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## Research Article

### Strategies In Learning Fluid Mechanics: A literature Review

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#### ABSTRACT

One of the broad and intricate subfields of physics is fluid mechanics. Learning techniques for students are an essential component of learning fluid mechanics because they increase their motivation to learn, enhance learning outcomes, and encourage active participation in class. An overview of the prior research was highlighted in this publication, and several fluid mechanics learning methodologies were looked at in this review. The study found that the majority of students performed well in group settings, particularly when fluid mechanics principles are used in practical settings, which is the most successful teaching method. The studies that were reviewed in this literature review demonstrated that offering students team-based experiential learning is the best way to inspire them to learn fluid mechanics and to recognize the value of doing so. Therefore, by developing ideas and putting them into practice through active exploration, students learn more.

**Keywords:** *Experiential Learning, Fluid Mechanics, Group learning Learning Strategies, Systematic Review*

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#### Background

Students employ a variety of different learning strategies when they study. The term "strategy" refers to a course of action that is carried out in order to accomplish a goal. Thus, a learning strategy can be thought of as a plan of action that students follow in order to accomplish their learning goals (Schmeck, 2013). Students learn more effectively when they participate in, act in, react to, and reflect on their learning, rather than simply watching and listening to lectures (AbdelSattar, A., et al. (2019). Students' prior knowledge and experiences, the amount of effort they put into learning,

their cognitive abilities, their meta-cognitive skills, the quality of curriculum and instruction, the efficiency of institutions' student-supporting systems, and many other aspects can all have an impact on a student's ability to learn. According to Paimin A., et. al. (2017), learning strategies include motivation, affect, cognition, metacognition, and behavior in order to increase the likelihood of learning, create meaningful and retrievable memories, and perform higher-order cognitive tasks, such as problem solving. Reading notes, solving practice problems, and self-testing are all examples of effective learning practices.

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The study of energy, forces, and their consequences on different types of bodies is the focus of the scientific discipline known as fluid mechanics. On the other hand, fluid mechanics is the subfield of mechanics that studies the behavior of fluids in response to external forces and the properties of fluids in their various states. "*Fluid mechanics is arguably one of the oldest branches of physics, and the literature on this subject is vast and complex* (Vaidya A., 2020)". Fluid mechanics already existed back in ancient times, and it is still being taught, and it has always been complex.

Many educators today emphasize on writing formulas and solving problems on the whiteboard in engineering education, and occasionally ask students to verify their understanding (Steward-Wingfield & Black, 2005). Students learn best when they participate actively in discussions, practice, play games, and apply concepts and ideas. (Collins, & DiCarlo, 2005). It is essential for educators to have a solid understanding of the methods that have proven to be the most successful in guaranteeing student achievement across all subject areas, as well as the steps necessary to incorporate such methods into their lesson plans. The process of teaching and understanding fluid mechanics has been labeled as challenging and uninteresting for a large number of engineering students due to its complexity and breadth. Some very interesting experiences have been introduced to address this, such as project-based learning (Barrio, Blanco, Martinez & Galdo, 2010). This method of learning such as project-based learning promotes a positive teaching-learning process for fluid mechanics.

Learning fluid mechanics is hard, but it is a must to learn. Kundo & Rowling, 2016 stated: "Taking into account that the vast majority of the observable mass in the universe is in a fluid state, the fact that life as we know it cannot exist without fluids, and the fact that the atmosphere and oceans that cover the planet are both fluids, we can say that fluids are absolutely necessary for life." Most of the things surrounding us are fluids. Therefore, the subject of Fluid Mechanics must be learned. Fluid mechanics is indeed a complicated subject, but not if appropriately understood. It all depends on the

students' strategies for learning and the teachers' teaching methods.

This literature review aims to know the different kinds of strategies for learning fluid mechanics, certain strategies being paired with different learning outcomes; and how these strategies are being implemented inside the classroom, whether face-to-face or online learning. Moreover, this literature review provides the students with different learning strategies to improve their learning outcomes.

### **Statement of the Problem**

For this literature review, the researchers broadly searched for empirical studies that utilize different learning strategies. Moreover, this study provides an overview of the literature review of the different studies involving strategies in learning fluid mechanics and other sciences, whether online or face-to-face learning.

The main goal of this literature review is to provide an extensive review of the conducted research about strategies for learning fluid mechanics and other related sciences.

Specifically, this research aims to answer the following:

1. What are the different strategies being used?
2. What are the different learning outcomes that are being paired with certain strategies?
3. How are these strategies being implemented inside the classroom?

### **Methods**

This chapter discusses the research design, Samples, Data gathering procedure, Data analysis, Discussion, Study Selection, Study Eligibility, Ethical reconsideration, and Results.

### **Research Design**

In conducting this research review, the researchers utilized PRISMA's guiding principle. PRISMA's principles focus on ways that researchers can ensure transparent and complete reporting of literature review. The PRISMA principle guided the researchers to have a flow in identifying, screening, and setting inclusion criteria for their data collection process.

### **Study Selection**

There were a total of sixty-four studies that had been chosen that seemed to be relevant to the study. Of the total studies that were chosen, only seventeen passed the screening based on the eligibility criteria. There were some studies that managed to pass through screening, but were later on removed due to these reasons:

- a. Duplicated file
- b. Could not be accessed
- c. Drifts away from the topic
- d. Similar idea has already been included

### **Study Eligibility**

The PRISMA method was used throughout the process of determining the inclusion criteria, and those criteria were then arranged using the PRISMA framework. The following are components of the search: Articles from reputable sources (such Google Scholar and Springer, for example), publication year ranging from 2015 to the present, aligned abstract and findings in the standard operating procedure (SOP).

In this review, only texts written in English or texts translated into English that had already undergone peer review were considered. Studies that did not meet the inclusion criteria were not considered for the review. This was done to maintain the consistency and dependability of the studies. The publications that did not indicate a substantial difference between the two groups were likewise disregarded since they met the criterion for elimination. In addition, research paper titles were only taken into consideration if they were pertinent to the abstract; otherwise, they were disregarded.

### **Samples**

For the research sample, the researchers only include data publication from 2005 to 2022. All the related studies are screened further for data analysis and the researchers used the six generic steps that are involved in conducting a literature review as explained in (Templier et.al, 2015).

The six generic steps are:

- (1) formulating the research question(s) and objective(s),
- (2) searching the extant literature,
- (3) screening for inclusion,
- (4) assessing the quality of primary studies

- (5) extracting data, and
- (6) analyzing data.

### **Sampling Technique**

Researchers collected a set of data or samples from the certain mentioned sources (Google Scholar and Springer), and PRISMA will be utilized to conduct this literature review.

### **Data gathering Procedure**

The first step taken by the researchers in conducting this literature review is to search for related literature in online databases such as Google Scholar, ieeexplore, PubMed, NCBI, and ResearchGate. In looking for journals and articles, the researchers used different terms to look for publications. The following words or phrases is used:

*Learning Strategies in Fluid Mechanics, Strategies in Learning in Physics, Learning Strategies in Engineering Education, Learning Strategies and Learning Outcomes in Fluid Mechanics.*

These search keywords should be part of the title, abstract keywords, or abstract of the publication from 2005 to 2021. The next step that is undertaken by the researchers is selecting the relevant publications articles to be included in the review by searching for the title and abstract of each record.

After initial screening 38 studies were found to be relevant and valid publications and the 47 studies were removed. After the thorough screening, 17 publication articles remained to be included in the review.

### **Data Analysis**

For the researchers to analyze the data, they followed different data set analysis steps, starting with researching related literature in online data. The next step that the researchers had undergone is selecting the relevant published articles to be included in the review by searching for the title and abstract of each record. Moreover, all the articles and journals are further analyzed and sorted out by the researchers.

### **Ethical Consideration**

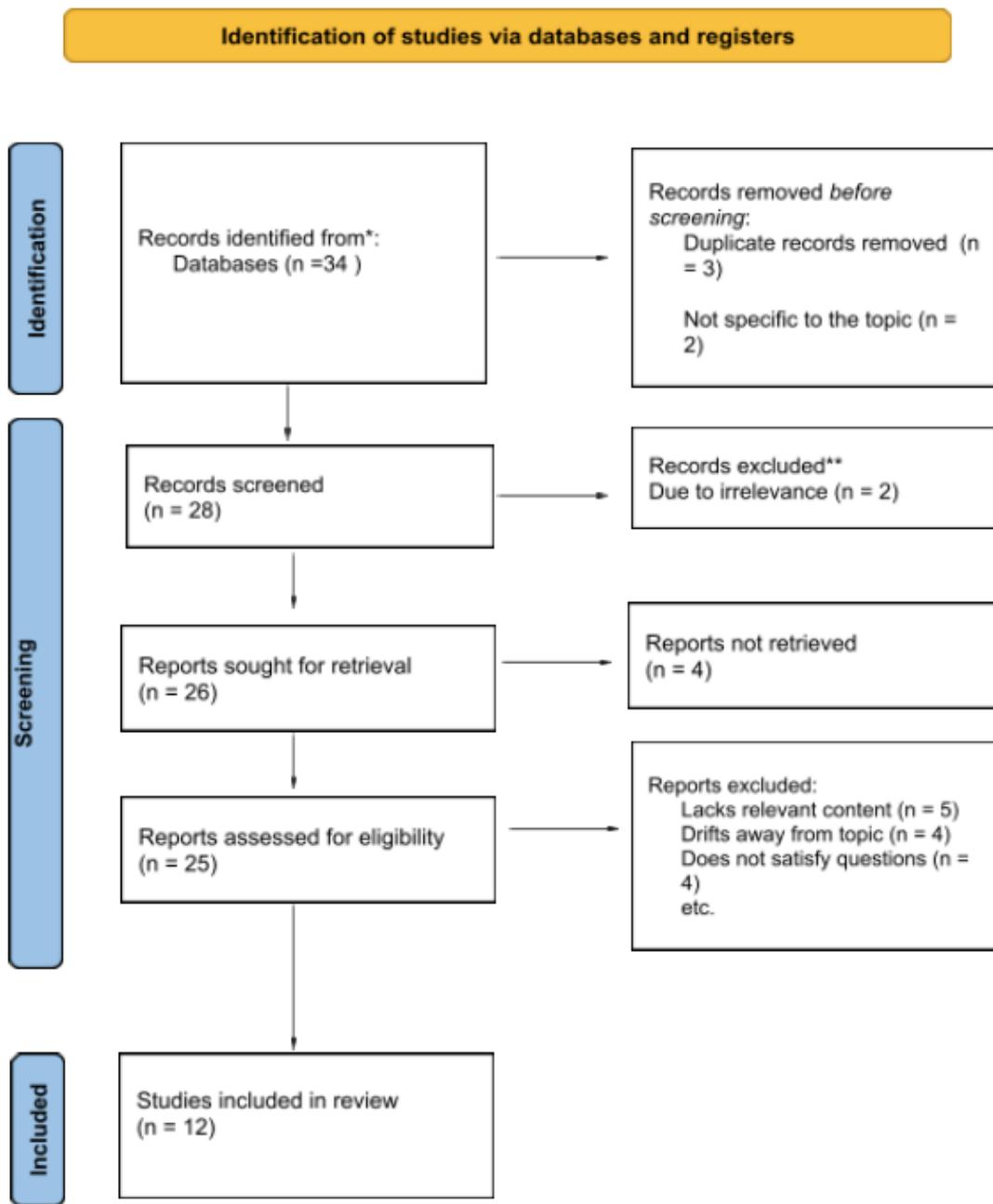
This paper is guided by ethical considerations, which include the following: individuals who engage in this paper are free from compulsion and are free to withdraw from the study at any time. This paper does not cause any bodily or mental harm, and as a result, it does not

cause any discomfort in the form of pain, tension, or anxiety. The citation of texts taken from other articles is something that must be done in order to prevent committing crimes like plagiarism. This also evaluates pertinent aspects in order to avoid dangers and other potentially detrimental activities.

### **Results and Discussion**

*Table 1. Final Database*

<b>Title</b>	<b>Author</b>	<b>Date published</b>	<b>Publication type</b>
Teaching and Learning of Fluid Mechanics	Ashwin V.	2020	Journal article
An active learning fluid mechanics course based on outcomes assessment	Ibrahim O.	2006	Research Article
A quantitative investigation of learning styles, motivation and learning strategies for undergraduate engineering students	Ning Fang Mohd F. bin Daud et.al.	2017	Journal article
Learning strategies of engineering students: How do they study outside class, and why?	Cervin-Ellqvist M. & Larsson D.	2019	Research Article
Methodology For Developing Teaching Activities And Materials For Use In Fluid Mechanics Courses In Undergraduate Engineering Programs	Gamez-Montero J. et.al	2015	Research article
Assessment of Hands-on Activities to Enhance Students' Learning in the First Year Engineering Skills Course	Patil A. et.al.	May 2009	Journal article
Perspective Study of Fluid Dynamics towards Engineering Students: A Short Review	Revathy, P.	2021	Journal article
Combining Modern Learning Pedagogies In Fluid Mechanics And Heat Transfe	Golter, P.B. et.al.	2005	Research Article
Teaching Impact And Evaluation Methodology Assessment In A Fluid Mechanics Course: Student's Perceptions	Sena-Esteves T.M. et.al.	2017	Journal Article
Active Learning in Engineering Education: Teaching Strategies and Methods of Overcoming Challenges	AbdelSattar A. & Labib W.	n.d.	Research Article
Teaching of Thermodynamics and Fluid Mechanics using Interactive Learning Methods in Large Classes	Dempster W. et.al.	2013	Journal Article
Learning strategies as an enabler of study success.	Paimin, A., et.al.	2017	Research Article



### Analysis

Table 2 presents the results and the outcomes of the filtered journals and articles. One of the central aims of this study was to examine the related literature of strategies in learning Fluid Mechanics. The filtered data was gained upon following the criteria given such as limiting the articles and journals from the year 2005 up to the present, analyzing the contents about its relevance and to see if it is reliable and applicable to the review itself.

Through the set criteria, the journals and articles were involved in different phases of the process and in the end, the higher and better-quality studies were chosen and represented. There are 34 (n=34) main articles that are included in this research and are subject for screening. Upon proceeding to the first stage of the inclusion and exclusion process, 26 (n=26) studies remained and 4 (n=4) studies were removed. Finally, out of 25 articles, through the

last inclusion criteria, 12 (n=12) articles remained.

With regards to the eligibility of the studies to be included on the text that should be fully reviewed, 5 lacks relevant content, 4 drifts away from topic and 4 does not satisfy questions.. Also, in between the filtering process, there are articles that did not pass the set criteria for the date published (2005-2022), that was tagged as “Maybe”. However during the process and stages of screening, the said article passed and achieved the criteria. As a result, there are 12 papers that are included in the data.

## **Discussion**

The studies shows in this review had similar results, we can confidently state that the findings are trustworthy. The research was also gathered from reliable sources. The findings also successfully addressed the paper’s stated issues.

Over the search period and across the articles retained, there are seven identified learning strategies that are beneficial in learning fluid mechanics- problem-based learning, experiential learning, think-pair-share, one-minute recap, game-based learning, cooperative learning and project-based learning. The strategy being regarded as the most effective is learning collaboratively in groups and applying fluid mechanics in real-world applications. Based on the included studies in this literature review, most students are motivated to learn different concepts in fluid mechanics when applying the principles in real life where they are understood cooperatively. Relevant studies in this literature review also proved that students performed well in the practical work, especially in teams, than in the individual tests. Hence, students are motivated to learn more when topics are elaborated upon by applying it directly in the real world.

Based on the included studies in this literature review, most students who are motivated and active in the class are those who engage in hands-on learning strategy where they participate in team and solve real-life situations related to the concepts of fluid mechanics. Additionally, there are different strategies in

learning the concept of fluid mechanics where instructors use other learning pedagogies that let the students learn and think individually with the concepts without any real-world examples being provided, hence the students are having a hard time understanding the concepts. Throughout the study we proved that there are different strategies used and each has a different effect on the students and different outcomes. To summarize, most students who study fluid mechanics excelled in class when all the concepts are being done through experiential learning. Studies proved that providing the students with practical situations that are relevant to a specific topic in fluid mechanics makes the students more engaged and interested.

Based on the included studies in this literature review, the students excelled in hands-on activities especially in learning in teams as a learning strategy. It is being implemented after the discussion of the concept wherein the students apply the concept in a real-life activity to better understand how a certain concept works. Furthermore, hands-on activities are a type of active learning that includes course material, problem solving, case studies, and other methods related to it.

Hands-on activities as learning strategies have team interaction in which students will be grouped together and the team members will contribute ideas to solve the given problem.

Technically, after learning the concept, of the lesson will follow a hands on performance or activity for the application of the concept.

## **Conclusion**

Over the search period and across the articles retained, a study by Gamez-Montero et al. (2015) identified more precise strategies focused on the learning of fluid mechanics in order to better motivate those students who, due to a lack of knowledge or motivation, fail to appreciate the importance of the subject in the overall context of their curriculum. These strategies should take into account that students value activities in which they participate as a team. This study proves how impactful learning is when presenting practical cases that have some connection to the specialties of the different groups of students.

A study from Olwi A. (2006) also proved that in order to understand the principles of fluid mechanics is to apply its applications in real life. The professor's experience lies in the wealth of applications he is aware of, and therefore he should relate those applications to the theory being studied. The applications related to the engineering concepts should be well emphasized by the instructors. This way, the students are expected to feel the relevance of fluid mechanics to their world, and henceforth an interest in the subject is created. Hence, this proved that experiential learning is also a great strategy, especially involving students to direct real-world experiences in transferring information about Fluid Mechanics.

From the findings of the study conducted by Patil et al. (2016), it was observed that throughout the semester, students enjoyed engaging in hands-on activities in group learning as they promoted active learning, effective participation, team interactions, and also developed problem solving skills. This way, principles in fluid mechanics are applied in real life and understood by various students. In general, students were enthusiastic participants in the hands-on activities and performed the learning tasks to a very high standard. Hence, it is consistent with the study of Gamez-Montero et al. (2015) that team interactions, especially group learning, are the best strategy in learning fluid mechanics.

A study from (Golter P.B et.al., 2005) discusses the modern learning pedagogies in fluid mechanics and heat transfer. Students initially thought the syllabus in Fluid Mechanics was confusing and long, and the methodology would be difficult. As the semester progressed, they came to enjoy the course and the hands on work. Some of the students came to the realization that group work would be valuable to their success in later jobs. Fluid Transport Systems and Fluid Mechanics are important topics in most Engineering courses. Nevertheless, students usually consider it a difficult and theoretical course (Sena-Esteves T. et.al.,2017). Students performed well in the practical work especially in teams, better than in the individual tests. In fact, it is authors' belief that since it is a team work, where real-world problems are

studied, it might motivate students and improve their collaborative skills (Sena-Esteves T. et.al.,2017).

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To the several areas in school, Notre Dame of Marbel University, namely: Teston Building (Physics Laboratory), New Building (meeting area), and lounging area near the book room that gave convenience in doing our research, without its efficiency, we were not able to discuss primarily what are the things needed to complete our paper.

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