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Impact of Physical Model Projects and Multidisciplinary Teams in Fluid Mechanics Education

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Abstract: Fluid mechanics, a required course in many undergraduate engineering disciplines, is often described as a challenging subject as it weaves together advanced mathematics and physics to solve conventional engineering problems. This study examines the effect of incorporating a physical model project via multidisciplinary teams into two theory-based fluid mechanics courses to address two general questions: Does the design and construction of the physical model aid in understanding fluid mechanics concepts? Does working with students of different engineering disciplines improve student experience and comprehension? The study was conducted in Spring 2023 with a cohort of 49 mechanical and civil engineering students; each project team had a mix of both disciplines. At the end of the semester, all projects were presented at a common venue, followed by an anonymous paper-based survey. The results indicate that around 83.7% of students felt the project had an overall positive impact on their learning experience. Despite initial student apprehension about multidisciplinary teams, 72% of students appreciated the opportunity to work with engineers from other disciplines, with qualitative inputs describing the value added from varied skill sets. In conclusion, this project enabled students to apply their in-class training to a real-world model while working in multidisciplinary teams. The results provide insight into the implementation of similar projects and the value of multidisciplinary teams.

Keywords: project-based learning; multidisciplinary teams; fluid mechanics; engineering education

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Citation: Sekaran, A.; Rodak, C.M. Impact of Physical Model Projects and Multidisciplinary Teams in Fluid Mechanics Education. *Educ. Sci.* **2024**, *14*, 658. https://doi.org/10.3390/educsci14060658

Academic Editors: María-José Terrón-López and Paloma J. Velasco-Quintana

Received: 6 April 2024
Revised: 6 June 2024
Accepted: 14 June 2024
Published: 17 June 2024

1. Introduction

Fluid mechanics, one of the oldest branches of physics and applied mathematics, has been an area of study for centuries. The fluid mechanics discipline is complex in its breadth, demand for prerequisite knowledge, intricacy, and disciplinary applications, which makes disseminating the basics of the field particularly challenging [1]. While topics in fluid mechanics are taught in physics, mathematics, environmental sciences, mechanical, and chemical and civil engineering departments, the teaching of this course did not receive significant attention until around 2000 [2]. Certain accepted pedagogical approaches in STEM, such as active learning and collaborative, problem-based learning, have been adopted with some success, paving the way for more inventive approaches [3]. Early acceptance of these pedagogical approaches has also resulted in focused efforts for faculty training in effective pedagogy, such as the National Effective Teaching Institute (NETI); engineering-specific efforts, such as the Kern Entrepreneurial Engineering Network (KEEN); and discipline-specific efforts, such as the ASCE Excellence in Civil Engineering Education workshop [4]. The literature around the application of innovative pedagogy in the fluid mechanics classroom has expanded substantially, including but not limited to blended or flipped classrooms [1], using virtual reality to move beyond computational fluid dynamics (CFD) models [5,6], unique student team-based projects [7] and hands-on teaching aids [8–10]. Two recent efforts to catalog advances included special issues in the

MDPI journal *Fluids* focused on teaching and learning in Fluid Mechanics with guest editor Dr. Ashwin Vaidya [2,11]. Overall, critical attention is needed to solve problems in the areas of teaching and research related to fluid mechanics while highlighting the value of multimodal approaches, including physical model projects [12,13].

STEM education is seen to be most effective when a range of learning style preferences are accommodated. Kolb's Learning Style Theory [14] and Dunn's theory [15] are common learning style theories applied to all educational settings, while the Felder–Silverman model is frequently used in engineering education [16]. The objective of all theories is to broadly address all four dimensions of learning within the classroom—sensing/intuitive dimension, visual/verbal dimension, the active/reflective dimension, and the sequential/global dimension [17]. The present study introduces an approach that combines the visual/verbal dimension and the active/reflective dimensions for present-day fluid mechanics education via the use of a physical model.

A physical model, as referred to in the present study, is a combination of experimental, analytical, and numerical work applied to a theoretical concept in order to develop students' abilities to tackle real-world problems [13]. Such models have been used extensively in research and practice and are becoming a more integral part of educational applications worldwide [18,19]. Pedogeological research also highlights the importance of integrating traditional instruction with visual, interactive activities; data from Stice [20] determine that reading alone led to student retention of 10%, followed by hearing alone or seeing alone at 26% and 30%, respectively. A multimodal approach was significantly better leading to retention of around 50% when reading and hearing material and as much as 90% when engaging with and applying the material. Employing varied modes of instruction spanning diverse approaches further allows more students to engage with the material, even if they were initially discouraged by the difficulty level of concepts from the traditional lecture.

The theory of experiential learning, originally introduced by Kolb in 1984, is a guiding study for introducing projects in college-level classes [14]. The findings from this work are summarized as a learning cycle (Figure 1) that shows the four critical elements of learning, with comprehensive learning occurring only when a student has passed through all stages of the cycle, despite their preference for mode of learning. In the study [21], it is suggested that while students can enter the cycle anywhere, learning occurs primarily during the 'Concrete Experience' stage, where students are actively engaged in physical experiments. This juncture urges them to reflect on and apply their knowledge, especially when accompanied by a complementary element such as a report or presentation. The application further allows them to translate concepts to a range of settings and internalize the fundamental principles, thus ensuring long-term retention [22,23].

While the value of physical models is generally appreciated, it is important to identify a strategic approach for introducing such components in traditional, largely theory-based, and analytical classes. For example, the implementation of hands-on learning modules was found to be most effective after the foundation of the topic was presented [9] and when used to reinforce learning objectives at higher-levels of Blooms' taxonomy [10]. The present study presents an application of a physical modeling component in one such instance: students will have gained fundamental theory from the classroom and work toward the design, construction, and evaluation of their own physical model. We discuss the materialization of the project in this context along with foundational steps and student preparation. This is followed by a detailed description of one representative submission and student impressions from survey data. Finally, limitations of the implementation of the study are discussed along with ideas for future applications.

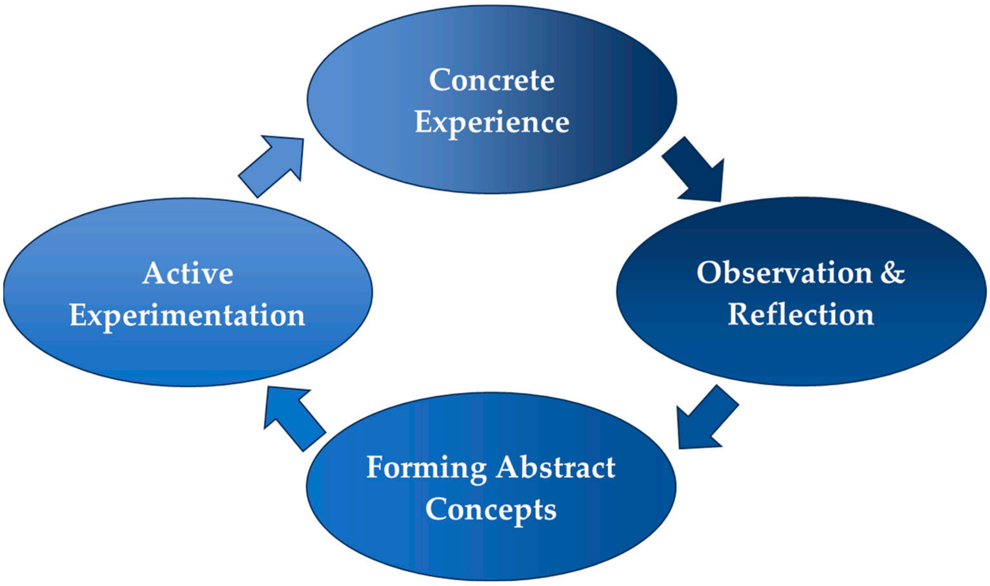


Figure 1. Kolb's learning cycle showing four elements of learning [adapted from [14]].

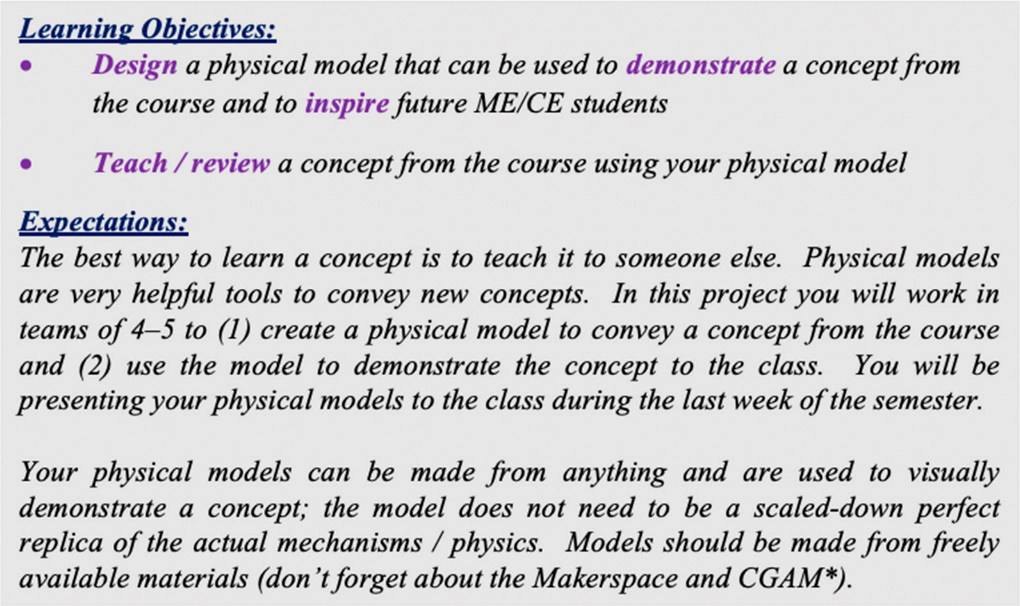
2. Materials and Methods

Fluid dynamics courses are typically introduced to second- and third-year engineering and science students and draw on their knowledge of calculus, engineering mechanics, and thermodynamics, which are all typically indicated as prerequisites. Students specifically require familiarity with dimensions and units, particle dynamics, rigid-body dynamics, and vectors and velocity fields [24]. Upon introducing the laws of conservation of mass and momentum, the primary challenge for students is to apply their training in calculus to a physical problem and consequently interpret numerical results in a physical context. While solving numerical problems in class as part of an active learning environment is helpful, many students are still unable to translate this to more complex or differently phrased problems. This approach of 'modeling-and-mimicry' is suggested as an insufficient mechanism for developing the schemas necessary for students to transition from novices to expert problem solvers [1]. As students work through such problems on their own, even in cases where the problem is solved correctly, the critical step of pausing to interpret the results, analyzing the rationality of the solution from a physical standpoint, and connecting the problem to others of a similar classification or schema is usually missing. Requiring students to reflect and think about answers can help, but students often struggle to articulate why their answers do or do not make sense beyond choosing the appropriate equation and rarely connect the problem-solving technique to others.

Physical models therefore allow students to take complex equations and solutions and cast them in a visual demonstration. Students are required to conceptualize, construct, demonstrate and present a physical model in order to (1) prompt Active Experimentation and Concrete Experience (as defined by Kolb [14]) and (2) implement a multimodal approach with various milestones to cover a range of learning styles with the goal of long-term retention.

The following prompt (shown in Figure 2) was provided to students at the beginning of the semester.

The objectives were set up to ensure students were able to (1) translate conceptual understanding to a physical setting, (2) compare real-world data to theory/computations, and (3) understand the theory well enough to explain it to an audience (comprised of mostly college students and faculty). The project prompt was supplemented with a timeline to enable feedback from instructors on the topic chosen and encourage the implementation of the engineering design process.



Learning Objectives:

- ***Design*** *a physical model that can be used to* ***demonstrate*** *a concept from the course and to* ***inspire*** *future ME/CE students*
- ***Teach / review*** *a concept from the course using your physical model*

Expectations:

The best way to learn a concept is to teach it to someone else. Physical models are very helpful tools to convey new concepts. In this project you will work in teams of 4–5 to (1) create a physical model to convey a concept from the course and (2) use the model to demonstrate the concept to the class. You will be presenting your physical models to the class during the last week of the semester.

Your physical models can be made from anything and are used to visually demonstrate a concept; the model does not need to be a scaled-down perfect replica of the actual mechanisms / physics. Models should be made from freely available materials (don't forget about the Makerspace and CGAM).*

Figure 2. Project prompt provided to students highlighting project requirements (* CGAM—Centre for Global and Advanced Manufacturing houses additive manufacturing equipment and machine tools for student/faculty use).

The steps on the timeline included:

1. Team formation.
2. Initial team meeting, brainstorming and presentation of ideas to instructors.
3. Submission of a model plan—a written discussion of (a) the concept chosen to cover, (b) a CAD drawing of the model, (c) a brief explanation of how the model will demonstrate the concept, (d) a materials list, and (e) a timeline for project completion.
4. A final model presentation with a live demonstration/video (for a longer experiment run time).

The class is a three credit, 15-week long course that meets twice a week for an hour and fifteen minutes each time. The document detailed above was provided to 49 students—20 junior-level mechanical engineering (ME) students and 29 civil engineering (CE) students who were a mix of second- and third-year students. Teams were assembled by semi-random selection, and each team had at least 1 student from each discipline, resulting in a total of 12 teams. Upon completion of the project presentation, all students were asked to complete an anonymous paper-based survey that included multiple-choice, Likert-scale-based answers and qualitative descriptions. Section 3.2 discusses the results of this survey in detail.

3. Results

3.1. Sample Physical Model Projects

Models based on the Bernoulli equation were chosen by multiple teams likely due to the early curricular timing of the introduction of the assignment in both fluid mechanics classes. A few such models are described here to provide a better understanding of the implementation of the physical model. The first model shown in Figure 3 was from a team (comprised of two CE sophomores and two ME juniors) that aimed to compute the velocity of a stream of water from a large 'reservoir' using kinematic expressions of projectile motion and freely falling objects to compare against the same velocity determined using the Bernoulli equation. The application of the Bernoulli equation in a similar context was discussed in both the CE and ME fluids lectures and therefore students were comfortable with the simplifications applied to the Bernoulli equation in this case. The preliminary project plan discussed the methodology, equipment and equations used along with details about the choice of fluid (water) and assumptions for subsequent calculations. This plan was discussed with the instructors, who provided feedback on additional considerations such as simultaneous measurements of height and horizontal stream distance and inherent losses in the formulation of the Bernoulli equation, which were to be covered later in the course.

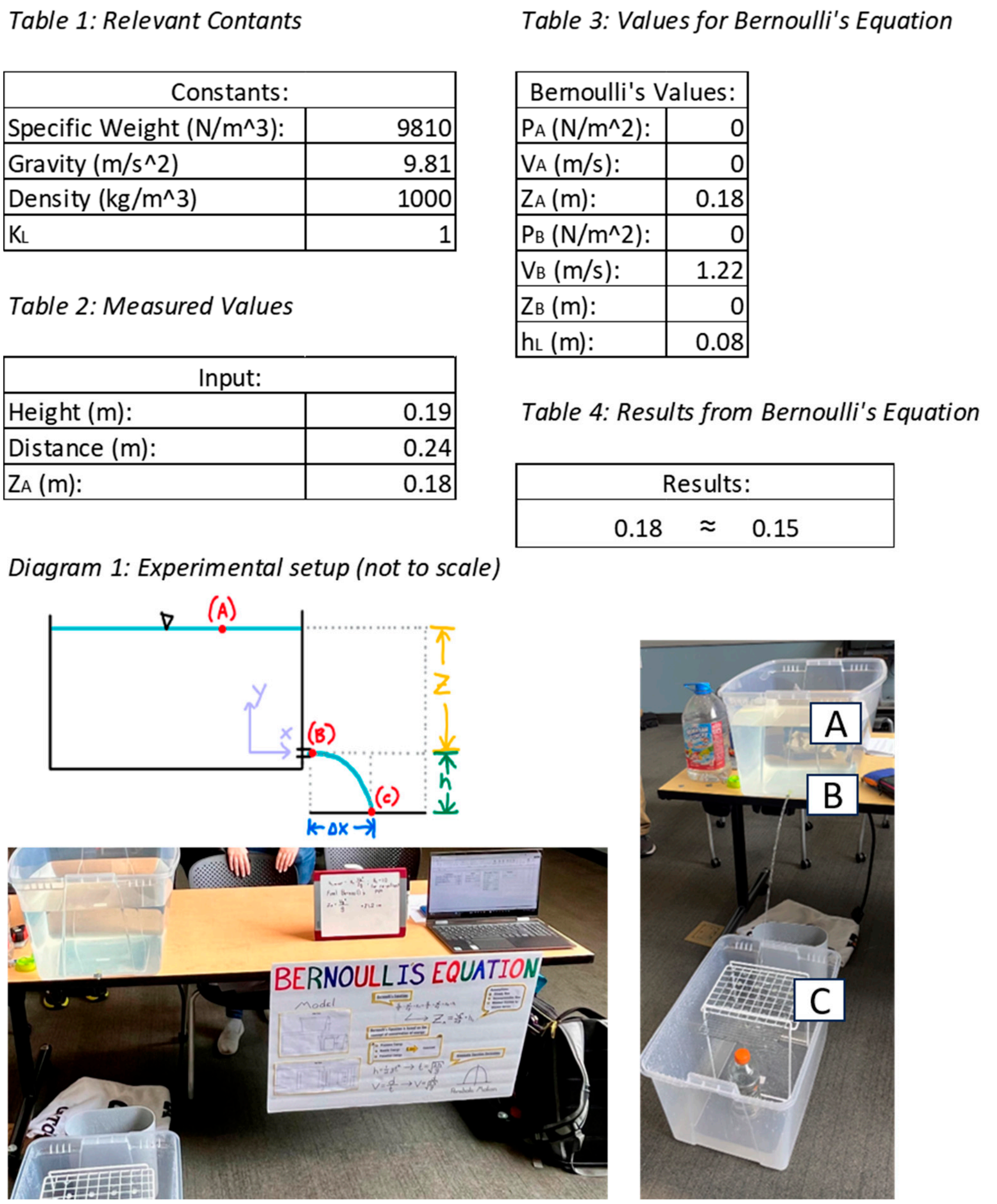


Table 1: Relevant Contants

Constants:	
Specific Weight (N/m^3):	9810
Gravity (m/s^2)	9.81
Density (kg/m^3)	1000
K_L	1

Table 2: Measured Values

Input:	
Height (m):	0.19
Distance (m):	0.24
Z_A (m):	0.18

Table 3: Values for Bernoulli's Equation

Bernoulli's Values:	
P_A (N/m^2):	0
V_A (m/s):	0
Z_A (m):	0.18
P_B (N/m^2):	0
V_B (m/s):	1.22
Z_B (m):	0
h_L (m):	0.08

Table 4: Results from Bernoulli's Equation

Results:
0.18 ≈ 0.15

Diagram 1: Experimental setup (not to scale)

Figure 3. Sample implementation of a physical model to demonstrate Bernoulli's equation with 'live' calculations in excel connecting theory to the physical model. A, B and C correspond to locations in Diagram 1 (inset) and are also shown in the physical setup in the bottom right corner of this figure.

The final model presentation (Figure 3) included a detailed explanation of the theories chosen via a poster, a demonstration of the stream from the large 'reservoir' and measurement, and 'live' calculations of the velocity using both methods, including the inclusion of a loss term that was introduced in the latter half of the course. The extract from the report presented in Figure 3 shows one such sample calculation, where Table 1 shows the constants used, Table 2 shows the values measured by the team during one iteration of the experiment, Table 3 shows their simplified assumptions for the Bernoulli equation (locations A, B are shown in Diagram 1), and finally, Table 4 shows the measured and computed values of Δx (location C in Diagram 1) as 0.18 m and 0.15 m, respectively. The report included an explanation of discrepancies observed and limitations of the equation, ensuring the team made the connection between the equation, calculations and observation. Recalling that Kolb's learning cycle [14] explains how learners undergo active experimentation when they take a practical approach, rather than simply observing a situation, this physical model's dynamic setting encouraged active experimentation, which is essential to forming new ideas and innovations.

All four students took turns in presenting certain aspects of this model and suggested shortcomings and improvements. The accompanying poster encouraged them to distill the information spanning model construction, equations used and assumptions/simplifications. This required reflection on the concept as introduced in class and a physical correlation of the terms used in theory and numerical problems. This experience, in conjunction with the physical construction of the model, exemplifies the 'Concrete Experience' stage of the learning cycle (Figure 1) and allows for a deeper understanding and improved retention of these fundamental concepts. While the model setup was straightforward, the creativity displayed in relating two distinct equations along with a recognition of the limitations of the model was appreciated by the instructors. The team also had a spreadsheet that conducted real-time calculations during their experiment and presentation. The concluding report (extract presented in Figure 3) included sample calculations and a justification of the discrepancy in the velocities in terms of the major and minor head losses for the flow from the 'reservoir'.

Figure 4a shows another project demonstration where the student team analyzed Pascal's Law. This was also a topic that the classes discussed as part of a hydrostatics lesson early in the semester, and multiple teams had different variations of this concept. The team used two syringes of different sizes connected by a small flexible plastic tube, with water as the working fluid. The report detailed the reasoning and computations behind applying a larger force for pushing the bigger syringe. The setup shown is particularly interesting since the students used a spring (with a known spring constant) to reconcile the force computations based on Pascal's Law. This also introduces a potential of building projects to incorporate concepts from different courses well before the senior capstone project to emphasize the relationships between seemingly distinct engineering classes. The authors are working on implementing one such joint project at the time of compilation of this manuscript.

Figure 4b,c is from a student team with a more qualitative representation of the Bernoulli equation. This team built a small wind tunnel (from 3D printed parts), seen in Figure 4b, which was used to elucidate two concepts—the idea of a stagnation point (as seen in the explanation in Figure 4c) and streamlined vs. blunt bodies (additional data omitted here for brevity). The stagnation pressure was computed based on the velocity of the fan powering the wind tunnel.

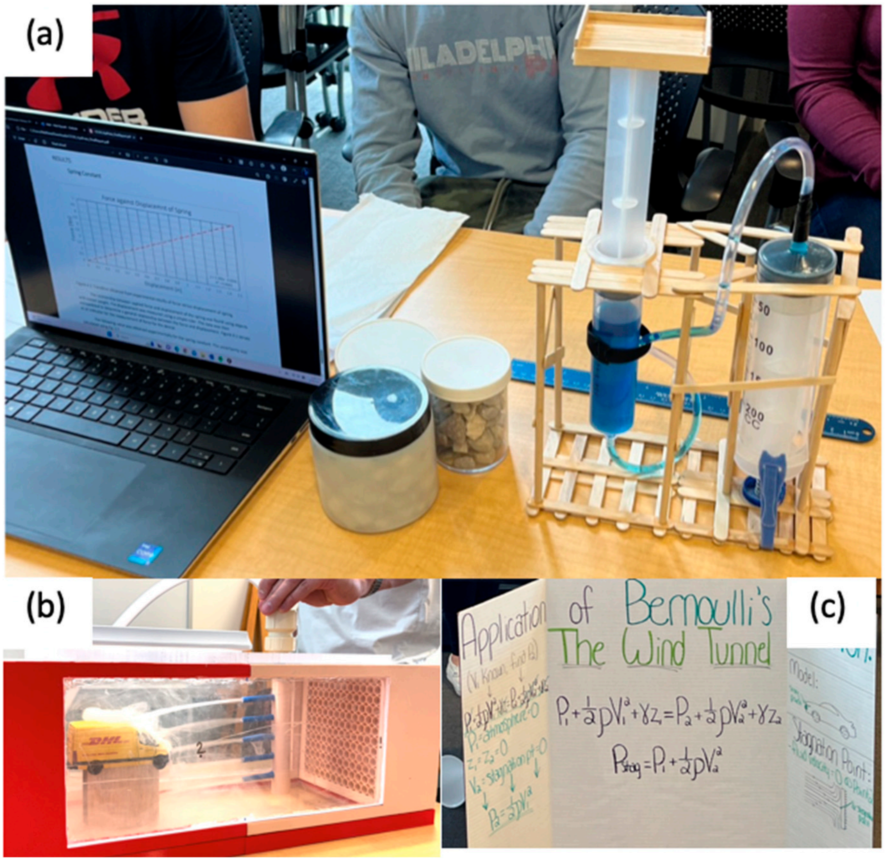


Figure 4. Physical models demonstrating (**a**) Pascal's Law via syringes of different sizes and (**b**) another implementation of Bernoulli's equation via a 3D printed wind tunnel. Also shown in (**c**) are related equations for the wind tunnel.

3.2. Survey Results

The anonymous paper survey was handed out to students following the presentation of their physical projects (discussed in more detail later). Of the 49 students enrolled in the course, 43 returned the survey, resulting in a response rate of 87.8%. Before presenting the study findings, we would like to acknowledge our position as engineering educators at a small undergraduate institution. Our results and interpretations are based on a moderate-sized group of students. While we expect our study's general trends to hold, implementing this project for larger classes spanning hundreds of students would require significantly more support to maintain the same level of instructor involvement. Both authors have experience teaching a range of courses, from foundational freshman engineering courses with large classes to specialized senior courses with only a few students. Our study, along with the associated survey, was designed primarily to improve student comprehension through physical model building. This approach is more applicable to certain levels of engineering courses than to courses that introduce base concepts, such as statics or material science. We also acknowledge that our perspective as women in STEM education may have influenced the setup of the survey. However, we consulted with other entities, such as the Institutional Review Board at our institution, to ensure minimal effect.

The first set of essay-type survey questions dealt with the project topic, team background, and individual student's preparation (classes completed, current classes). It should be noted here that no specific topics were suggested by the instructors. Results from the topic selections (Figure 5) indicated that most students favored Pascal's Law and the Bernoulli equation followed by viscosity measurements and hydrostatic pressure computations. The choice of topics signified that students were more comfortable applying simplified algebraic expressions that were introduced earlier in class as compared to more complex conservation equations, pipe flow networks, or non-Newtonian fluids. The topic chosen may also have been influenced by the availability of online resources when researching potential topics. While teams were directed to shortlist 2–3 topics for the preliminary check-in meeting with the instructors, most students had settled on one specific topic with options for the application. The choice of the application does not appear to be a function of team composition across disciplines—final demonstrations included an equal spread of civil and mechanical engineering-inspired applications.

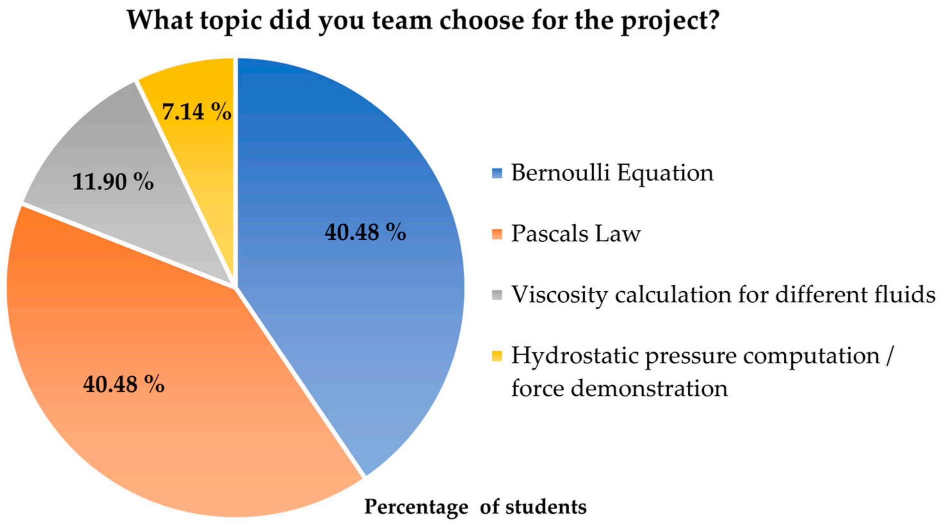


Figure 5. Survey results for topic selection for the physical model demonstration.

Students were then asked to reflect on the execution of the model using two multiple-choice questions. First, students were asked to reflect on the performance of their physical model. While most teams had working prototypes on the day of the demonstration, one team had trouble with the working of their model and a few others had minor operational issues. Overall, just over 75% of the students felt they had effective models as represented in Figure 6. Scores from the graded reports averaged around 85%, indicating that the students' perception of their understanding and the ability to apply this understanding was justified.

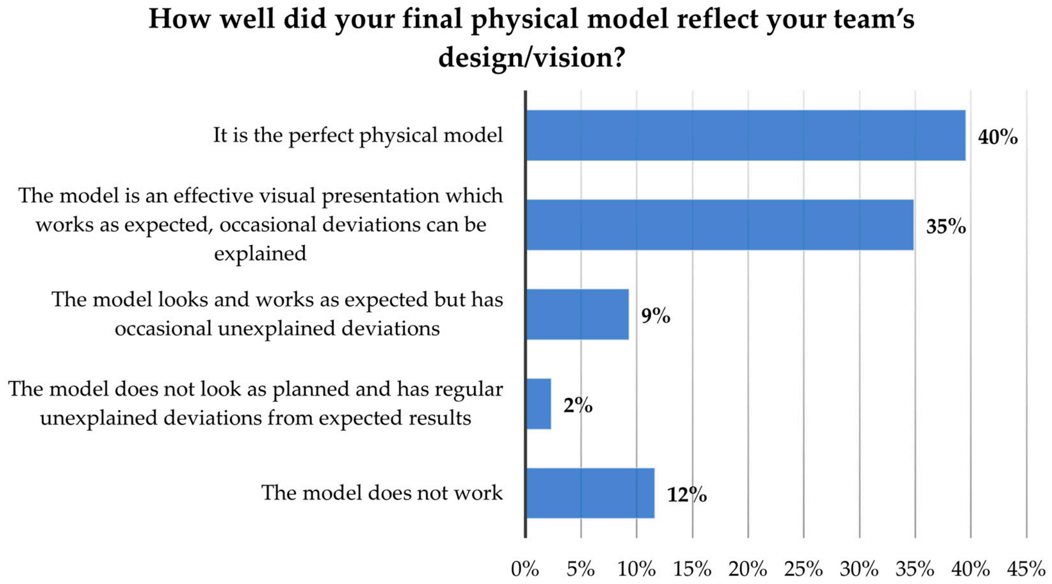


Figure 6. Survey results for model performance based on student perception.

Students were further challenged to examine their performance by categorizing reasons for shortfalls, as seen in Figure 7. Students were provided with five general shortfall categories for this question: time management, knowledge of fluid mechanics, resources available, team dynamics, and 'other'. Most students determined that the availability of resources (both time available to use the resources and physical resources) was the primary factor for the underperformance. The issue with availability was likely owing to delays in ordering, shipping, and obtaining specific parts. The instructors aim to rectify this for future classes by prescribing a specific online vendor and building in time for such delays in the project timeline. A secondary barrier for some students was time management—this was due to the varied schedules between the two student populations (CE vs. ME and sophomores vs. juniors). Some class time was allocated for group work, but the instructors will aim to schedule more built-in time as well as lab resources for the model construction. It is important to note that less than 5% of students felt underprepared in terms of their knowledge of fluid mechanics. While this could, in part, relate to the choice of topics, most students were comfortable in translating theoretical concepts into a working physical model.

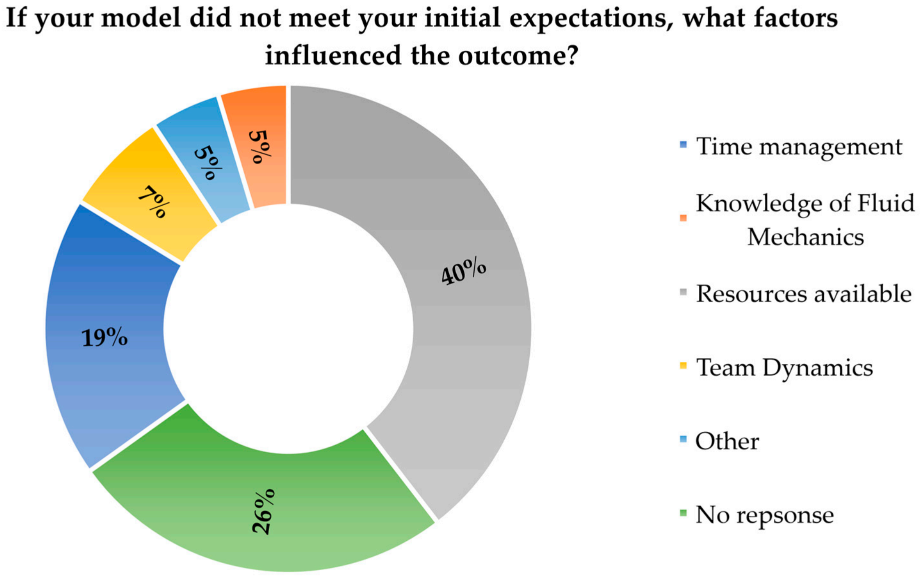


Figure 7. Survey results for shortfalls in model performance.

The final two questions in this set pertained to the students' experience of (1) how building a physical model strengthened their understanding of their topic and (2) how the project helped their learning experience. Based on a Likert scale response, over 90% of students agreed or strongly agreed that building the physical model had a positive impact on their understanding of their topic (Figure 8). Around 84% of students agreed or strongly agreed that the overall project had a positive impact on their learning of fluid mechanics concepts. This is similar to [7], who found that approximately 78% of students involved in similar team-based projects felt it helped them learn and demonstrate fundamental concepts. Students were not directly asked to provide qualitative comments on this specific topic, but one response related to teamwork included feedback in this regard:

> *'I was not looking forward to this but after some setbacks I'm happy with how our group responded. It felt really good to see the experiment working after so much troubleshooting.* ***It was also nice to apply some hands-on skills to course material.****'*

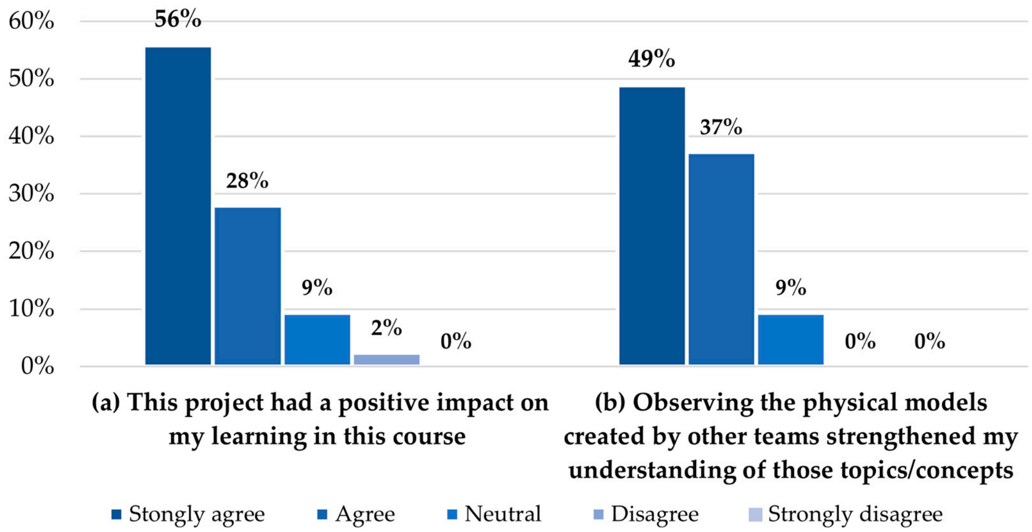


Figure 8. Survey results for (**a**) whether the project had a positive impact on their learning and (**b**) the impact of viewing other models on the learning experience.

The physical models were presented as part of an inaugural Engineering Festival held during the last day of class, which promoted physical models and projects from CE, ME, and Engineering Science courses. The venue was a large indoor hall where multiple tables were set up (one per team) in a U-shaped formation, allowing for interaction between teams and for audience engagement. The festival was open to all students, faculty and staff, promoting a range of audience knowledge, which required students to adapt their explanations accordingly. The overall spread of topics covered by the fluid mechanics teams further allowed students to witness other concepts in project form and improve their understanding of the fluid mechanics subject area as a whole. Figure 8 shows that around 86% students agreed that their exposure to all of the fluid mechanics projects on the last day was beneficial to their grasp of different concepts. This common demonstration platform also enabled students to engage in reflective observation/visual learning [14]—students were encouraged to walk around the hall, talk to other groups and ask questions about the models demonstrated. In comparison, each group presented to the class in turn, and the instructors walked around from table to table, allowing for a more engaged experience and unrestricted student contact. The authors note that the 'festival'-style presentation and exclusion of a formal presentation (which was part of a previous implementation of this study) facilitated increased interaction and discussion between groups.

Mandavgane [7] also found that approximately 78% of students felt their project helped them learn the nuances of teamwork, supporting the qualitative comment from the student above. Participation in undergraduate interdisciplinary collaborations has also been shown to strengthen engineering identity—the overall belief and confidence in themselves as engineers [25]. A significant novelty of this study was pairing civil and mechanical engineering students as teams. Given the course placement in both departments, this also led to sophomores (CE) working with juniors (CE and ME). Therefore, in addition to having different discipline-specific perspectives, the academic preparation and experience also varied (e.g., progression through required courses in mathematics, classroom experience with engineering presentations and written reports, etc.). The next set of survey questions was related to understanding the impact of this interdisciplinary setup via a mix of long answers and multiple-choice questions on a Likert scale. Figure 9 presents the results of these multiple-choice questions. Around 12% of students were initially apprehensive in working with engineers from another discipline. Mandavgane [7] found that during the course of their chemical engineering fluid mechanics laboratory project, 100% of the students engaged with students, staff, or faculty outside of the chemical engineering discipline. The instructors emphasized the importance of such interdisciplinary collaborations by providing examples of the common ground in their classes as well as practical applications that require partnerships. Students were also given the opportunity to voice their concerns with working with another class. Responses included:

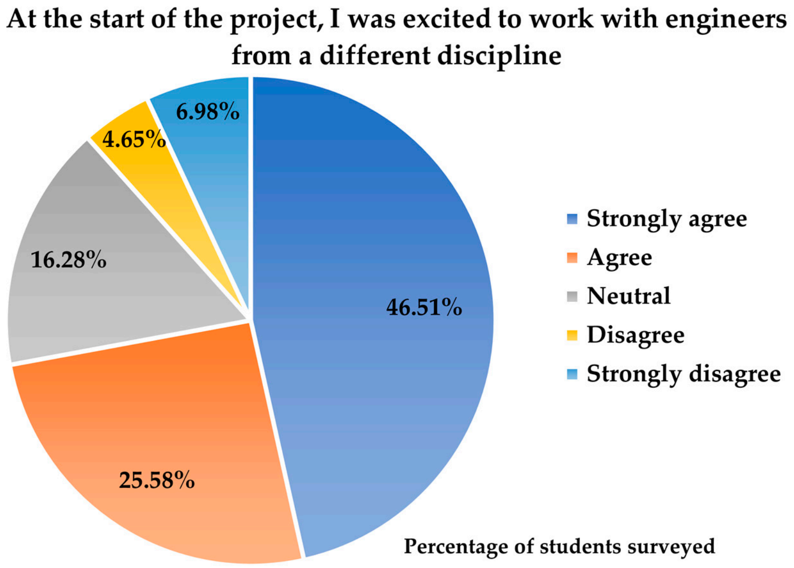


Figure 9. Survey results for students' initial feeling toward multidisciplinary teamwork.

> *'That we focused on different things within the same class, and we would not want the same idea'*
>
> *'I didn't have any concerns other than their familiarity with other topics'*
>
> *'Hard to communicate, make time, different schedules, not same ways of going about project'*

Despite their initial concerns, when asked about how the mix of engineers influenced their final design, most students were overwhelmingly positive about their experience. Some sample responses to this question include:

> *'Having two different engineering backgrounds helped work together to* ***form solutions to project problems****'*
>
> *'Different schedules made it harder to meet but the* ***varying knowledge*** *was very helpful'*
>
> *'It actually* ***helped a lot*** *the ME 320 and CE students were able to come together to build a good physical model. The ME students provided excellent insights when it came to all of us* ***building the model together****.'*
>
> *'It worked out really well actually. I had a lot of tools at my disposal and some* ***carpentry skills*** *to lend. The ME students were very good with software like* **SOLIDWORKS (Version 2023)** *and the other CE student had a* ***good vision of the project****.'*

4. Discussion

The inclusion of the physical model project as part of the undergraduate fluid mechanics course via interdisciplinary teams was an overall valuable experience for students and instructors. Many results supported those found by Mandavgane [7], as discussed above. While additional implementation and variations to include other disciplines/courses are underway, the authors note that the present study has some limitations as currently employed. The total number of students (49) was relatively small, leading to the acknowledgement that the conclusions from statistical data would be more effective for a larger cohort.

The format of the course with the inclusion of the project was the first attempt for both instructors at this institution, and there was limited prior data/survey information to compare against and quantify the impact of this module on the original course learning outcomes. The corresponding author has taught a similar course at a prior institution where a project-based component was excluded but a prescribed lab module was integrated into the class. The lab module, while providing additional learning modalities, was useful but not as successful as the present method, where students are asked to reflect and create their own physical models. This can be attributed to the direct implementation of the Active Experimentation phase [14] in the present case, where learners are asked to apply their own ideas to the world around them to see what happens rather than follow a set of instructions and complete standard reports. As a specific example, students typically find the application of the Bernoulli equation complex useful, despite it being introduced early in the semester. Their typical issues arise from the simplification of the equation, and students are doubtful on why certain terms are ignored. The authors observed that this cohort was more comfortable with the implementation of this equation and overall performed better on related questions on the final exam (conducted after project presentations) compared to the mid-term exam (held before the project build and presentation). Future iterations of this project will include specific markers to track student performance and compare against other engineering/engineering technology class populations that do not employ a project-based learning module.

Multiple years of implementation would further lead to a more streamlined process and an additional resource library (for both physical supplies and project ideas) for students, which the instructors aim to develop. The emphasis of this study therefore is the introduction of class projects spanning disciplines and enabling the building of physical models based on theoretical class concepts. The authors also note that many schools have a common first-year curriculum with minor deviations in the second-year courses between civil and mechanical engineering disciplines. Replicating similar collaborative projects would therefore be more beneficial at junior or even senior levels for complementary classes. The present study was also amiss at tracking the availability of online resources and their influence on project topic selection or final design. While students cataloged all references used for individual projects in the design reports, the authors aim to include more survey questions to gauge correlations more efficiently.

5. Conclusions

The current study details the implementation of a physical model project for a fluid mechanics class composed of interdisciplinary teams of civil and mechanical engineers. Moreover, 49 students were asked to design and build physical models of a concept discussed during a fluid mechanics class and use it to teach and/or reinforce the concept in an audience mostly composed of their peers. While students expressed some apprehension about working with engineers of other disciplines, owing to differences in approach and schedules, most students agreed that the team composition helped them by drawing on different strengths. The range of project ideas also helped with the overall comprehension of subject knowledge and allowed students to experience complications in translating a theoretical concept into a physical model. Building the models was impeded by the on-time availability of resources and dedicated class time for the construction, which can be mitigated by developing a streamlined purchase process and strategic allocation of common class time. Students can be further supported by a preliminary survey at the beginning of the semester to ascertain pre-existing skills including CAD and machine tool experience—this will ensure the creation of more equitable teams and the same foundation for all.

Author Contributions: Conceptualization, A.S. and C.M.R.; methodology, A.S. and C.M.R.; software, A.S. and C.M.R.; validation, A.S. and C.M.R.; formal analysis, A.S. and C.M.R.; investigation, A.S. and C.M.R.; resources, A.S. and C.M.R.; data curation, A.S.; writing—original draft preparation, A.S.; writing—review and editing, A.S. and C.M.R.; visualization, A.S. and C.M.R.; supervision, A.S. and C.M.R.; project administration, A.S. and C.M.R.; funding acquisition, NA. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of SUNY Polytechnic Institute (protocol code IRB-SEKARAN-2023-1 approved 26 April 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author as further iterations of this project are ongoing.

Acknowledgments: The authors wish to acknowledge the support of John Knight and Steve Murphy, Center for Global Advanced Manufacturing and the generous support of the College of Engineering at SUNY Polytechnic Institute.

Conflicts of Interest: The authors declare no conflicts of interest.

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