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Analyzing Usage of Various Study Resources by Engineering Students

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Introduction

We define self-study as study without direct supervision or attendance in a class. Students primarily undertake it for comprehensive examinations and use a variety of resources for that. This area does not seem to have attracted enough researchers. Grave has studied the amount of time students spend on the coursework versus self-study and found that on average students spend 19 hours on coursework and 12 hours on self-study per week. [1] Dolton et al. studied the relationship between students' study time allocation and examination performance, and found that time spent on lectures is more productive than time spent on self-study. [2] Inglis et al. observed how often students attended live face-to-face lectures, accessed online recorded lectures, and visited a mathematics learning support center during a multivariate calculus course. [3] Krause et al. have developed an instrument to understand use of resources for self-study. [4] We have adapted that with some modifications for our experiment.

We found that undergraduate engineering students from an Indian college prefer going through their classroom notes, reading textbooks and discussing with classmates or friends during self-study for their comprehensive examinations. There are minor variations in this pattern between the freshman (first year) and other students. The major contribution of the paper is to analyze students' use of resources for their self-study for the comprehensive examinations so that teachers can plan their teaching and administrators and librarians can plan their resources. The next section outlines the research design that includes analysis and interpretation of the collected data and concluding remarks.

Research Design

Our study analyzed resources that undergraduate engineering students use while doing regular study for comprehensive examinations. We have outlined the overall research design in Figure 1.

Objective, Scope and Type

Students spend considerable time on self-study. Administrators and faculty must understand the resources used for that purpose. Earlier studies have included limited number of students i.e. around forty. [4] Our study was larger in scale - we surveyed close to 200 students by randomly inviting 30% students from each year of study and each department from an undergraduate engineering program. We also studied differences in use of resources by freshmen and other students.

Our research is descriptive, diagnostic, cross-sectional, and field setting. Descriptive research describes the characteristics of a population being studied and does not explore the reasons for those characteristics. Diagnostic research studies determine the frequency with which something occurs or its association with something else. We did not study the resource usage over time but at a particular cross section, making the study cross-sectional. Our research covers real life situations and, therefore, is a field-setting study.

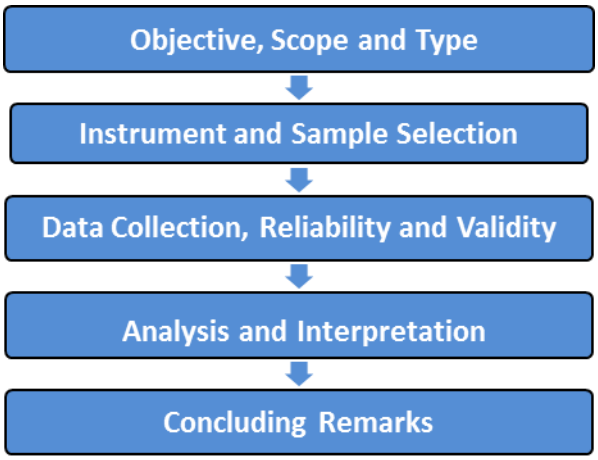

Figure 1 Research design

Instruments and Sample Selection

This is a critical step as it maps research problem to mathematical domain. We used the form designed by Krause et al [4] and made some modifications such as not including web resources developed by faculty, and teaching assistants. These options were not available at the university, where we carried out the experiment. Our form is provided in Appendix A.

We carried out the experiment at an Indian university campus that has several engineering and other undergraduate programs. The university campus is located in a tier 3 city and hosts close to 900 of engineering students. The university has a well-equipped library that provides textbooks and reference books. The library has one textbook per five students and issues three books at a time for fifteen days. Our sample consisted of randomly chosen students from each year of study and each department of undergraduate engineering program. The departments covered are Computer Engineering, Information Technology, Electronics and Telecommunication Engineering, Mechanical Engineering, and Civil Engineering. We randomly chose around 30% of students from every program making the total sample size 246.

While most of the students were admitted to the four year Undergraduate (UG) engineering program after twelve years of schooling, a few of them had lateral entries in the second year of the program after ten years of schooling followed by three years of engineering diploma. The college is one of the best in the region and attracts above average students but they have noticeable variations in performance in the entrance examinations and in courses prior to the ongoing engineering program.

Data Collection, Reliability and Validity, Analysis and Interpretation

We randomly chose 30% of the students from each class making the total sample size 246. We invited them to an auditorium for the survey. Of them, 195 students participated in the survey (N=195). We apprised them importance of the survey and administered it using hard copy forms. We have shown the details of the respondents in Table 1.

Table 1: Number of total, selected, and responded students from each class.

Class	Total students in the class	Number of students selected (around 30%)	Number of students responded
First Year (Freshman)	214	64	60
Second Year (Sophomore)	193	58	55
Third Year (Junior)	227	69	42
Fourth Year (Senior)	184	55	38
Total	**898**	**246**	**195**

We had varied responses from different classes. However, we had chosen samples randomly and the minimum response from a class was more than 18% of the class population, making aggregated analysis of the responses statistically valid.

Reliability and Validity

It is important to conduct a thorough measurement analysis of the instrument. It gives assurance that the findings reflect accurate measures and that results are trustworthy. Test reliability indicates the extent to which individual differences in scores are 'true' differences. As a proof of reliability, we chose two random sets of 25 sample records and confirmed that they are not statistically different, i.e. the means of the two sets are within a standard deviation as given in Table 2. We also carried out two-sample T test that resulted in p-value of 0.82, indicating that the two samples do not have different means.

Table 2: Means and standard deviations of two random samples of 25 data-points.

Resource	Sample A - Mean	Sample A – Std Dev	Sample B - Mean	Sample B – Std Dev
Your own classroom notes	3.1	1.1	3.2	0.8
Homework problems	2.3	1.2	2.4	1.2
Posted lecture slides	2.6	1.1	2.2	1.2
Old exams or quizzes	2.0	1.4	1.9	1.4
Textbook readings	2.6	1.3	3.2	0.9
Classmates / friends	2.8	1.0	2.7	0.9
Instructor	2.0	1.2	2.2	1.3
Tutoring service	1.5	1.4	1.4	1.3
Google	2.1	1.3	2.2	1.4

Analysis

We have tabulated responses and analysis making using Tukey method using Minitab version 17 of all the students to 'How often did you use the following resources to help you study for your exam?' on the scale of 0 to 4 (0 meaning never and 4 meaning always) in Table 3.

Table 3: Reponses of All Engineering Students to Exam Resources Used

(0 meaning never and 4 meaning always; Grouping Information using Tukey Method with 95% confidence)

Resource	Mean	*Grouping
Your Own Classroom Notes	2.76	A
Textbook Readings	2.64	A
Classmates/Friends	2.51	AB
Posted Lecture Slides	2.10	BC
Homework Problems	2.04	C
Google	1.94	C
Instructor	1.83	C
Old Exams Or Quizzes	1.69	C
Tutoring Service	1.16	D

*Means that do not share a letter are significantly different.

Students' top preferences seem to be their classroom notes and textbooks. Consulting classmates or friends is not significantly different from those two as well as using posted lecture slides. Homework problems, Google, asking instructors and old exams or quizzes are at the same level and not significantly different from posted lecture slides. Tutoring service is the least preferred option. That could be due to the remoteness of the campus resulting in poor availability of the tutors.

We have segmented freshmen and others and analyzed their resource usage. We have tabulated responses and analysis using Tukey method using Minitab version 17 of the freshman (first year) students to 'How often did you use the following resources to help you study for your exam?' on the scale of 0 to 4 (0 meaning never and 4 meaning always) in Table 4.

Table 4: Reponses of Freshman Engineering Students to Exam Resources Used

(0 meaning never and 4 meaning always; Grouping Information using Tukey Method with 95% confidence)

Resource	Mean	*Grouping
Your Own Classroom Notes	2.90	A
Textbook Readings	2.77	AB
Classmates/Friends	2.57	ABC
Homework Problems	2.07	BCD
Google	1.88	CDE
Instructor	1.83	DE
Posted Lecture Slides	1.53	DEF
Old Exams Or Quizzes	1.25	EF
Tutoring Service	0.93	F

*Means that do not share a letter are significantly different.

The top preferences of the first year (freshman) students do not seem to differ much as compared to 'all the students'. The freshmen tend to rely on their own classroom notes, reading textbooks, and consulting classmates or friends, the most. The last two are not significantly different from the homework problems. Discussing with classmates / friends' options is not significantly different from homework problems and accessing Google. Further, homework problems are not significantly different from accessing Google, asking instructor and using posted lecture slides. Accessing Google is not significantly different from discussing with instructors, using posted lecture slides, and using old exams or quizzes. Posted lecture slides and old exams or quizzes are not different from using tutoring service.

While responses of all the students did not show much difference in the preferences, responses of the first year (freshman) students showed much difference. Therefore, we decided to analyze responses of other (sophomore, junior and senior) students, separately. We have tabulated responses and analysis using Tukey method using Minitab version 17 of all 'other' students to 'How often did you use the following resources to help you study for your exam?' on the scale of 0 to 4 (0 meaning never and 4 meaning always) in Table 5.

Table 5: Reponses of Sophomore, Junior, and Senior Engineering Students to Exam Resources Used

(0 meaning never and 4 meaning always; Grouping Information using Tukey Method with 95% confidence)

Resource	Mean	*Grouping
Your Own Classroom Notes	2.71	A
Textbook Readings	2.58	A
Classmates/Friends	2.48	AB
Posted Lecture Slides	2.36	ABC
Homework Problems	2.03	BCD
Google	1.97	BCD
Old Exams Or Quizzes	1.89	CD
Instructor	1.83	D
Tutoring Service	1.27	E

*Means that do not share a letter are significantly different.

The top preferences of this group do not seem to differ much. They tend to use their own classroom notes, read textbooks, consult classmates or friends, and use posted lecture slides. Discussing with classmates and friends is not significantly different from using posted lecture slides, homework problems, and accessing Google. Further, posted lecture slides are not significantly different using homework problems, accessing Google, and using old exams or quizzes. Moreover, homework problems are not significantly different from accessing Google, using old exams or quizzes, and asking instructor. Relying on tutoring service is the least preferred resource.

Interpretation

It is clear that all students enormously rely on their classroom notes. The teachers need to take efforts so that they can provide proper notes. Textbook readings and discussions with classmates and friends are also favored resources. It is important to provide sufficient number of textbooks in libraries. Since students find it helpful to consult their colleagues, libraries can provide some soundproof discussion rooms. Also during the examination preparation time, we can organize sessions where students with good academics can help others. We can impress upon the good students benefits of such sessions by making them understand that teaching is the best way of learning. Posted lecture slides tend to be cryptic and, therefore, may not be favored. Most of

the question papers shy away from problem solving and rely on descriptive answers, which may be a deterrent from studying through homework problems. Students may be using old exams or quizzes as a supplementary and not main resource. That may be the reason for it being a less preferred resource. Tutoring service is the least preferred option and that could be due to the remoteness of the campus resulting in poor availability of the tutors. It is important that faculty understands current usage of the resources, the reasons behind them, correct the reasons, and steer the resource usage in the right direction.

Concluding Remarks

Engineering education – all over the world – is undergoing transformation. The rise of the Internet and allied technologies, and regulatory requirement of outcome-based education that is rooted in the challenging 21st century problems are the driving forces behind this transformation. These changes are making newer resources available as well as imperative for self-study. It is important to analyze the use of these resources so that faculty members can plan for various resources appropriately, and steer usage of the resources in the right direction, and administrators and librarians can plan for the required resources.

We found that studying from classroom notes, discussing with classmates / friends, and reading from textbooks are the most preferred resources when students study for comprehensive examinations. We did not observe any significant difference between the first year (freshman) and other students. Further segmentation into the years of study and the departments may provide more insights. Some of the resource usage may be due to the current pattern of conducting examinations i.e. asking more closed and descriptive questions. Mere reading of classroom notes and textbooks may suffice for those types of questions. They may not accrue higher level of learning. We may have to change examination and pedagogical methods that could result in higher level of learning and changes in resource usage in the right direction. Krause et al. utilized formative feedbacks to develop new web-enabled resources and found students preferring them to textbooks, and registering better achievement. [4]

We plan to segment the students based on the year of study and the program to glean some more insights. We must repeat the experiment in different settings such as autonomous colleges, affiliated colleges, and different geographies to enhance our understanding of use of the resources. Analyzing use of resources in the context of courses, faculty, and their teaching methods can also be helpful. We can also study correlation, if any, between resources in use and performance at the examination.

In general, students and even many faculty members are not sufficiently information literate – they do not know sources of information and optimum ways to access them. It has to change. In case of students, we have to integrate information literacy instruction across their engineering curriculum. [5, 6 and 7] This can include regular interactive sessions on usage of available resources. [8] In case of faculty, we have to organize specific seminars or sessions. These steps can influence use of the resources positively and significantly.

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APPENDIX A:

STUDENT RESOURCE VALUE SURVEY (SRVS)

DIRECTIONS: Please read the questions below. Mark the box that corresponds to your level of agreement.

1. How often did you use the following resources to help you study for your exam?	**Never *0**	**Rarely *1**	**Sometimes *2**	**Frequently *3**	**Always *4**	**Not Applicable (did not include)**
a) your own classroom notes						
b) homework problems						
c) posted lecture slides						
d) old exams or quizzes						
e) textbook readings						
f) classmates/friends						
g) instructor						
h) tutoring service						
i) Google						

- **The numbers indicate weightage to the occurrences.**