

# Assessment on Intervention Strategy to Reduce the Failure Rate in Fluid Mechanics: Face-to-Face and Online Approaches

Azyan Zafyrah Mohd Zahid, Nadia Zalikha Saifullizam, Wan Syarizawani Wan Chik and Siti Farahin Kamaruddin

School of Civil Engineering, College of Engineering, Universiti Teknologi MARA Johor Branch,  
Pasir Gudang Campus, 81750 Masai, Johor, Malaysia  
Corresponding Author Email: azyan8410@uitm.edu.my

To Link this Article: <http://dx.doi.org/10.6007/IJARPED/v12-i1/16106>

DOI:10.6007/IJARPED/v12-i1/16106

**Published Online:** 04 January 2023

## Abstract

The Fluid Mechanics course has been identified as one of the highest failure rate courses in the Diploma in Civil Engineering among undergraduate students. This course deals with the behaviour of fluids under various forces as well as its application in the civil engineering field and is equally important compared to other fundamental courses. It appeared that students' achievements based on designated course outcomes, which are to explain basic knowledge of fluid mechanics and formulate engineering problems related to fluid mechanics, were mostly unsatisfactory. In an effort to foster the issue, an intervention programme was introduced, whereby it has been conducted for two semesters, physically and virtually. This programme maintains the conventional teacher-centred method while applying an active learning environment where lecturers guide students creatively in problem-solving exercises that focus on critical subtopics. During the face-to-face sessions, the programme was conducted for two hours in three sessions. The online programme session, on the other hand, was carried out due to COVID-19 restrictions, conducted in three live sessions led by different lecturers. The recorded videos were shared with the students for further use afterwards. The findings indicate that the Intervention Programme fulfilled physically (semester March 2019 – July 2019) has decreased the percentage of failure rate by 0.48% compared to the previous semester without the intervention (semester September 2018 – January 2019), while for online intervention, the failure rate has slightly increased by 0.35% (semester October 2020 – February 2021) when compared to no intervention held (semester March 2020 – July 2020). However, a comparison made between these two methods shows that an online intervention programme has significantly improved the percentage failure rate as compared to a face-to-face intervention programme by a decrement of 12.77%. Such interventions, especially if conducted online, would have a significant impact on academic outcomes and help in eliminating the achievement gap among students.

**Keywords:** Fundamental Course, Intervention Programme, Teacher-Centred, Undergraduate Students, Course Outcomes

## Introduction

Traditional learning systems support the use of conventional learning tools by providing knowledge in real-time. However, as seen by the rapid advancement in information technology, online education has become a significant trend in education (Mu *et al.*, 2019). The outbreak of COVID-19 has forced all sectors, particularly the education sector, to break down the traditional classroom barriers and shift to the virtual classroom. The online learning method facilitates course content accessibility and eliminates time and distance limitations (Zamakhsari & Ridzuan, 2016), compared to the traditional educational system that needed lecturers to engage, guide, and discuss face-to-face with students.

Online learning is not only convenient for students but also allows them to take any courses based on their interests with a simple click at their fingertips. E-Learning courses use high-quality multimedia information to enhance students' comprehension and offer a remarkable, virtually interactive environment (Moore *et al.*, 2003). Moreover, it has been stated that engagement in online learning enhances student-centred learning, fosters greater student participation, and generates more in-depth and rational conversations than conventional face-to-face learning experiences (Smith & Hardaker, 2000).

In ensuring there are no gaps in learning for each individual, the intervention strategy can be an alternative solution for struggling students with low academic performance. Intervention in education can be a balancing act of supporting those students who need additional help during a lesson. Education interventions offer students the aid necessary to acquire the skills taught by the educational system and should focus on functional skills, academic, cognitive, behavioral, and social abilities that have a direct impact on the student's access to education (Charman, 2013). In addition to assisting students in attaining their Course Outcomes (COs) and Program Outcomes (POs), the intervention programme was designed and implemented to address the persistently high student failure rate.

Researchers discovered that when specific motivational processes are addressed at crucial phases in the learning process, focused interventions can have substantial and long-lasting impacts (Harackiewicz & Priniski, 2018). Therefore, this paper aims to assess the effectiveness of intervention programmes held by face-to-face and online learning approaches.

## Methodology

The Fluid Mechanics course introduces students to the concepts of fluid mechanics that include fluid properties, fluid statics, and hydrodynamics. This course involves programme learning outcomes PLO1 and PLO2, which explain the basic knowledge of fluid mechanics and formulate engineering problems related to fluid mechanics, respectively. The evaluation of this course is based on continuous assessments and the final examination. For the normal semester, the evaluation was split into 30% for Test 1, 10% for Assignment, and 60% for the Final Examination. For the ODL semester, the assessment consists of 30% Quiz, 10% Assignment, 30% for Test 1, and another 30% for Test 2 as shown in Table 1.

Table 1

*Assessment Mapping for normal and ODL semesters for the course Fluid Mechanics*

Normal semester			ODL semester		
Type of assessment	PLO	Percentage breakdown	Type of assessment	PLO	Percentage breakdown
Test	PLO1 PLO2	30%	Quiz	PLO1 PLO2	30%
Assignment	PLO2	10%	Assignment	PLO2	10%
Final Examination	PLO1 PLO2	60%	Test 1	PLO1	30%
			Test 2	PLO2 PLO1 PLO2	30%

Due to the constant high failure rate obtained by the students for this particular course every semester, the intervention programme was introduced and conducted for two semesters, March 2019 – July 2019 using the face-to-face method and October 2020 – February 2021 using the online learning method, as shown in Table 2.

Table 2

*Implementation methods applied to the Intervention Programme (before and during COVID-19)*

Semester Intake	Implementation of the Intervention Programme	Method	Remark
Sept 2018 – Jan 2019	No	Face-to-face	F2F – without intervention
Mar 2019 – July 2019	Yes		F2F – with intervention
Mar 2020 – July 2020	No	Online	Online – without intervention
Oct 2020 – Feb 2021	Yes		Online – with intervention

### Face-to-face Approach

For intake March 2019 – July 2019, the total number of students taking this course is 77. This intervention programme was conducted face-to-face using a teacher-centred approach whereby the lecturer acted as a facilitator and assisted the students during the programme. The programme has been conducted twice for three hours each session. The sessions were divided into two parts; the first session covered Chapter 1 and Chapter 2, while the second session covered Chapter 3 and Chapter 4. The lecturers briefly explained on the introduction and overview of each topic covered before starting the exercise. The materials provided by the lecturers included examples as well as question samples for each topic and were given to the students beforehand. During the session, the lecturers would assist and answer questions related to the topic discussed (Zahid *et al.*, 2021).

### Online Approach

A total of 151 students were taking this course for the October 2020 – February 2021 intake. This intervention programme was shifted from the face-to-face method to online due to COVID-19. The programme was conducted by using Microsoft Teams for three sessions, with two hours per session for that particular semester. Four lecturers were designated to

conduct the programme, and each lecturer covered one topic for one session. During that programme, the lecturer began by giving a brief introduction and overview of the topic before distributing question samples and explaining the possible solutions to the problem. Students can ask questions by turning the microphone on or writing in the chatbox, and the lecturer will answer questions in detail. Discussions and lecture sessions were recorded, which can be watched, paused, and reviewed by students. Online learning allows them to review the course materials as often as they like and at a time when they are most focused.

In this study, the percentages of failure rates (less than 50%) were compared to the previous semesters where there was no intervention have been conducted for both face-to-face and online learning methods. Apart from that, a comparison of failure rate percentages was also done according to the semester during the implementation of the intervention programme (face-to-face and online). At the end of the programme, a feedback form was given to students to assess their perceptions of the online intervention programme, which was held and analysed accordingly.

## Results and Discussion

The intervention programme has been conducted as an intervention to improve educational practises for struggling students whose academic performance is significantly lower than their peers. The positive outcomes of this intervention programme were measured by tests, quizzes, assignments, and final exam scores, and a reduction in withdrawals or failures. In this study, comparisons were made between a) the face-to-face method; without and with intervention, b) the online method; without and with intervention, and c) the face-to-face and online methods; with intervention.

Segregation percentages of students' achievement based on grades obtained for four (4) semesters are presented and compared in three graphs (Figure 1, Figure 3, and Figure 5). The grades for marks above or equal to 50 are considered as distinction (grade A+, A and A-), credit (grade B+, B and B-) and pass (grade C+ and C), whereas below 50 is considered a fail (grade C-, D+, D, E and F). The students are required to retake the failed course in order to improve their grades and be able to take the intermediate course, Hydraulics, in the upcoming semester.

The percentages of failure rates were also recorded and compared to the previous semesters where there was no intervention have been conducted for both learning approaches; face-to-face (Figure 2) and online (Figure 4). Lastly, a comparison of failure rate percentages has been made according to the semester during the implementation of the intervention programme (face-to-face and online) (Figure 6). In general, the implementation of the programme has improved the performance of students in the Fluid Mechanics course.

## Comparison of Face-to-face Approach – without intervention Versus with Intervention

Figure 1 compares the percentage of students' achievement based on grades without and with face-to-face intervention programmes conducted in each particular semester. Based on the results, 10.55%, 30.73%, and 34.86% of students have received "distinction", "credit", and "pass" for the Fluid Mechanics course during the semester where no intervention was conducted, respectively. With the face-to-face intervention programme implemented, the result showed that 1.3%, 22.08%, and 53.25% of students have received "distinction", "credit" and "pass" for this course, respectively.

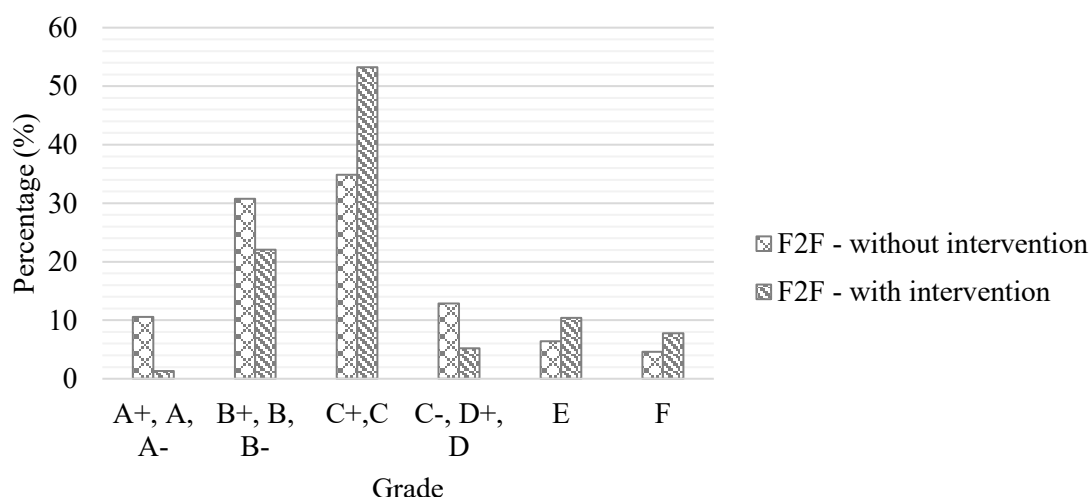


Figure 1: Percentage of students' achievement according to grade (without and with face-to-face intervention)

The face-to-face intervention conducted in the semester March 2019 – July 2019 showed a slight decrement in the failure rate percentage among students by 0.48% compared to the previous semester without the intervention (September 2018 – January 2019) (Figure 2). Despite a small reduction in percentage, the implementation of the intervention programme proved its relevance to be conducted and included, not only as a way to reduce the failure rate percentage among students every semester but also to maintain the percentage from not exceeding the failure rate limit (25%) as set by the university.

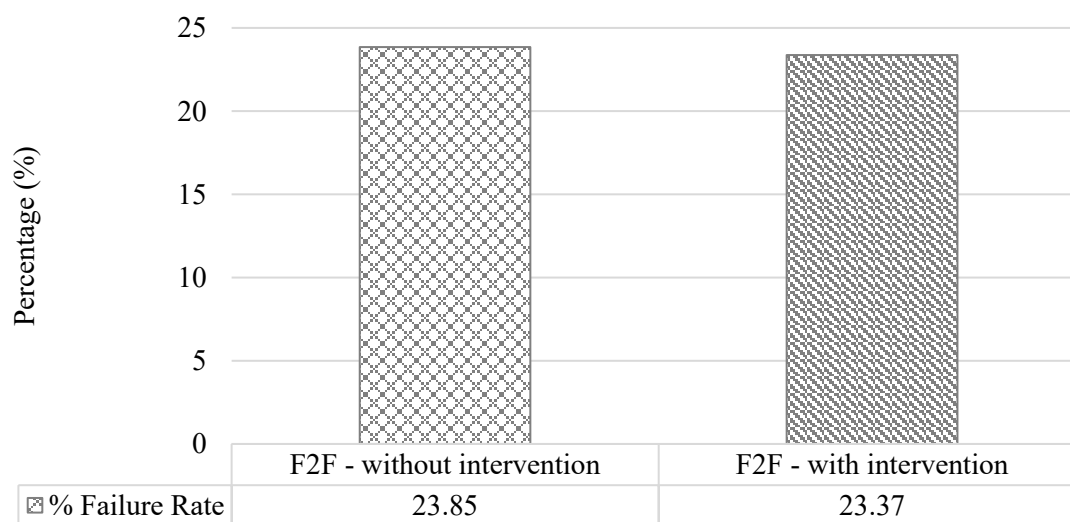


Figure 2: Percentage of failure rate according to semester without and with face-to-face intervention

### Comparison of Online Approach – Without Intervention Versus with Intervention

Figure 3 shows the comparison of grades in percentages among students. The comparison was made without and with intervention programmes conducted in two consecutive semesters based on the online approach. Based on the graph, the implementation of the online intervention programme in the semester October 2020 –

February 2021 has recorded 17.88% of students receiving A+, A, and A- grades for this course compared to the previous semester with only 5.13% without this intervention (March 2020 – July 2020). The high percentage of students that have achieved “distinction” in the later semester demonstrates that online intervention has benefited them in scoring good grades for the course. Meanwhile, 53.85% and 30.77% of students have achieved “credit” and “pass” during the semester March 2020 – July 2020 where there was no intervention conducted compared to 52.98% and 18.54% in the semester October 2020 – February 2021.

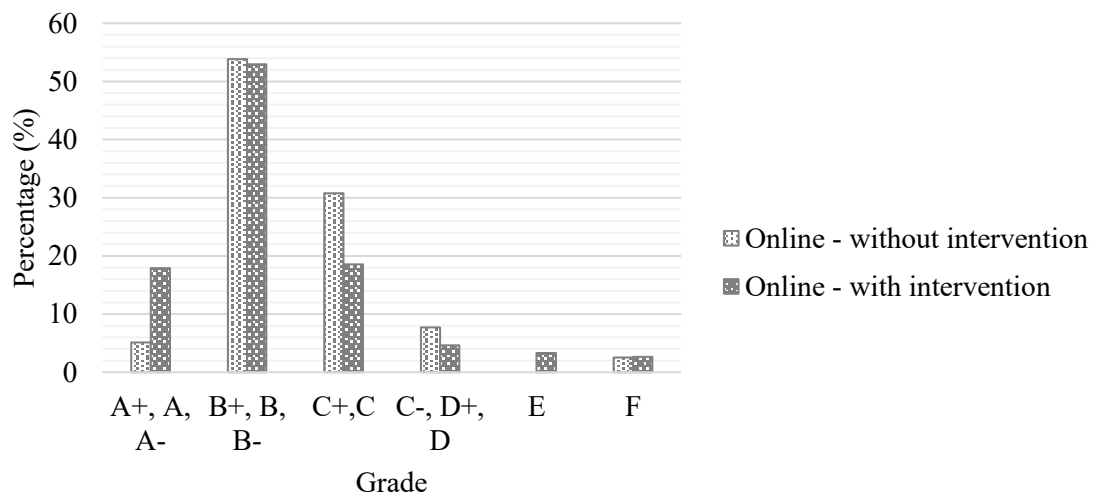


Figure 3: Percentage of students' achievement according to grade (without and with online intervention)

Figure 4 shows the percentage failure rate recorded according to semester without (March 2020 – July 2020) and with (October 2020 – February 2021) online intervention. Although the result in October 2020 – February 2021 (with intervention) shows a slight increment compared to the semester before online intervention was held (March 2020 – July 2020), this small increment of 0.35% was highly due to a higher number of students taking the course in October 2020 – February 2021 (151 students) in comparison to the total of 39 students from the previous semester March 2020 – July 2020 (without intervention). However, the percentage failure rate for both semesters is considered relatively low and does not exceed the limit of a 25% failure rate.

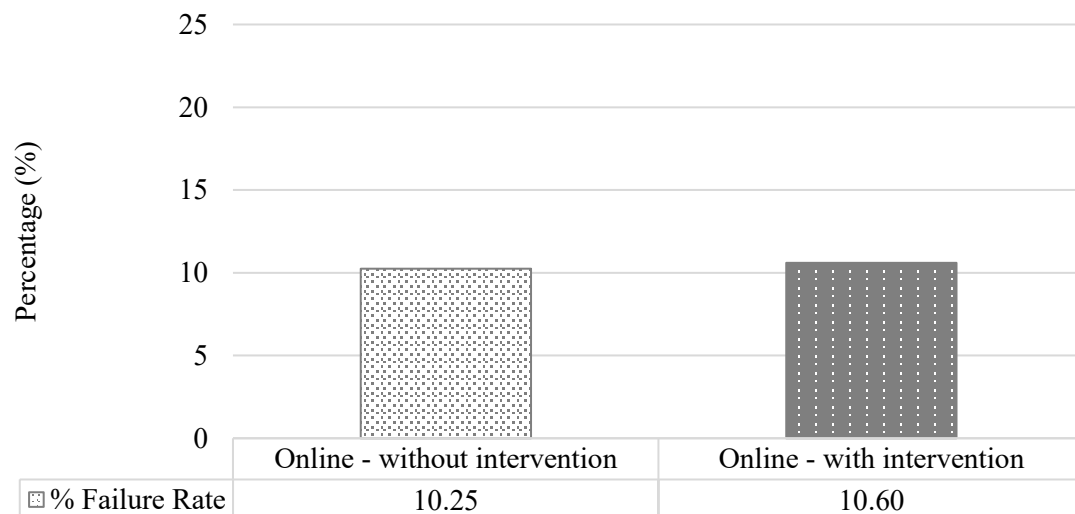


Figure 4: Percentage of failure rate according to semester without and with online intervention

### Comparison of Interventions between Face-to-face and Online Approaches

A comparison based on grades was made based on the implementation of the intervention programme by face-to-face and online methods (Figure 5). The implementation of an online intervention programme has shown a significant increment in the number of students getting A+, A, and A- grades in the semester October 2020 – February 2021 (17.88%) compared to the previous semester, March 2019 – July 2019 (1.3%), when the intervention was conducted face-to-face. The differences between students who achieved B+, B, and B- also recorded a high difference of 30.9%. Meanwhile, 52.98% of students received a grade “credit” while 18.54% of students received a grade “pass” for this course when the intervention was held online, compared to 22.08% of students who received “credit” and 53.25% of students who managed to receive a grade “pass” when it was conducted by the traditional face-to-face method.

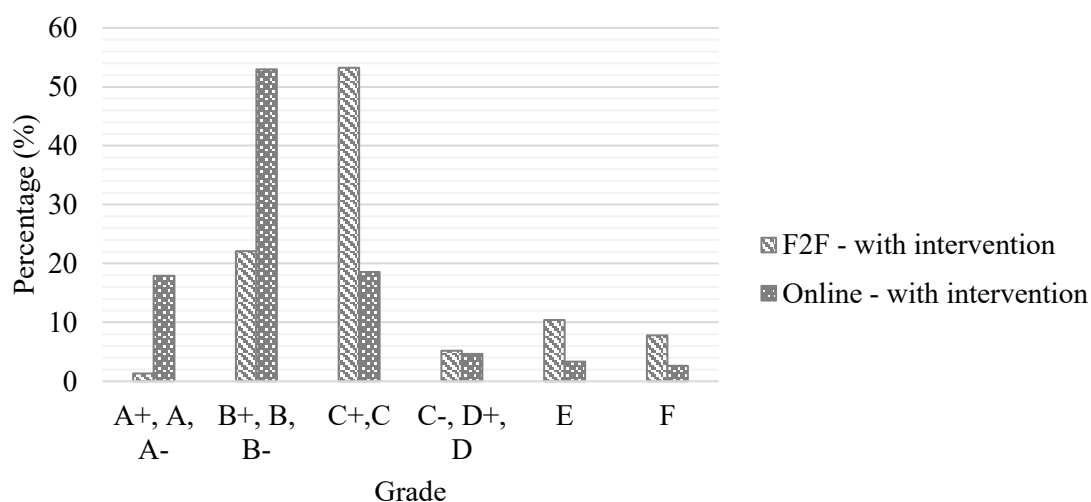


Figure 5: Percentage of students' achievement according to grade (Face-to-face and online interventions)

The implementation of an online intervention programme has also reduced the percentage of failure rate among students taking this course in October 2020 – February 2021 (10.6%) compared to the previous semester March 2019 – July 2019 (23.37%) when the intervention programme was held face-to-face (Figure 6). Based on grades and percentages of failure rate, the implementation of intervention showed positive improvements in both methods. The 12.77% decrement in failure rate recorded when the online intervention was conducted has demonstrated that this approach greatly reduces failure rate problems for one course compared to the face-to-face method. Intervention, particularly by online methods, would be an excellent additional strategy in improving educational practises for students in their academic performance for either fundamental, intermediate, or advanced courses.

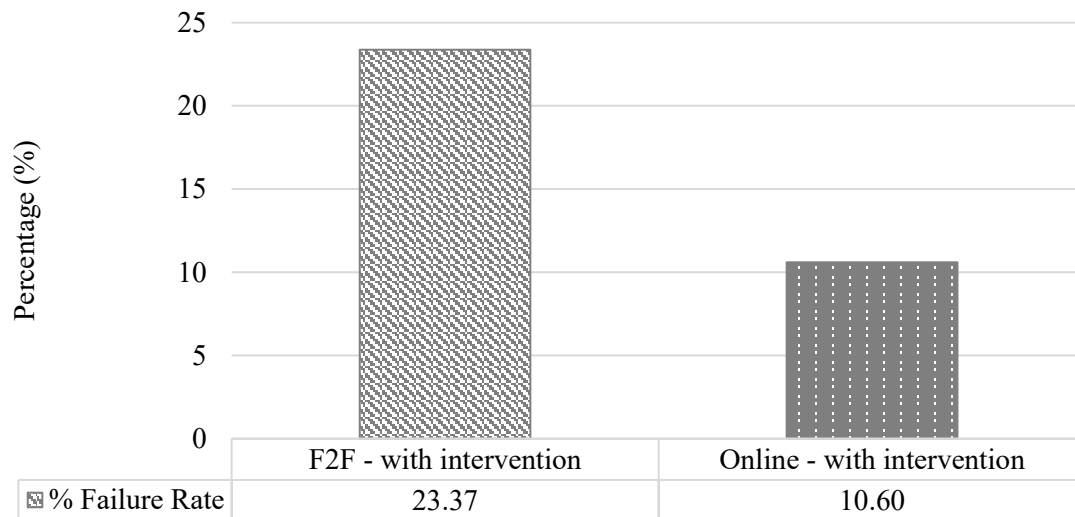


Figure 6: Percentage of failure rate according to semester with face-to-face and online interventions

### Perception of students on an online intervention programme

The study has assessed the perception of students on the intervention programme held online as shown in Figure 7. 60.7% of the students strongly agree that the activities and discussions have enhanced their understanding of the topic content. 35.7% agreed with the statement, while only 3.6% chose neutral on the question given. 67.8% and 28.6% of the students strongly agree and agree that the sessions have helped to improve their Course Outcome (CO) and Programme Outcome (PO) levels, respectively. Overall, 64.3% of students strongly agreed and 35.7% agreed that the programme had delivered the information that students were expected to receive.

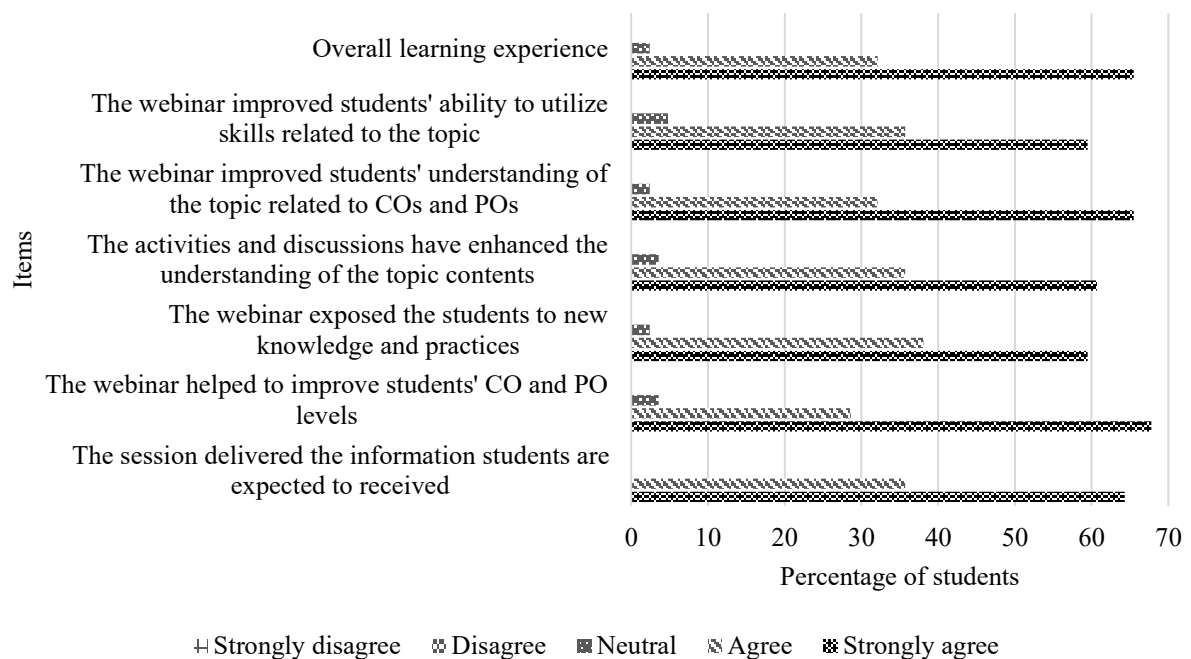


Figure 7: Perception of students on the sessions held online



The global outbreak of COVID-19 that spread rapidly has led the world to lockdown and affected educational advances around the world. Hence, this caused the physical classrooms to close and boosted the development of online learning. Online education has evolved and now allows students to access an infinite number of educational materials from their comfort zones and study at their own pace. This statement correlates with previous findings conducted by Adedoyin & Soykan (2020) that show that online learning offers students the flexibility to access online materials at any time of the day. The advantages of online learning also include less commuting time, time management, and more time spent with the family (Almaiah *et al.*, 2020; Armstrong-Mensah *et al.*, 2020). The rising flexibility of online learning in various ways has empowered independent learning among students (Muller *et al.*, 2021).

Shifting to virtual, the intervention programme allowed students to be more focused and ask questions comfortably without making eye contact or being the centre of attraction for other students. Muller *et al.* (2021) reported in their study that students who were normally quiet during face-to-face classes had shown an increasing level of engagement during the online learning session. Based on previous studies on the effectiveness of distance and online learning, Nguyen (2015) concluded that, of all the distance and online education, they are at least as effective, if not better, than traditional education (face-to-face).

However, a study conducted by Al-Mawee *et al.* (2021) has shown less positive perceptions of online learning among college-level students. Based on their study, students reported negative experiences such as a lack of social interaction among students and instructors as a result of the shift to online education during the pandemic. Online learning during the pandemic has created more frustration, stress, and isolation for students who have lost the opportunity for peer interactions (Daniel, 2020; Gillett-Swan, 2017) and increased concerns about online violence, exploitation, and other psychological issues due to the difficulties associated with this matter (Daniel, 2020; Heng & Sol, 2020; Yan, 2020).

Besides, online learning may not be effectively applied in some disciplines, especially sports sciences, engineering, and medical sciences, where hands-on practical experience is necessary as part of instructional activities (Leszczynski *et al.*, 2018). Therefore, in order to solve the problem of compatibility, further research and action need to be conducted in order to develop a uniform online learning framework and model that applies to all disciplines (Adedoyin & Soykan, 2020).

There is no doubt that the pandemic has disrupted the natural ecosystem of conventional teaching and learning environments. The challenges of online learning at the beginning of the pandemic were added by inadequate educational material resources made available online, insufficient access to essential technologies such as internet connectivity and computer devices, ineffective time management, lack of a positive learning environment, and difficulties shifting and adapting from offline to online teaching and learning mode. However, these challenges would strengthen the capability of students to adjust to this crisis scenario and strengthen their skills in handling a possible similar situation in the future.

## Conclusion

The impact and interruption in learning trajectories that COVID-19 has caused forces the stakeholders to continuously look for flexible alternatives to help students get back on track. Student engagement is the key to successful delivery and can be achieved by hybrid or blended learning. Hence, the intervention programme is designed to cater to both physical and remote learning to enhance the performance of undergraduate students enrolling in the Fluid Mechanics courses. The programme was conducted for two semesters; one was a face-

to-face session, particularly before the COVID-19 hit, and the other was fully online. During the face-to-face semester, the study reports that the intervention programme implemented physically has improved the percentage of failure rate for this course with a decrement of 0.48% compared to the previous semester where no intervention programme was implemented. A traditional lecture delivery, separate sessions for each chapter, and intensive problem-solving discussion allow students to be fully engaged with instructors.

Starting March 2020, the intervention programme was paused for one semester due to a lack of resources for the online platform. The programme was then continued for the semester October 2020 – February 2021 with the implementation using an online approach. An increment of 0.35% of the failure rate was recorded after the online intervention programme was conducted. However, the number of students undertaking the course for each must also be considered as it affects the overall percentage.

A much better comparison was made for both intervention programmes delivered online and face-to-face. It reveals that the online intervention programme has greatly reduced the failure rate to only 10.6% compared to the implementation of the face-to-face intervention programme, which has a failure rate of 23.37%. Based on feedback received from students, more than 60% strongly agreed that the online intervention programme has enhanced their understanding of the course, improved their Course Outcome (CO) and Programme Outcome (PO) attainment, and agreed that the programme objectives have successfully been conveyed. Utilizing online platforms for intervention programmes is very useful as students appreciate the material, such as recorded videos, for further review at their convenience. Furthermore, an online session may affect some students' attitudes toward their engagement when asking questions. Nonetheless, the physical presence and guidance from lecturers or instructors on the subject are also crucial.

## References

- Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments*, 1–13.  
<https://doi.org/10.1080/10494820.2020.1813180>
- Al-Mawee, W., Kwayu, K. M., & Gharaibeh, T. (2021). Student's perspective on distance learning during COVID-19 pandemic: A case study of Western Michigan University, United States. *International Journal of Educational Research Open*, 2.  
<https://doi.org/10.1016/j.ijedro.2021.100080>
- Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Education and Information Technologies*, 25(6). <https://doi.org/10.1007/s10639-020-10219-y>
- Armstrong-Mensah, E., Ramsey-White, K., Yankey, B., & Self-Brown, S. (2020). COVID-19 and Distance Learning: Effects on Georgia State University School of Public Health Students. *Frontiers in Public Health*, 8. <https://doi.org/10.3389/fpubh.2020.576227>
- Charman, T. (2013). Encyclopedia of Autism Spectrum Disorders. In *Encyclopedia of Autism Spectrum Disorders*. <https://doi.org/10.1007/978-1-4419-1698-3>
- Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, 49(1–2). <https://doi.org/10.1007/s11125-020-09464-3>
- Gillett-Swan, J. (2017). The Challenges of Online Learning: Supporting and Engaging the Isolated Learner. *Journal of Learning Design*, 10(1). <https://doi.org/10.5204/jld.v9i3.293>
- Harackiewicz, J. M., & Priniski, S. J. (2018). Improving Students Outcomes in Higher Education:

- The Science of Targeted Intervention. *Annual Review of Psychology*, 409–435. <https://doi.org/10.1146/annurev-psych-122216-011725>
- Heng, K., & Sol, K. (2020). *Online Learning During COVID-19: Key Challenges and Suggestions to Enhance Effectiveness*. Cambodian Education Forum (CEF). Retrieved on 19 July 2022, from <https://cefcambodia.com/2020/12/08/online-learning-during-covid-19-key-challenges-and-suggestions-to-enhance-effectiveness/>
- Leszczynski, P., Charuta, A., Laziuk, B., Galazkowski, R., Wejnarski, A., Roszak, M., & Kołodziejczak, B. (2018). Multimedia and interactivity in distance learning of resuscitation guidelines: a randomised controlled trial. *Interactive Learning Environments*, 26(2), 151–162. <https://doi.org/10.1080/10494820.2017.1337035>
- Moore, K., Bartkovich, J., Fetzner, M., & Ison, S. (2003). Success in cyberspace: Student retention in online courses. *Journal of Applied Research in the Community College*, 10, 107–118.
- Mu, S., Cui, M., Wang, X. J., Qiao, J. X., & Tang, D. M. (2019). Learners' attention preferences of information in online learning: An empirical study based on eye-tracking. *Interactive Technology and Smart Education*, 16(3), 186–203. <https://doi.org/10.1108/ITSE-10-2018-0090>
- Muller, A. M., Goh, C., Lim, L. Z., & Gao, X. (2021). Covid-19 emergency elearning and beyond: Experiences and perspectives of university educators. *Education Sciences*, 11(1). <https://doi.org/10.3390/educsci11010019>
- Nguyen, T. (2015). The Effectiveness of Online Learning: Beyond No Significant Difference and Future Horizons. *MERLOT Journal of Online Learning and Teaching*, 11(2), 309–319.
- Smith, D., & Hardaker, G. (2000). e-Learning Innovation through the Implementation of an Internet Supported Learning Environment. *Journal of Educational Technology and Society*, 3, 433–432.
- Yan, Z. (2020). Unprecedented pandemic, unprecedented shift, and unprecedented opportunity. *Human Behavior and Emerging Technologies*, 2(2). <https://doi.org/10.1002/hbe2.192>
- Zahid, A. Z. M., Saifullizam, N. Z., Chik, W. S. W., Khalid, N., Kamaruddin, S. F., & Zin, M. M. (2021). Intervention Programme: The Implementation of Buddy System Programme amongst Civil Engineering Students. *INSIGHT Journal*, 8(3). <https://doi.org/10.24191/doi.org/10.24191/ij.v8i2.81>
- Zamakhsari, Z., & Ridzuan, A. (2016). An investigation on students participation and satisfaction towards online learning. *2015 IEEE Conference on E-Learning, e-Management and e-Services, IC3e 2015*, 143–147. <https://doi.org/10.1109/IC3e.2015.7403502>