studies, and writing exercises. Imparting knowledge to students has complex factors like social, cultural, and economic impacts on different levels of society. Such various aspects of modern education must be reflected in models of teaching including constantly evolving needs (LoganFiorella et al., 2013). Teaching is very deliberate work done for the improvement of the learner in a professional manner. Teachers always strive for the betterment of the learners, and for that many teaching models and methodologies are developed so that proper learning can be ensured. The role of the teacher is very important for delivering curriculum effectively. Teachers must always challenge three domains - the cognitive, affective, and psychomotor domains of learners. Setting up objectives before any course or curriculum is as essential as making efforts to achieve them. Output of any course taught within the stipulated time is always measured in terms of outcomes. Educates task is incomplete until he/she evaluates to find whether the objectives are achieved. After completing an evaluation, the main task is analyzing the results to check the weak section of the course (David Duran, 2016; Allen, V. at al., 1973).

In order to promote learning in the students teacher delivers his/her course to students based on certain strategy with predetermined objectives and various teaching methods. For effective implementation of any course, big extent of availability of different teaching methods is of prime importance. Giving learners a type of education which will train them for personal as well as professional growth and development should be the teacher's commitment (Benware, C. A et al., 1984).

The general definition of learning can be given as it is a process involving changes in the behavioural patterns of a group or individual. There are a lot of alternate terms for active learning like, technology-based learning, learning through play, and activity-based learning and project method. Along with just watching and listening to any lecture students must do some things simultaneously for active participation and to enhance their thinking capabilities. Learning by teaching is one of the teaching methods in which a specific concept should be learnt by students and then taught to other students (Chi, M. et al.,

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2001). Many researchers work on the improvement of students with problem-solving, teamwork, life-long learning, and communication. These critical skills of students can be improved using the different teaching-learning techniques used during the lecture (D.R.Woods et al., 2000).

The performance of students in a laboratory course in microcontrollers and microprocessors can be improved by giving mini projects to the students from the same course. This teaching approach is called project-based learning. In this method, student groups can be formed, and one mini project is assigned to each group. This group of students must work on a given mini-project and they need to complete it before the end of the semester by following certain steps. With this method team coordination, learning through project and communication skills can be improved (Rajanikant A. Metri et al., 2018). Not only mini projects be built through the teaching-learning activity but also journal papers can be published in reputed journals. Students are used to analyzing the results of journal papers through the teaching-learning activity. and with these results, research papers can be published. This methodology can enhance the research ability of the students (H. T. Jadhav at al., 2022). During the Covid-19 period, many online teaching-learning techniques were presented by many researchers. A mixed learning approach using the MOODLE and the learning management platform can be used to provide videos to the students. These videos are made using the lightboard and handled with the MS Teams platform. All videos related to the course are distributed among the students using the Moodle platform. Additional study material, post quizzes, assignment submissions and FAQs can improve student's performance (Gururaj N Bhadri et al., 2022).

The course-oriented teaching-learning technique is proposed as some courses face issues like variety of instruments, high instrument cost, a smaller number of industries, and limited lab capacity. Think Aloud pair problem-solving technique (TAPPS) teaching-learning approach will increase the concept implementation ability of the students (Supriya S. More et al., 2023). Similarly, the concept of flipped classroom activity can be used to improve student's performance. This approach will increase students' knowledge before entering the classroom and during classroom activities instructor must guide students (D. V. S. Bhagavanulu, 2022). A project-based learning approach can improve students' interest towards the course and enhance student's enthusiasm for the Theory of Machine I course (N. S. Chandrashekhar et el., 2020). The teaching mode is changing to collaborative learning in which social media is taking part in it. Social media platforms help students to get knowledge of their surroundings and help to build their interpersonal relationships with others. So, using a social media platform like WhatsApp can improve students' learning index (Sandeep R. Desai, 2020). As mentioned by many authors, the main goal of the learning process is to provide domain education to all students with an attainment ratio. To check the learning outcomes of students the learning-centric technique is proposed to ensure outcomes at each level (A. Sheik Abdullah et al., 2020). Not only are learning-centric techniques used to ensure outcomes, but cooperative learning tools are also used. Cooperative learning improves the process of learning, and it helps to develop solutions and other skills like problem analysis (T. S. Desai et el., 2016). Along with outcomes, it is important to develop skills among the students to make them highly demanded in the job marketplace. Proper instructional designing of course and with active learning strategies improves the attainment of learning outcomes and student engagement (Jeyamala Chandrasekaran et al., 2020). Sometimes it is easy to gain knowledge from the different techniques, but to develop skills requires a systematic approach. By practising active learning techniques, the skills related to thinking, problem-solving, and analysis can be improved (Bharati Dixit et al., 2020). Many active learning techniques like buzz activity, poster presentation, and simulation tools can be used for course outcome attainment for two consecutive years for the same course (Snehal S. Patil et al., 2020). With more focus on teaching methods, the status of education can be improved. Problem-based learning is one of the methods that improve education status (Preeti Thakur et al., 2021). Considering this literature, the learning-by-learning-by-teaching approach is proposed in this article and the outcome is analyzed through the SPSS tool.

The proposed specific method of having students teach other students has been used since antiquity. This is quite a simple method, after giving a proper introduction and sharing important points with students, the teacher divides specific parts of the course and assigns topics to students. Students individually or GroupWise prepare a detailed presentation on other topic assigned and then they must present the topic in front of the whole class. Students must study the topics assigned very thoroughly to present them in front of the class. After the presentation, students can ask any questions to the individual or group of students who are presenting. This teaching method ensures student participation. Also, students become responsible as the burden of teaching falls on them. With this approach, many of the objectives can be achieved. This method not only improves student's technical ability but also improves skills like planning, problem-solving, communication, and confidence.

Power Electronics, a third-year course in electrical engineering has been taken for implementing learning by teaching method. A total of 61 students were enrolled for this course. The curriculum splits the course into 20% ISE (In Sem Examination), 30% UT (Unit tests) and 50% ESE (End Sem examination) for assessment purposes. This method is implemented as one ISE type and quizzes are taken before and after the method implementation. Both the marks of ISE as a quiz are compared. The comparison is done using IBM's SPSS software. There are many methods for proving a hypothesis like a one-tailed test, T-test, ANOVA etc. In this paper, the ANOVA method is used to prove a hypothesis.

Section I of this paper addresses the background and introduction of the technique. Section II of the paper deals with course outcomes and program outcomes where details about course objectives related to the power electronics course and program outcomes of electrical engineering are explained. Part III gives the details about learning by teaching method. The

detailed analysis of data acquired is done using the ANOVA method using IBM SPSS, this is explained in part IV followed by Results and discussion in part V.

## II. Course outcomes and Program outcomes

The very first thing before starting any course is to write proper course outcomes that are achievable as well as challenging. The course selected for the study of this method is power electronics. This is a third-year course in electrical engineering's curriculum structure. A total of 5 course outcomes are framed for the course according to (Dr. (Mrs). Shaila Subbaraman et al., 2013).

TABLE I
Course outcome of power electronics

| Course Outcomes | Statement (On completion of this course, students will be able to) |
|---|---|
| CO 1 | Compare performance of various power electronic switches. |
| CO 2 | Analyze the performance of uncontrolled rectifiers and phase controlled converters. |
| CO 3 | Design DC-DC converters for different type of loads. |
| CO 4 | Analyze the performance of different types of inverters and AC-AC converters |
| CO 5 | Suggest suitable power electronic converters for specific application. |

Table 1 states the course outcomes for the power electronics course. These COs must be addressed through teaching methods as well as assessments. This course is very important as far as electrical engineering is concerned. Electrical engineering students need to acquire complete knowledge of the course as this course demands skills and higher understanding.

TABLE II
Program outcomes

| Program Outcomes | Statement (On completion of the program, students will be able to) |
|---|---|
| A | Apply knowledge of mathematics, science, and electrical engineering. |
| B | Design and conduct experiments, as well as to analyze and interpret data |
| C | Design a system, components or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability. |
| D | Function on multidisciplinary teams. |
| E | Identify, formulate, and solve electrical engineering problems |
| F | Demonstrate professional and ethical responsibility. |
| G | Communicate effectively at work. |
| H | Understand the impact of electrical engineering solutions in global, economic, environmental, and societal context. |
| I | Engage in life-long learning. |
| J | Use the techniques, skills, and modern engineering tools necessary for engineering practice. |
| K | Apply the knowledge to evaluate contemporary issues with project and finance management skills. |
| L | Participate and succeed in competitive exams. |

Students must study various switches, their comparison, and characteristics along with controlled and uncontrolled rectifiers, inverters, and converters with different loads. Another hurdle while teaching this course is visualizing and interpreting applications based on converter operation. Self-learning is of utmost importance while learning this course (Lavanya1 et al., 2022). The strategy used here will ensure students' self-learning capabilities as well as their efforts to learn certain concepts. The assessment with a quiz will mark the difference and give the results of whether the method is useful or not. After the course outcomes the next important thing is to align the course outcomes with program outcomes. Table 2 states the program outcomes which are decided at the institute level.

Mapping between COs and POs must be high at each level so that all the attributes of POs are addressed. This is true that mapping should be higher but at the same time, one should look for POs carefully because some POs are hard to map, for example POs – G, H and I. To map these POs one should develop some strategy or teaching method. The method used here will help address this as it involves self-learning and presentation that will help build confidence in students.

## III. Learning by teaching method

The method used for assessment and analysis is teaching by learning technique. As technology is advancing and so does the people's approach, it has been developing since the 90s in regard to teaching. Active learning techniques have been very famous and become very handy for educators across the world. Normal board teaching does not ensure students learning, participation and problem-solving abilities. Many studies have been done in various parts of the world to know how much time a normal human can concentrate, and it is found that the average attention time for any human being is 20 minutes to 30 minutes. This result will be problematic for the teachers as the span of a lecture is generally 1 hour to 2 hours. So, does that mean one is wasting his/her time? NO but as educators and mentors one's main job is to ensure student's maximum learning. So here the important question is I am teaching but are they learning? And here the active learning methods come into the picture to help both teachers as well as students.

There are many active learning methods for various study groups and courses. In general, one can say that you can't teach unless you know the whole concept and its details. This is the background for the technique that is analyzed in this paper. This method is quite simple and easy to implement with great results. The teachers' main job is to teach any concept in a very easy manner and that can be easily absorbed by the students. Lot many teachers face difficulties while teaching complicated or complex concepts to students within a stipulated time and at the same time this becomes a very difficult task for students to learn that concept. For such cases, learner-centric teaching is the utmost important factor.

For learning by teaching method, a class of 61 students is selected. The subject of power electronics is quite difficult to understand at first because of all the scattered concepts within the syllabus. The topics for each of the 61 students are assigned. Then a definite period is given for the preparation of presentations. This is done as an individual activity; groups of students are not formed. Now students are instructed to collect all the data of the assigned concept like images, videos, and websites. Then students are told to create a detailed presentation of the concept. After preparing the presentation students are

instructed to get help from the teacher for any mistakes in the concept or the presentation. Once the presentation is final, the class is divided into 5 student groups to take the presentation and the very important thing is that it is made compulsory for the whole class to listen to every presentation on the concepts assigned and ask any doubts or queries.

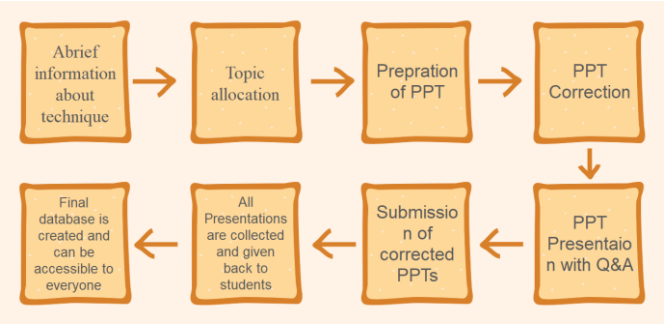


Fig. 1. General block diagram of the technique.

The general block diagram used for the technique step by step is shown in the above fig. As shown in Figure 1 the very first step is to provide information regarding this technique to students and have a detailed discussion. After that proper topics from the course Power Electronics are allocated to each student. A specific period that will be sufficient for data gathering and preparation of the presentation is given to students. During this time PPTs of each student are checked rigorously and corrections are given to them. After finalizing the PPTs, students need to present them in front of the whole class followed by a Q&A session for each concept. After this step all the presentations are collected at the faculty level, presentations are sorted and given back to the students for their future study and doubt clearing.

The beauty of this method is,

- ✓ All the topics in the syllabus are covered.
- ✓ Students need to learn concepts by searching in books and other resources
- ✓ All the presentations are checked, verified and corrected.
- ✓ All the presentations are given back to students so that they have complete library of the course material.

This method will not only ensure self-learning of the students but also helps the teacher to know students' weak point that will be further used for the development of students. The last part of the method, which is data gathering, arranging, and returning to students is done so that students feel comfortable as well as confident because now they have all the course content well arranged. After using this method, a quiz is taken at the end to know the impact of this method on students. The analysis part of the quiz before and after the method is addressed in the next section.

## IV. Method Analysis and Statistics

The teaching-learning methods details and implementation are given in the previous part. This section mainly deals with the analysis of the data gathered with two ISE modules which are two quizzes, one before the technique and one after the technique. For both ISE modes, 61 students were present. The analysis is done using statistical methods. As discussed earlier there are lot many methods for data analysis (A.P. Christoforou et al., 2008). One-way ANOVA method is selected for the analysis of the data gathered. ANOVA in statistics stands for analysis of variance. This is one of the famous methods followed by many people for analyzing their respective data.

The hypothesis is defined as an idea suggested as the possible explanation for something but has not yet been found correct. So, anyone can suggest a hypothesis based on the data that they have but the only problem is proving the hypothesis. There are main two hypotheses, one is called the null hypothesis (H0) and the other is called the alternative hypothesis(H1). The null hypothesis is generally unbiased at any point. A null hypothesis is a hypothesis that says there is no statistical significance between the two variables that one is going to compare. Alternative hypothesis is a hypothesis stated to disapprove the null hypothesis or to fail the null hypothesis, this is contrary to the null hypothesis.

So, the Null hypothesis can be expressed as,

$$H0 = U1 = U2 \quad (1)$$

Where,

U1 = Results of first quiz taken before implementing the technique.

U2 = Results of second quiz taken after implementing the technique.

So, the null hypothesis for this situation can be stated as there is no variance in results meaning that there is no difference in results with or without implementing the technique. This is an unbiased approach.

An alternative hypothesis for this condition is given by

$$H1 = U1 \neq U2 \quad (2)$$

The alternate hypothesis states that the result of both the quizzes that is before and after implementing the technique is not the same. After analysis of the data if an alternate hypothesis stands then it is safe to say that the null hypothesis has failed meaning that there is surely a significant difference between the results of the two ISE modules. In statistics, this analysis can be done with two confidence values 95% and 99%. This analysis

| | Learning_Method | Quiz_Group |
|---|---|---|
| 51 | 9 | Quiz before Technique |
| 52 | 9 | Quiz before Technique |
| 53 | 6 | Quiz before Technique |
| 54 | 8 | Quiz before Technique |
| 55 | 4 | Quiz before Technique |
| 56 | 5 | Quiz before Technique |
| 57 | 8 | Quiz before Technique |
| 58 | 8 | Quiz before Technique |
| 59 | 6 | Quiz before Technique |
| 60 | 8 | Quiz before Technique |
| 61 | 5 | Quiz before Technique |
| 62 | 9 | Quiz After Technique |
| 63 | 8 | Quiz After Technique |
| 64 | 9 | Quiz After Technique |
| 65 | 8 | Quiz After Technique |
| 66 | 7 | Quiz After Technique |
| 67 | 8 | Quiz After Technique |
| 68 | 8 | Quiz After Technique |
| 69 | 7 | Quiz After Technique |
| 70 | 8 | Quiz After Technique |
| 71 | 9 | Quiz After Technique |
| 72 | 8 | Quiz After Technique |
| 73 | 6 | Quiz After Technique |

Fig. 2. Data labelling in IBM SPSS.

is based on 95% confidence theory. If the significance value is less than 5% then the null hypothesis is rejected or failed meaning that the method implemented has a certain impact on student's results.

Analysis can be done by books but that is a very lengthy and time-consuming process. IBM SPSS software is designed to do such critical analysis within a fraction of a second. This software is very simple to use, also one can use this software on a trial period. In this software, two groups are created one group of 61 students marks of ISE1 out of 9 marks and another group of 61 students for ISE2 out of 9 marks.

The snap of IBM SPSS software is shown in Fig. 2. The total data entered in the first column is 122 with 61 students with two ISE module marks out of 9. Two groups are labelled such as Quiz before technique and Quiz after technique. The first column is also divided according to the learning method.

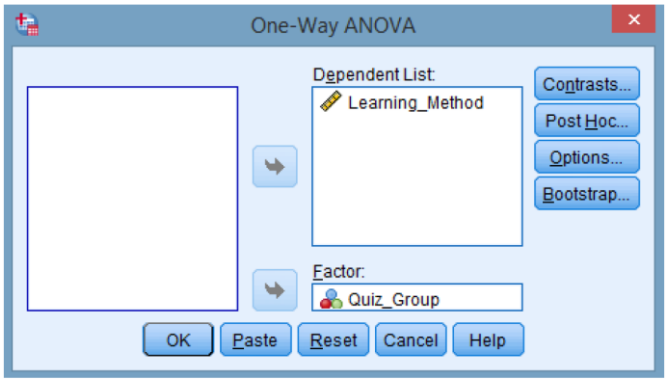


Fig. 3. One way ANOVA block in IBM SPSS.

The one-way ANOVA block in IBM SPSS software is shown in fig. 3. This tool is very simple to use. One should just differentiate between a dependent variable and a factor. For this case dependent variable is the student marks and a factor is a method implemented. After entering this if OK is pressed the results will appear on the screen. All results are discussed in the next Section.

## V. Results and Discussion

Data entering, interpretation and some basic concepts related to IBM SPSS software were covered in the last section. In this section, the results are discussed in brief. The value 1 is assigned to the result of the first ISE group and 2 to the results of the second ISE. Fig 4 shows the descriptive table of the way ANOVA method. By just looking at the table a total of 122 samples are analyzed that is 61 in two groups according to two ISEs. As one can see the mean value of group 2 which is after the implementation of the method is higher, but this value does not give us any detailed idea about ANOVA analysis. This means value is just a primary observation of the table. One can't base their hypothesis just by relying on mean values, so the ANOVA table is important for further analysis.

The final ANOVA table for the complete analysis is shown in Fig. 5. The end value, which is the significance value, is very important for concluding the analysis. As already discussed in Section III the one-way ANOVA analysis is based on 95% confidence theory. According to that theory If the significance value is more than 5% then the null hypothesis stands correct meaning that it can't be rejected on the contrary if the significance value is less than 5% the null hypothesis gets rejected meaning that the alternate hypothesis stands.

**Descriptives**

Learning_Method

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| 1 | 61 | 6.82 | 1.607 | .206 | 6.41 | 7.23 | 4 | 9 |
| 2 | 61 | 7.41 | 1.257 | .161 | 7.09 | 7.73 | 4 | 9 |
| Total | 122 | 7.11 | 1.467 | .133 | 6.85 | 7.38 | 4 | 9 |

**ANOVA**

Learning_Method

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 10.623 | 1 | 10.623 | 5.104 | .026 |
| Within Groups | 249.770 | 120 | 2.081 | | |
| Total | 260.393 | 121 | | | |

Fig. 5. One way ANOVA table.

If the alternate hypothesis stands that means H1 stands corrected.

$H1 = U1 \neq U2$

This suggests that there is some difference between the marks of two ISEs and If that is true one can say that this teaching technique is effective. In this case, the significance value is 2.6% (0.026) which is less than 5% so it is safe to say that there is surely a significant difference between the two techniques. So, it is totally clear with this IBM SPSS, analysis, and statistics that teaching methods have a positive impact on students learning. Fig 6 shows the mean plot of two groups from that and with significance value it is very easy to conclude that group 2 has performed way better than group 1. So, this method of

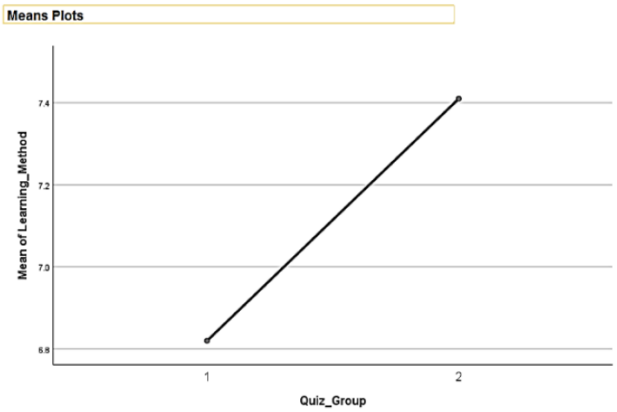


Fig. 6. Mean plot of analysis.

teaching is quite effective.

The CO-PO mapping of the power electronics course in third-year electrical Engineering is given in Table No. III. The ticks show there is a mapping between OC and PO. Here one can see that the blue ticks are the new mapping because of the implementation of this teaching technique, It mainly addresses POs G, I and L. Which are,

G – Communicate effectively at work.

I – Engage in life-long learning.

L – Participate and succeed in competitive exams.

TABLE III
COURSE OUTCOME OF POWER ELECTRONICS

| CO / PO | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | ✓ | | | | ✓ | | ✓ | | ✓ | | | ✓ |
| CO 2 | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | | | ✓ |
| CO 3 | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | | ✓ |
| CO 4 | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | | | ✓ |
| CO 5 | ✓ | | ✓ | ✓ | ✓ | | ✓ | | ✓ | | | ✓ |

The PPTs are collected after a presentation by individual students. This is a new detailed database created by students and created for students as shown in Fig. 7. Students can refer to this when and where they face difficulties. This is one of the main goals behind implementing this teaching technique..

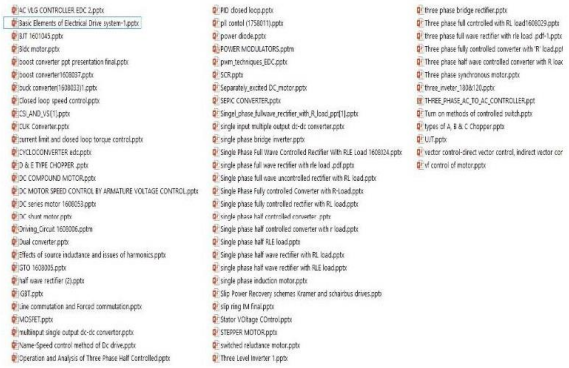


Fig. 7. PPT files database.

## VI. CONCLUSION

In this paper teaching by learning method is implemented on a third-year engineering class of 61 students. Two ISE modules as quizzes are taken and the result data is gathered. The methodology of using this method is expressed in a detailed way. Analysis of results is done with statistical methods. The theory used for analysis is one-way ANOVA with 95% confidence parameters. The result as a significance value is less than 5% meaning that the null hypothesis gets rejected and so the alternative hypothesis stands. One can conclude from the results that by using active learning techniques a student's learning index can be surely improved.

This learning-by-teaching method is very simple to use and proves very effective while assessing the students. One more important thing is that this method agrees with the PO which is not addressed by COs by normal teaching strategy. This method not only improves students' technical ability but also focuses on student's communication, problem-solving and confidence levels.

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