EDUCATIO : Journal Of Education
Volume 5 , Number 2, November 2020
ISSN : 2579-8383 (Print) ISSN : 2579-8405 (Online)

Improving Students Performance In Fluid Mechanics Course Through Remedial Action, Case Of Jimma Institute Of Technology, School Of Chemical Engineering, Jimma, Ethiopia

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Accepted:	reviewed:	Published:
August 10th 2020	September 5th , 2020	November 20th 2020

Abstract : This research study aims to improve students' performance in the Fluid mechanics course through active learning methods. The method for this research was conducted on a longitudinal study design. It takes about four-month interventions in teaching the course by using active learning methodologies following with tutorials. The study population number and the target groups were also identified by the guidance and support given by the Jimma University Institute of Technology registrar. Before handling the research, all the essential conditions were done such as giving orientation, fixing the duration of the study, and rearrangement of the program according to the interest of most of the students. The sampling technique used was availability sampling. The sample size was included for year II both female and male students of Fluid mechanics course students in the second semester of 2019. After this secondary data was collected from the Jimma University Institute of Technology registrar office and questionnaires collected from the second-year students; reached with the problem of the nature of the course. Therefore, we conclude that the study output indicates that the percentage of passed students increased from 66.92% to 91.82% after active learning methodology training had given for instructors in addition to delivering on spot tutorial. The group study recommends that active leaning methodology can improve the performance of the students and the school should have to emphasize this methodology in addition to monitoring and appreciating on spot tutorial.

Key Words: Chemical Engineering, Fluid mechanics, Remedial action

INTRODUCTION

It is a pre-requisite and compulsory course to the majority of the courses offered under the school of chemical engineering[1]. Thus, in some cases, it is mandatory first to obtain passing grades in this course to continue studying the subsequent courses[2]. Consequently, many number

[1] Abreham Bekele Bayu, Samuel Gessese Filate[1], and Tarkegn Kumela Hundie, "Enhancing Students' Performance in Heat and Mass Transfer Course through Active Learning Methods-A Case of Jimma Institute of Technology, School of Chemical Engineering, Ethiopia" (n.d.).

[2] Douglas N Harris and Tim R Sass, "Teacher Training, Teacher Quality and Student Achievement," *Journal of Public Economics* 95, no. 7–8 (2011): 798–812, http://dx.doi.org/10.1016/j.jpubeco.2010.11.009.

of students enrolled every year to take a Fluid mechanics course as part of their course[3]. Most of JiT students in chemical engineering fail in the Fluid mechanic's course as such documents' from JiT the registrar depicts that in the academic year 2015/16 to 2018/19. For the Fluid mechanics' course, the following data were obtained as that of 2015/16, 31 students scored fail grade out of 160 students which are 18.75 %, 2015/16, 40 students were scored fail grade out of 155 students which are 24.80%, 2017/18, 23 students were scored F grade out of 175 students which is 13.71 % from every three consecutive years. According to these mentioned data, the research is decided to conduct action research on the course Fluid mechanics in the department of chemical engineering.

The course Fluid mechanics is one of the subjects known as a major factor in the development and technological reform that attracts the attention of policymakers to make it part of the higher education agenda to focus on this[4]. For low achievements in many fields are now the concern for all academic and government institutions in academic areas[5]. Therefore, revisiting how the way students learned and the way students' achievement was performed is an effort worthwhile to consider.

Fluid mechanics course is considered by many individuals of learners as a difficult subject to grasp. This kind of observation may have a direct relation with achievement[6]. Especially, students with negative attitudes towards Fluid mechanics have performance problems because they develop anxiety. Thus, if this problem continues to develop in their academic progress, it will affect their performance in a subject containing master and computation[7]. The core content of active learning is that providing opportunities to actively engage with content during their classes leads to positive learning results[8]. The active learning method can be defined as any instructional way that enhances students in the learning mechanisms[9]. In a precise, active learning method requires students to do a meaningful way of learning activities and think about how they are doing. The definition may include traditional works such as homework activities. Active learning refers to practices that are introduced into the classroom for the learners[10]. The major elements of active learning methods are student practical activity engagement in the learning mechanisms[11].

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[3] Catherine H Crouch et al., "Peer Instruction: Engaging Students One-on-One, All at Once," *Research-based reform of university physics* 1, no. 1 (2007): 40–95.

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[8] Angela Lumpkin, Rebecca M Achen, and Regan K Dodd, "Student Perceptions of Active Learning," *College Student Journal* 49, no. 1 (2015): 121–133.

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[10] Scott Freeman et al., "Active Learning Increases Student Performance in Science, Engineering, and Mathematics," *Proceedings of the National Academy of Sciences of the United States of America* 111, no. 23 (June 10, 2014): 8410–8415, https://pubmed.ncbi.nlm.nih.gov/24821756.

[11] Adrián Domínguez et al., "Gamifying Learning Experiences: Practical Implications and Outcomes," *Computers & Education* 63 (2013): 380–392, http://dx.doi.org/10.1016/j.compedu.2012.12.020.

Within the active learning method approach, the learner actively constructs their way of understanding of Fluid mechanics concepts in an iterative fashion[12]. In this way, the word iterative refers to the structure and content of the teaching process which is enhancing procedural being confidential of which steps to take and to know the conceptual meaning[13]. Thus a more and more complicated cognitive chain of relationships under different parts of the course Fluid mechanics information is forming in the mind of the learner[14]. The cognitive chain consists of knowledge of both procedures and concepts, a knowledge that is connected in ways that give the learner both a good intuitive feel for the course and good problem-solving mechanisms and answer-generating capacity[15]. According to different literature, an active learning approach can be explained by using four core statements as described as follows[16].

The learner is the owner-person in the active learning methods, i.e. Fluid mechanics course teaching delivery must be learner-centered.

1. The Teacher is full of authority since his/her knowledge of both Fluid mechanics active learning and his/her respect for the learners as a positive thinker and socially active individuals.
2. Open-ended and rich with performance in learning tasks are considered a prerequisite for the possibility of constructing a conceptually rich cognitive structure and a relational understanding of Fluid mechanics concepts.
3. The set-up of the classroom should support interaction in small groups, whole-class discussion, and individual seatwork in accordance with the needs of the learner and the learning task.

METHODS

Research aims

The overall aim of this research is

1. To detect the extent to which learners performance in Fluid mechanics course
2. To evaluate the positive impact of active learning methods on the learners' Fluid mechanics course.
3. To summarize the effectiveness of teaching mechanisms in the improvement of students' performance in the Fluid mechanics' course.

To improve students' performance in the Fluid mechanics' course through active learning methods, first, the problem should be detected as students fail on the Fluid mechanics course by

[12] Wanda M Kunkle and Robert B Allen, "The Impact of Different Teaching Approaches and Languages on Student Learning of Introductory Programming Concepts," *ACM Transactions on Computing Education* 16, no. 1 (2016): 1–26, http://dx.doi.org/10.1145/2785807.

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[15] Michele A Leininger, "From Librarian to Proficient Manager: The Journey of Public Library Front-Line Managers" (University of Pittsburgh, 2015).

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providing research questions and questioner. Before assessing the problem with learner it is better to know the problem which makes the Fluid mechanics' course failures.

Research questions

Research questions are based on a questionnaire prepared in order to conduct the required research. Research questions are provided as below

1. To what level active learning methods can measure the progress of learners' results in Fluid mechanics course?
2. What is the positive impact of implementing active learning methods on the students' performance in the Fluid mechanics' course?
3. What can be done to improve the result of learners' Fluid mechanics' course?

Questionnaire:

1. What was your major favorite subject when you were at the high school level?
2. Are you joined the campus-based on your choice?
3. If your answer to Q 2 is no, where did you interested to join the campus?
4. Are you placed in the faculty you were planning to join previously?
5. If your answer to Q 4 is no, which Faculty you were planning to join?
6. Are you placed in the field of engineering of your interest?
7. If your answer to Q 6 is no, which field of engineering, you were planning to join?
8. Why you are not placed in the field of study of your interest?
9. Are you satisfied by the engineering field currently you placed in (chemical engineering)?
10. If your answer is no for Q 9, what is your fear about the field?
11. Which course did you find the most difficult for the current semester?
12. What do you think is the problem behind the difficulty?
13. What would you find to be helpful as a solution to overcome this difficulty?

Data collection and experimental design

A Survey of four consecutive years was collected on the results of students registered in Jimma University institute of technology in the school of Chemical Engineering from the academic year of 2016 to 2019. This research was conducted with the design of a longitudinal study because it takes a semester or five-month interventions in delivering the course by using active learning procedures together with different instructional media. This research number of population and the target groups were also identified by cooperation given from Jimma University Institute of Technology registrar. Before the research was started all the essential or basic conditions were done such as providing orientation, fixing the duration of the study, and rearrangement of the program as per the interest of most of the learners. Finally, the delivery of the course was accomplished by conducting continuous assessment which was done according to the time frame scheduled.

Study Parameters

The Study area was Jimma University institute of technology (JiT) under the school of chemical engineering. The target population was all students who took the Fluid mechanics course

in the past four years moreover; the study population was all students who scored F or failed in Fluid mechanics particular course.

Sample Size and Sampling Technique

The sampling technique used was availability sampling. The study sample size was complied with both female and male learner students who scored "F" grade in Fluid mechanics from the population of second-year students for the second semester.

Data Analysis

The collected data was ful1y analyzed using Microsoft Office Excel 2007-2013 software. Thus this application software was selected as the data of students was 110.

Identification of the Problem

The total numbers of students registered for an action research are 110 which completed the program successfully. The following graph shows the relationship between scored F against registered one on the course Fluid mechanics for three years starting from 2015 /16 till 2017/18.

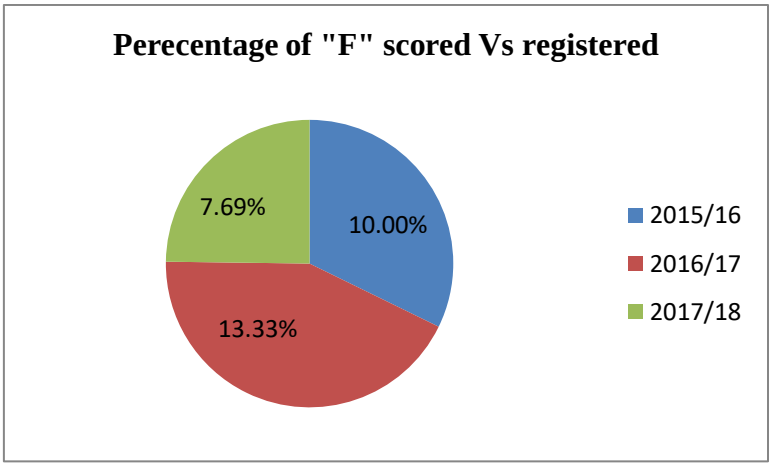

Figure 1. Percentage of "F" scored against registered on the course Fluid mechanics

From the above figure 1 we observe that there is much number of students who failed to pass Fluid mechanics course for the consecutive three years starting from 2015/16 till 2017/18. This forced the researcher to take action on this course.

The following data were taken through questioner from 110 second year chemical engineering students who had taken the course Fluid mechanics course for 2018/19 academic year.

Table 1. Number of respondent for course difficulty

S/N	Course name	No of students respond for its difficulty	Rank for difficulty
1	Fluid mechanics	15	1
2	Organic chemistry	13	2
3	All course	12	3
4	Numerical methods for chemical engineers	11	4
5	Fluid machine	9	5

6	Chemical engineering thermodynamics I and II	11	4
7	No course	6	8

From the above table 1 we conclude that 15 students respond for the course Fluid mechanics course difficulty. When we compare with other courses the number of student's respondent for Fluid mechanics difficulty is higher. Therefore Fluid mechanics course is the course which needs remedial action in the school of chemical engineering.

Table 2. Number of respondent for the reason behind difficulty

S/N	The reason behind difficulty	No of students respond for its difficulty from 15 students	Rank for difficulty
1	The nature of the course	9	1
2	Other	4	2
3	Instructor's approach	2	3

From the above table 2 the reason behind the difficulty of the course Fluid mechanics is the nature of the course. Because 9 students respond as the nature of the course out of 15 students. Therefore the problem is related with the nature of the course. Therefore it was believed that giving tutorial for the students was of utmost paramount.

Table 3. Number of respondent for the helpful ways to overcome the difficulty.

S/N	Helpful ways to overcome this difficulty	No of students respond for helpful ways	Rank for difficulty
1	If I could get tutorial	8	1
2	If I could get additional supportive material	5	2
3	If the instructor's approach is changed	4	3
4	Other	2	4

RESULTS AND DISCUSSION

As the information gained from the above table 1 to 3 the helpful way to overcome the difficulty with Fluid mechanics course is giving tutorial. Since from table 3 it was observed that, eight students respond as the way to overcome the difficulty is getting tutorial.

Actual performance

From the treatment group, all of them were taken from 2018/19 batches. In 2018/19, totally 110 students have taken the course Fluid mechanics, out of these (9) 8.18% of them fail to score pass grade. Hence, 110 of them were registered as a treatment group. The following table

summarizes the comparison of pass and failures for the four successive years starting from 2015/16 till 2018/19.

Table 4. Scored grades with percentage for 2015/16-2018/19

Years	Number of students	Scored grades with %age						No of Passed	
		F	%	D	%	C -	%		
2015/16	140	14	10.00	20	14.29	22	15.71	84	60.00%
2016/17	120	16	13.33	21	17.50	19	15.83	64	53.33%
2017/18	130	10	7.69	12	9.23	21	16.15	87	66.92%
2018/19	110	2	1.82	3	2.73	4	3.64	101	91.82%

From the above table 4 we conclude that the number of pass increased from 66.92% to 91.81% comparing academic year of 2017/18 to 2018/19. In another way the number of fail reduced by 24.89% after taking remedial action.

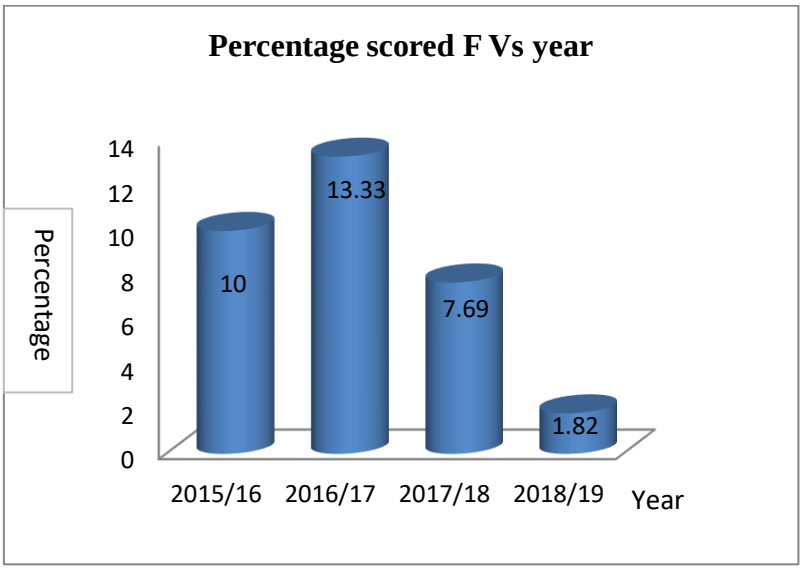

Figure 2. Percentage of failed students with respective years

From the above figure 2 we conclude that the number of fail is reduced from 7.69% to 1.82% from the year 2017/18 to 2018/19 after taking an action.

Table 5. Percentages against scored F in year

Year	2015/16	2016/17	2017/18	2018/19
Percentage	10.00	13.33	7.69	1.82
F scored	14	16	10	2
Registered	140	120	130	110

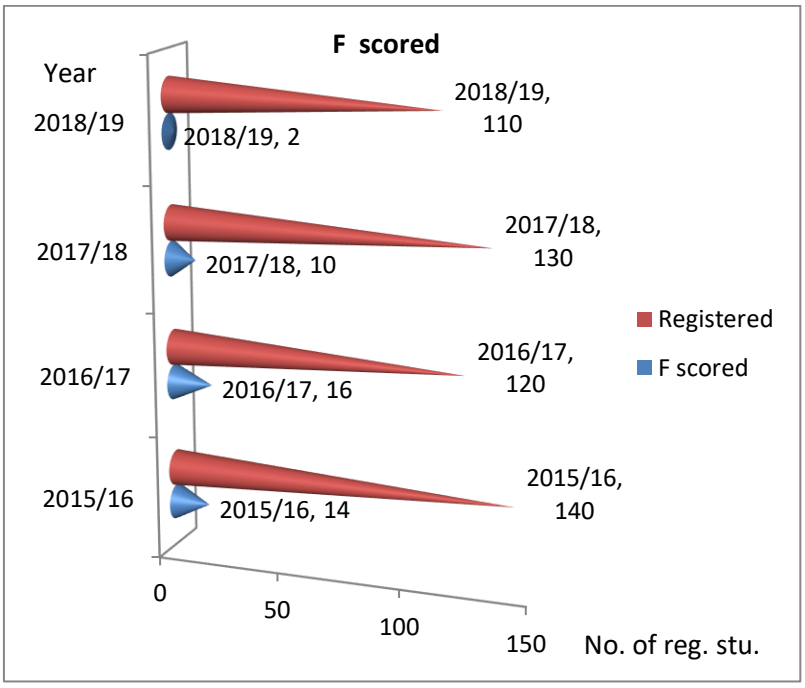

Figure 3. Percentages comparison against scored F in year

The above figure 3 and table 5 illustrates the number of F scored against the year comparing before taking remedial action and after taking remedial action. As it is observed the number of students were reduced to 2 (1.82%) after taking remedial action. The following table 6 shows the detail information of the 2017/18 academic year grade for 130 students in this course.

Table 6. Detail profile of students' grade for academic year of 2017/18

S/N	Grade Scale	Letter Grade	Sex		Total
			Male	Female	
1.	[90-100)	A+	6	3	9
2.	[85-90)	A	14	4	18
3.	[80-85)	A-	9	2	11
4.	[75-80)	B+	6	3	9
5.	[70-75)	B	6	0	6
6.	[65-70)	B-	10	1	11
7.	[60-65)	C+	11	0	11
8.	[50-60)	C	10	2	12
9.	[45-50)	C-	14	7	21
10.	[40-45)	D	10	2	12
11.	[30-40)	FX	0	0	0
12.	[0-30)	F	8	2	10
Total			104	26	130

The above table, is summarized with the following mini table 7 as follows

Table 7. Summary of students

	Passed	Fail	Total
Male	72	32	104
Female	15	11	26
Total	87	43	130

The following table shows the detail information of the actual grade of treatment group in this course.

Table 8. Detail profile of students' performance for academic year of 2018/19

S/N	Grade Scale	Letter Grade	Sex		Total
			Male	Female	
1.	[90-100)	A+	4	1	5
2.	[85-90)	A	20	10	30
3	[80-85)	A-	5	2	7
4	[75-80)	B+	4	2	6
5	[70-75)	B	10	2	12
6	[65-70)	B-	12	2	14
7	[60-65)	C+	9	2	11
8	[50-60)	C	10	6	16
9	[45-50)	C-	2	2	4
10	[40-45)	D	1	2	3
11	[30-40)	FX	0	0	0
12	[0-30)	F	0	2	2
Total			77	33	110

For summary for the above table, the following mini table 9 is also summarized as follows

Table 9. Summary of students

	Passed	Fail	Total
Male	74	3	77
Female	27	6	33
Total	101	9	110

The experiment conducted show as it is tabulated from the above table 5 up to table 8, in academic year of 2017/18, from 130 students 43 of them fail to score pass grade, this implies around one third of them (43) (33.08%) fail to score pass grade. In another way 87 (66.92%) of them were passed the course. But in academic year of 2018/19 from 110 students (9) (8.18%) of them only fail to score pass grade that means 101(91.82%) of them were passed the course. This indicates that the percentage of students in academic year of 2018/19 who failed in this course is reduced by 24.90 % comparing with that of 2017/18 after taking an action.

In another expression the action research conducted has shown that, from 110 students 101 (91.82%) of them score pass grade, this implies that only 9 of them (8.18%) scored fail grade

in 2019. But in 2018 from 130 students 87(66.92%) of them get score pass grade, this implies that 43 of them (33.08%) scored fail grade. Therefore, this indicates that the percentage of passed students increased from 66.92% to 91.82% after remedial was given.

CONCLUSION

Almost all of the students engaged in this action research were committed to perform good result and performance. In this study according to professional commitment all the basic preparation and sounded active methodology were implemented accordingly for wellbeing performance of the treatment group of students. As a result appreciated change was observed and most of the students were motivated and became happy in the delivery of the course in the usage of teaching aid methodology and on spot tutorial delivery. However, due to certain constraints like class sizing, frustration about the course as being they took twice or three times and thus, the intended result were not attained. The research team wants to conclude that most of the treatment group was taken this course at least twice before this program was conducted, that means all of them scored fail grade twice. But by conducting active learning method and giving tutorial, almost all of them 101(91.82%) were get pass grade out of 110 students in 2019 after remedial action. Thus the active leaning method together with teaching aid can enable and facilitate the performance of students in Fluid mechanics course.

CONFLICT OF INTEREST

Authors declare no conflicts of interest.

ACKNOWLEDGEMENT

The authors' want to say thanks to Jimma University Institute of Technology School of Chemical Engineering and second year chemical engineering students of 2018/19 for their willing to fill the questioner.

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Appendix – I

Questionnaire Used for Action Research

S.no	Question	Response classification	Skip
101	How old are you?	Age in completed years_____	
102	Sex of the respondents	1. Male 2. Female	
103	Where are you from?	_____	
104	What was your major favorite subject when you were at high school level? ?	_____	
105	Are you joined the campus based on your choice?	1. Yes 2. No	
106	If your answer to Q 105 is no, where did you interested to join the campus?	_____	
107	Are you placed in the college you were planning to join previously?	1. Yes 2. No	If **yes** go to Q109
108	If your answer to Q 107 is no, which college you were planning to join?	1. College of agriculture and veterinary medicine 2. College of business and economics 3. College of education and behavioral sciences 4. College of law and governance 5. College of Natural sciences 6. College of social sciences and humanities 7. College of medicine and public health 8. Other_____	
109	Are you placed in the field of engineering of your interest?	1. Yes 2. No	If **yes** go to Q112
110	If your answer to Q 109 is **no**, which engineering field you were planning to join?	_____	
111	Why are you not in the field of study of your interest?	1. Placed by the MoE/or the university 2. Family member/or friend influence 3. Misinformation 4. Other_____	

S.no	Question	Response classification	Skip
112	Are you satisfied by the field of study you are placed (chemical engineering)?	1. Yes 2. No	
113	If your answer is **no** for **Q 112,** What is your doubt about the field?	1. I've doubt that I will have a job opportunity by this field 2. I don't think I can perform efficiently in the field because I'm not interested in the courses given 3. Other _____	
114	Which course did you find the most difficult one in this semester?	_____	
115	What do you think is the reason behind the difficulty?	1. Instructor's approach 2. The nature of the course 3. Other _____	
116	What would you find to be helpful to overcome this difficulty?	1. If the instructor's approach is changed 2. If I could get tutorial 3. If I could get additional supportive material 4. Other_____	

Appendix – II

Some of Pictures Taken while Collecting Data