Enhancing Web Development Education in Higher Education: A Comparison of Traditional and Flipped Classroom Models

Patrizia Sailer[1,2][a]

[1]*Department of Information Technology, University of Applied Sciences Burgenland, Campus 1, 7000 Eisenstadt, Austria*

[2] *Doctoral Sch* *Vienna, Austria*

patrizia.sailer@hochschule-burgenland.at, a00905041@unet.univie.ac.at

Keywords: Flipped Classroom, Web Development Education, Teaching Methods, Higher Education.

Abstract: Teaching web development in non-technical university programs presents distinct challenges, including varying levels of prior knowledge and engagement among students. This study compares the effectiveness of traditional teaching methods with a flipped classroom approach in two courses. The flipped classroom included asynchronous learning pathways with interactive videos, quizzes and in-class hands-on activities, while the traditional approach relied on lectures followed by guided exercises. The evaluation was conducted using grades, a motivation questionnaire (FAM) and open-ended surveys. Results show that the flipped classroom model improved student engagement, confidence, and collaborative skills, while the traditional approach maintained more structured guidance. Challenges such as time constraints and group dynamics were observed in both formats, though students in the flipped classroom reported higher satisfaction with active learning opportunities. These findings underscore the potential of the flipped classroom to enhance learning outcomes in technical subjects, provided sufficient resources and support are available.

1 INTRODUCTION

In higher education, lecturers are increasingly challenged to deliver effective teaching to a diverse and expanding student population, particularly in practical subjects such as web development. Students often enter these courses with varying levels of prior knowledge and technical expertise, making it difficult to meet their needs within a traditional classroom setting. The conventional teaching-centered approach, which typically involves lectures followed by hands-on sessions, has been shown to be ineffective for technical subjects, particularly in non-technical study programmes that incorporate technical courses (Pawelczak, 2017). This is due to its time-intensive focus on theoretical explanations and limited opportunities for immediate application during class time.

This challenge is further compounded in mixed-ability groups, where students' prior knowledge and skills vary. In such environments, traditional classroom often fail to engage all students, resulting in some students struggling to keep up and others being under-stimulated. The absence of sufficient practical application and immediate feedback further worsened the issue, as students find it difficult to bridge the gap between theory and practice (Sailer, 2024).

In order to address the challenges previously mentioned, it is important to adopt teaching methods that create a more dynamic and inclusive learning environment. An increasing number of teachers are turning to innovative, student-centred approaches, such as flipped classroom. This model reverses the conventional structure by enabling students to engage with lecture material before class, reserving in-person sessions for interactive discussions, collaborative problem-solving and practical exercises (Bishop and Verleger, 2013; O'Flaherty and Phillips, 2015). This pedagogical paradigm offers a multifaceted approach, optimizing instructional time, fostering active engagement and nurturing a more profound comprehension of the subject matter among students, particularly those from non-technical background.

Recognizing the limitations of traditional methods, a survey of 62 students at a University of Applied Sciences was conducted to identify the specific needs of web development students, particularly those from non-technical backgrounds. The survey revealed that inconsistent prior knowledge among participants posed a significant barrier to achieving uniform learning outcomes. Follow-up interviews further high-

[a] https://orcid.org/0000-0001-7833-9475

Sailer, P.
Enhancing Web Development Education in Higher Education: A Comparison of Traditional and Flipped Classroom Models.
DOI: 10.5220/0013433300003932

In *Proceedings of the 17th International Conference on Computer Supported Education (CSEDU 2025) - Volume 2*, pages 606-617
ISBN: 978-989-758-746-7; ISSN: 2184-5026

lighted the demand for a more flexible and engaging approach to learning.

The objective of this study is to evaluate the impact of the flipped classroom approach on the learning outcomes of students with non-technical backgrounds in web development courses. By leveraging the strengths of the flipped classroom model, this research seeks to demonstrate how a personalised, hands-on approach can overcome the challenges posed by diverse student populations and improve the overall learning experience. Therefore, this study is guided by the research question (RQ) "How does the flipped classroom approach impact the learning outcomes of non-technical students in web development courses compared to the traditional classroom approach in higher education?".

2 RELATED WORK

2.1 Teaching Methods for Technical Classes

The field of engineering is evolving as lecturers integrate digital competencies such as programming, AI and big data into the curriculum to prepare students for the challenges of digital transformation (Gumaelius et al., 2024). While traditional lectures are still common, there's an increasing focus on interactive, project-based learning to develop engineers with both technical expertise and interdisciplinary skills such as teamwork and systems thinking. Research supports this shift, showing that active learning methods such as flipped classroom and gamification improve student engagement and skills development (Calderon et al., 2024). Innovative approaches, including mobile compilers and industry-aligned courses, address resource limitations and evolving industry needs (Aničić and Stapić, 2022; Eteng et al., 2022). With the rise of AI-generated coding tools, programming education needs to emphasise problem solving, critical thinking and communication, drawing on strategies from mathematics education (Jacques, 2023). These studies highlight the need for adaptive, hands-on and student-centred approaches to technical education to keep pace with technological advances and industry expectations (Al-Nasra, 2013; Noga, 2014; Idris and Rajuddin, 2012).

2.2 Teaching Methods in Web Development Education

In the field of web development education, a variety of teaching methodologies and platforms have been subjected to evaluation in order to ascertain their efficacy in facilitating student learning. Problem-Based Learning is frequently supported by techniques such as "Problem Decomposition" and "One Problem with Multiple Solutions", which assist students in decomposing complex tasks and exploring multiple solutions, thereby enhancing their problem-solving and critical thinking abilities (Zhou et al., 2020). The centralised and collaborative WIDE approach employs a client-server framework to minimise setup challenges and enhance student collaboration, allowing more focus on coding rather than technical issues (Jevremovic et al., 2018). Furthermore, a top-down approach with preparatory tutorials and capstone projects facilitates students' comprehension of the interplay of various web technologies, thereby offering a comprehensive learning experience (Liang and Martell, 2018). Additionally, it is recommended to use effective platforms such as Codecademy, FreeCodeCamp and Udacity for their interactive and professional learning capabilities (Petrikoglou and Kaskalis, 2019).

Recent research highlights the need for innovative teaching approaches in web development education to meet both student and industry demands. Transitioning courses to online formats (Brown, 2006) and integrating hands-on, collaborative projects (Margaret et al., 2016) have been shown to enhance engagement and skill application. However, a gap between academic content and industry practices persists (Connolly, 2019), emphasizing the need for curriculum alignment. Sustainable, standards-based teaching using open-source tools (Stolley, 2011) and interactive methods (Mammadova, 2019) further supports student autonomy, critical thinking, and adaptability. Collectively, these studies advocate for dynamic, student-centered methods to prepare learners for the evolving demands of web development.

A further study explores a flipped classroom approach in a web design course, focusing on coding skills like HTML, CSS, and JavaScript in Malaysia (Vellappan and Lim, 2021). While students appreciated self-paced learning and improved engagement, challenges emerged, including outdated technology, unpreparedness, and time constraints. Many preferred shorter videos, struggled with self-regulation, and faced delays in instructor feedback. Some resisted the flipped model, favoring traditional methods, and uncooperative peers hindered group work. Instructors faced time demands and difficulty tailor-

ing content. Despite these issues, the flipped classroom fostered responsibility and collaboration. Recommendations include shorter, graded pre-class tasks, timely feedback, and improved resource access.

2.3 Flipped Classroom vs. Traditional Classroom

There are notable differences between the flipped classroom and traditional classroom methods in the context of technical education. In the traditional classroom setting, teachers deliver lectures to students who then passively absorb the information presented, with a focus on memorisation and recall and with limited engagement or collaboration. In contrast, the flipped classroom model requires students to engage with theoretical content, such as video lectures or readings, outside the classroom. This allows for more in-depth and interactive student-centred activities within the classroom, including problem-solving, discussions and group projects (Hernàndez-Sabaté et al., 2024). The evidence indicates that flipped classrooms enhance theoretical comprehension and non-technical abilities such as self-management, while the development of technical skills remains comparable to that achieved through traditional methods (Cieliebak and Frei, 2016). The implementation of flipped classroom requires substantial adaptations, including increased preparation from students and a facilitative role for instructors (Lee et al., 2015). Despite these challenges, flipped classrooms are lauded for their capacity to enhance engagement, critical thinking and practical knowledge application, making them a valuable alternative in technical education.

2.4 Research Gap

A number of studies have previously demonstrated the efficacy of the flipped classroom model in technical subjects, including web development. However, no studies have focused specifically on its application at the university level in Europe, thus creating a research gap. This underscores the necessity for further research to explore how the flipped classroom approach impacts university students, particularly those enrolled in non-technical programmes, in the context of web technology courses. Although the study of Vellappan and Lim (2021) is similar, it is important to note that their results cannot be directly transferred to this particular context, as access to laptops and other necessary resources is always guaranteed in the present study.

3 METHODOLOGY

3.1 Human-Centred Design

Human-centered design (HCD) is a creative problem-solving methodology that aims to balance human desirability, technological feasibility and economic viability. Initially rooted in disciplines such as computer science, visual design and architecture, HCD has evolved to address a broad spectrum of products and services beyond traditional user-centered design. The process comprises three core phases: inspiration, ideation and implementation (IDEO, 2015; Dam, 2024). The inspiration phase entails the cultivation of empathy through research, the identification of user needs and the delineation of specific challenges and requirements, ensuring a comprehensive understanding of the problems to be addressed. The ideation phase involves the generation of creative solutions through activities such as brainstorming, leading to the development of prototypes that provide tangible representations of potential solutions. The implementation phase emphasises the testing of these prototypes, the collection of user feedback and the refinement of solutions to align closely with user expectations. This iterative process is instrumental in ensuring that HCD delivers innovative, user-centric outcomes by continuously adapting to real-world needs. Figure 1 provides a visual representation of the HCD process.

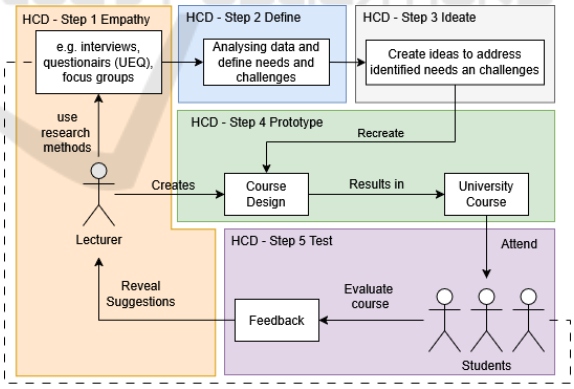

Figure 1: Visualization of the use of Human-Centred Design (Author own creation).

In this research, the principles of human-centered design (HCD) were applied iteratively to develop and refine a web development course. The process began with the analysis of an existing curriculum (Step 1) and the definition of the needs and challenges to address the course requirements (Step 2). Based on this, a course design was created to target these requirements (Step 3). The initial design followed a tra-

ditional teaching approach, which served as the first prototype (Step 4). The students were then invited to provide feedback on this initial setup through a series of evaluations (Step 5). The gathered feedback was then analysed and further interviews were conducted in order to gain deeper insights into the students' needs and experiences (Step 1). This process resulted in the identification of new problems and requirements (Step 2), which in turn informed a redesign of the course using the flipped classroom approach (Step 3). The resulting prototype (Step 4) - a web development class structured around flipped classroom principles - was then tested and evaluated by the students (Step 5). The process continues iteratively, with new insights guiding further refinements to the course design, ensuring ongoing alignment with student needs and continuous improvement.

3.2 Flow-Acceptance-Model

The Flow-Acceptance Model (FAM) (Rheinberg et al., 2001) is a questionnaire designed to assess current motivation in experimental learning and performance scenarios. It evaluates four key components using 18 items on a seven-point scale:

- Probability of Success – Items reflect confidence in performing well, influenced by self-assessed competence or perceived task simplicity.
- Interest – Items measure the intrinsic appreciation of the task's content, with some items requiring task-specific adjustments for different contexts.
- Fear of Failure – Items address the negative impact of potential failure, emphasizing how situational pressure might inhibit optimal learning.
- Challenge – Items assess the task's relevance as a performance opportunity.

Unlike traditional methods that focus on stable personal traits, the FAM captures situationally activated motivation, bridging the gap between individual abilities and task demands. By focusing on immediate motivation, the FAM provides a reliable and efficient tool for understanding how individuals engage with specific tasks, making it valuable for research in education and experimental contexts.

4 COURSE DESIGN

This section focuses on a comparative analysis of two different teaching approaches used across different semesters: the traditional classroom and flipped classroom. Both approaches were applied within the framework of HCD, as described in section 3.

4.1 Traditional Classroom Approach

In the Summer Semester of 2023, a traditional teaching approach was employed in the web development class with 35 students, which is called Class 1 in this paper. This is a method commonly referred to as traditional learning and often characterised as the"sage on the stage" model. In this approach, the teacher plays a central role, delivering lectures, while the students adopt a primarily passive role, absorbing the information presented. The traditional classroom setup has long been a fundamental cornerstone of education, prioritizing direct instruction, drill and practice and standardised assessments (Felder and Brent, 1996). The teacher serves as the primary source of knowledge, with limited student interaction during class sessions. Assessments typically focus on recall and comprehension, using tests and quizzes to assess student understanding. While this pedagogical approach has been found to be effective in imparting fundamental knowledge, it has been the subject of critique on account of its alleged failure to engender engagement and to nurture critical thinking and problem-solving skills (Prince, 2004). The course design with the traditional teaching approach is shown in Figure 2.

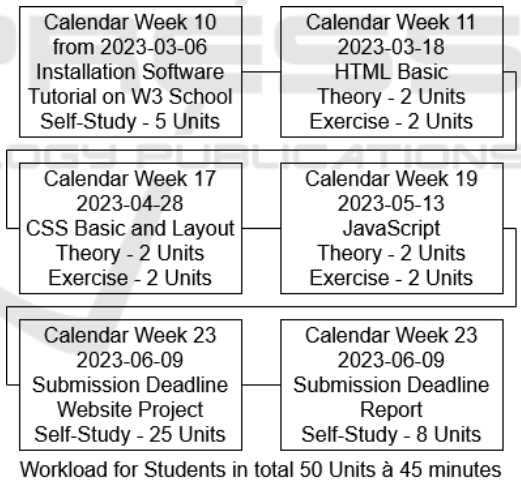

Figure 2: Structure Web Development Course Class 1 during Summer Semester of 2023

Nonetheless, despite its long-standing application, the traditional learning approach has confronted numerous challenges during the present semester, as evidenced by the course evaluation, which has revealed several areas of concern:

- Content overload – The content presented in class was overwhelming for students.
- Excessive Theory – Students reported excessive theoretical content, limiting practical exercises.

- Insufficient preparation time – Students needed more time to prepare for class.
- Lack of Supporting Materials – The lack of additional materials like scripts or videos was seen as a shortcoming, with students suggesting such resources would enhance learning.
- Pre-class preparation – It was recommended that lecture slides should be made available before class to allow for better preparation.
- Inappropriate didactic method – The traditional method was considered inappropriate for students without a technical background as it did not meet their learning needs.

The evaluations conducted resulted in a critical evaluation of the conventional approach. Consequently, at the beginning of the following course, an introductory questionnaire was conducted to gain insight into the students' expectations.

4.2 Flipped Classroom Approach

In consideration of the feedback received from the web development class from Summer Semester of 2023, the course was redesigned for the Summer Semester of 2024 using the flipped classroom approach, called Class 2 in this paper. This approach entails the transition from a traditional teaching model to a student-centred model that emphasises active engagement. In the flipped classroom approach, students engage with course material outside of class, typically through video lectures or readings. This allows in-class time to focus on activities that facilitate active learning, critical thinking and the real-world application of knowledge, such as discussions and problem-solving (Bishop and Verleger, 2013; O'Flaherty and Phillips, 2015). This approach is conducive to a personalised learning experience.

In order to evaluate the extent to which students had accepted the revised approach, the FAM questionnaire was employed in conjunction with supplementary questions. Students completed one questionnaire at the beginning and one after the conclusion of the course in order to assess their response to the flipped classroom approach. Based on the questionnaire at the beginning some modification on the course content were made.

4.2.1 Pre- and Post-Questionnaires

The initial questionnaire was designed to gather insights into students' perspectives and expectations before the course. It covered self-assessment of prior knowledge, course expectations, and the relevance of the content to personal or professional goals. The questionnaire also explored students' intrinsic motivation, alignment of interests with course topics, sense of obligation to attend, and long-term interest in the subject. Additionally, students identified preferred teaching methods, provided examples, and evaluated their learning styles to better understand their study and retention preferences.

The post-course questionnaire evaluated students' experiences and outcomes after completing the course. It assessed their knowledge, whether expectations were met, and reasons for satisfaction or dissatisfaction. Students reflected on the course's relevance to their personal and professional goals and provided insights into motivation changes, long-term interest, and alignment with intrinsic or external factors. The questionnaire reviewed the effectiveness of teaching methods, requested feedback on learning materials, and explored students' learning preferences. Participants also offered suggestions for improving teaching methods, materials, and course structure to enhance the learning experience for future iterations.

4.2.2 Implementation of the New Course Design

The flipped classroom included three asynchronous learning pathways, implemented in Moodle using H5P activities for interactive content. Students engaged with recorded videos containing intermediate questions to enhance engagement and comprehension, with video skipping disabled to prevent cheating. The first learning path encompassed the fundamentals of HTML and comprised six components: an introduction to the history of web development, fundamental information on web development, a guide to preparing a website, an overview of the technology employed, a section on HTML essentials and a concluding quiz on the material covered. The second learning path focused on CSS and included four elements: videos on CSS theory, responsive design and flexbox and a final quiz. The third learning path dealt with JavaScript and consisted of four elements: a theory video, two videos with exercises (part 1 and part 2) and a final quiz. In response to student feedback, the course duration was reduced from 13 to 8 weeks to streamline learning, while maintaining a consistent workload of 50 units across both formats. The overall course structure is depicted in Figure 3.

The new course design also addressed challenges highlighted by Vellappan and Lim (2021). Although issues like limited internet or computer access are not prevalent in Austrian universities due to the availability of on-campus equipment, the video duration was capped at 10 minutes to align with students' attention. Although pre-class learning demands time, it enables

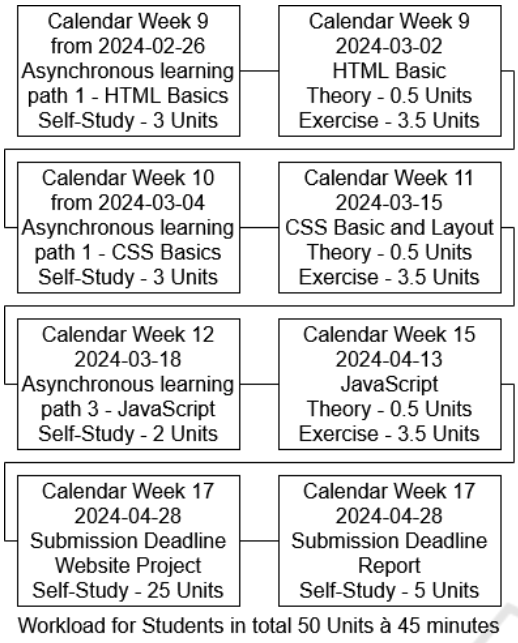

Figure 3: Structure Web Development Course Class 2 during Summer Semester of 2024.

more efficient use of classroom sessions for hands-on exercises. The integration of the platform was supported by an introductory video and additional explanations during the first in-class session. Real-time support is ensured through email communication and regular evening meetings to address questions. These considerations were carefully incorporated into the course design to avoid the identified challenges.

5 RESULTS

This section employs a three-part structure to analyse the evaluation results. Initially, the evaluation is analysed in terms of grading. Subsequently, the official course evaluations of the university are utilised. Finally, the individual feedback via FAM and questionnaires from Class 2 is considered. As not all students participated in all evaluations and these were carried out on a voluntary basis, Table 1 provides an overview of the respective numbers.

Table 1: Overview Number of Participants of Evaluation.

Kind of Evaluation	C1	C2
Grades	35	31
Offical Course Evaluation	26	22
Flow-Acceptance-Model	–	16
Pre-Class-Questionaire	–	30
Post-Class-Questionaire	–	21

C1 = Class 1, C2 = Class 2

5.1 Evaluation of the Grades

The present section is concerned with the evaluation of students' grades. In order to facilitate this evaluation, box plots were created based on the data presented in Table 2.

Table 2: Overview data for box plots in percentage.

	Projects		Participation		Reports	
	C1	C2	C1	C2	C1	C2
MIN	47.3	41.8	30.0	25.0	45.0	80.0
Q1	63.8	63.8	57.5	75.0	59.0	85.0
MED	71.6	76.3	65.0	100	83.0	95.0
Q3	83.9	79.7	100	100	90.0	95.0
MAX	98.1	100	100	100	100	100

MIN = Minimum, Q = Quartile, MED = Median, MAX = Maximum, C1 = Class 1, C2 = Class 2

5.1.1 Grading of Projects

The statistical analysis of the homework reveals significant differences between the two classes, as shown in Figure 4. The results of Class 2 show a wider range and greater differences in performance, which indicates increased heterogeneity within the group. At the same time, the higher median value (76.3% compared to 71.6% in Class 1) indicates that the students performed better on average. This observation could be due to a more effective design of the homework, better preparation on the part of the students or increased interest on the part of the students.

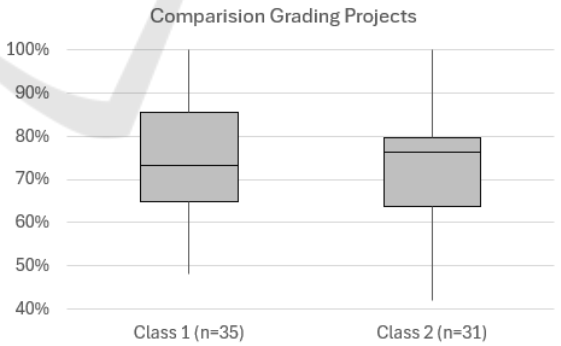

Figure 4: Comparison of the grading from the web development projects of two classes.

While Class 1 is characterized by a right-sided skewness, which indicates an increased number of below-average results, Class 2 shows a left-sided skewness, which indicates that more students achieved above-average results. These high performances could be due to targeted preparation or a better understanding of the topic. However, the wider spread of results in Class 2 also shows that some stu-

dents performed worse than average, possibly indicating different levels of effort, learning styles or difficulties in understanding the content. Compared to Class 1, where the results were more homogeneous, it can be concluded that Class 2 is more differentiated, both in a positive and negative sense.

5.1.2 Grading of Active In-Class Participation

The findings of the analysis demonstrate that the overall level of active participation in class was higher and more consistent in Class 2, like shown in Figure 5.

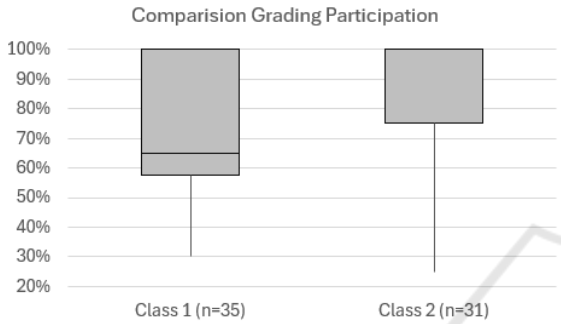

Figure 5: Comparison of the grading from the in class participation of two classes.

The median value of 1 indicates that a minimum of half of the students exhibited maximum participation during the lessons. In contrast, Class 1 exhibited a lower average participation level, with a median value of 65% and a wider dispersion in the middle 50% values. This suggests that active participation in Class 1 was less consistent and exhibited greater variability among students.

The findings indicate that the teaching method employed in Class 2 effectively motivated students to actively participate in class, as evidenced by the reduced variation. This suggests that the flipped classroom approach is more effective in encouraging a consistently high level of participation in the classroom, potentially due to its alignment with the needs and motivations of the students.

5.1.3 Grading of Reports

An analysis of the reports on the implementation of the website reveals disparities between the two groups with regard to the quality and consistency of the submissions. The students were required to write a report detailing the technical implementation of their project to ensure they understood why specific technologies and code snippets were used. Figure 6 shows, that Class 2 demonstrated a consistent tendency to achieve higher scores, suggesting that their reports were more detailed and accurate. The median score for Class 2 was 95.0%, in comparison to 83.0% for Class 1, indicating that the majority of students in Class 2 produced documentation of a higher standard.

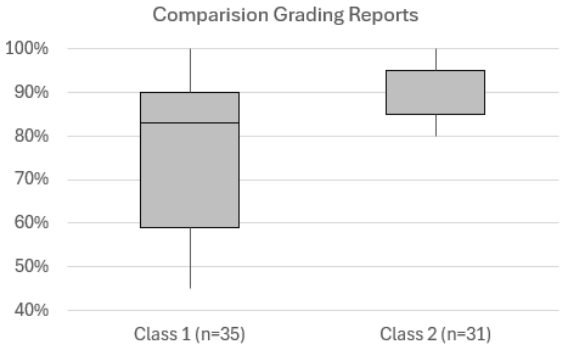

Figure 6: Comparison of the grading from the reports of two classes.

The distribution of values in Class 2 exhibited greater homogeneity, suggesting superior performance by the students in this group. The gap between the first quartile and the minimum was only 5.0% in Class 2, compared to 14% in Class 1, indicating that even the weaker reports in Class 2 achieved a higher level. Furthermore, the absence of a gap between the third quartile and the median in Class 2 signifies the consistency in the quality of the top 50% of reports, while in Class 1, the gap of 7.0% indicates variations in the performance of the best reports.

The reduced variability in Class 2, particularly at the lower end, suggests that the teaching method was effective in promoting a uniform level of reporting quality. The attainment of the maximum score of 1 by students in both groups indicates that they were able to produce reports of the highest standard. The results suggest that the Class 2 method was more effective in encouraging students to write accurate and thoughtful reports on the implementation of their websites. This enhanced learning experience may be attributed to the high proportion of hands-on practice, as the theoretical concepts were mastered in advance, enabling the formulation of increasingly complex inquiries in the classroom setting. Consequently, a greater volume of content was rehearsed, thereby fostering a more profound comprehension.

5.2 Evaluation Flow-Acceptence-Model

The FAM was administered in two instances: initially following the explanation of the course tasks and again at the conclusion of the programme, once the grades had been allocated. Only those questionnaires that were completed by the students in both instances were considered in this analysis, with the

objective being to ascertain the existence of any correlations between the initial levels of motivation and the subsequent assessments. The results of these two evaluations are presented in Table 3 and shown in Figure 7, offering a comprehensive insight into the fluctuations in motivational factors throughout the duration of the programme.

Table 3: Comparison FAM before and after course.

		FAM 1	FAM 2
Interest	Mean	3.963	4.547
	SD	1.308	1.072
Probability of Success	Mean	3.188	3.618
	SD	0.895	0.699
Fear of Failure	Mean	3.413	3.874
	SD	1.660	1.425
Challenge	Mean	5.453	5.618
	SD	1.216	1.223

SD = Standard Deviation, 1 = strongly disagree, 7 = strongly agree

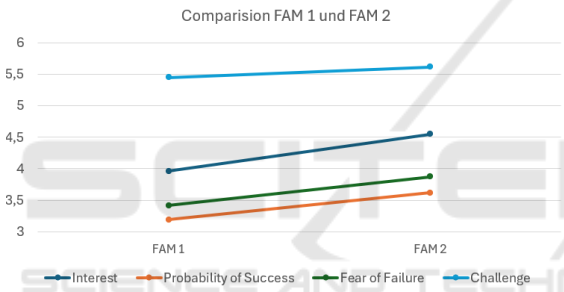

Figure 7: Comparison of FAM 1 and FAM 2.

The analysis of the FAM before (FAM 1) and after (FAM 2) reveals insights into the motivational dynamics of the students. Interest increased from 3.963 to 4.547, with a reduction in standard deviation from 1.308 to 1.072, indicating that the course successfully engaged students more uniformly over time. This rise in interest suggests that the course content and structure became more appealing as the students progressed, potentially reflecting effective instructional strategies.

Similary, the Probability of Success exhibited an enhancement from 3.188 to 3.618, accompanied by a decline in standard deviation from 0.895 to 0.699, showing that students gained confidence in their ability to succeed while experiencing less variation in self-perception. These observations imply that the course effectively fostered the development of students' self-efficacy.

Conversely, the Fear of Failure dimension exhibited an increase from 3.413 to 3.874, though the standard deviation decreased from 1.660 to 1.425, suggesting a more consistent experience of increased anxiety. This rise may be indicative of increased stakes or pressure as students approached the final evaluation, emphasizing the necessity to address potential stressors in subsequent course iterations.

The Challenge dimension exhibited negligible change, with a slight increase from 5.453 to 5.618 and minimal variation in standard deviation (1.216 to 1.223). This consistency suggests that the tasks were perceived as consistently challenging throughout the course, aligning with the objective of stimulating and engaging students.

The findings imply that the course effectively augmented engagement and confidence while sustaining a conducive learning environment. Nevertheless, the escalation in fear of failure signifies the necessity for targeted interventions to harmonise challenge and emotional well-being. Strategies such as the explicit communication of expectations, incremental assessments, or the provision of additional support mechanisms could assist in mitigating anxiety while preserving the observed enhancements in motivation and self-efficacy.

5.3 Questionnaires

The employed rating scale in the questionnaires ranged from 1, denoting "excellent/totally true" to 6, signifying "bad/does not apply at all". All values shown in brackets are the mean values.

5.3.1 Pre-Class-Questionnaire

The questionnaire revealed that students exhibited a diverse range of prior knowledge and expectations regarding wen development, including HTML (4.8), CSS (5.2), JavaScript (5.5) and content management systems (4.4). Many students expressed a desire to acquire basic skills for creating or modifying websites, while others aimed to build on their existing knowledge for professional or personal projects. A common concern was their lack of prior knowledge, which led to anxiety about keeping up with the course content.

Motivation to participate in the course varied. While some students displayed intrinsic motivation (2.1) and interest in the subject (3.1), others attended out of a sense of obligation or as a requirement of their program (3.2). However, many participants recognized the long-term relevance of the course for their academic or career goals (3.0), aligning it with personal and professional aspirations.

In terms of teaching methods, students overwhelmingly preferred a hands-on, step-by-step approach that combined theory with practical application. Interactive teaching methods, such as solving

exercises in small groups, were highly favored, as they allowed for peer collaboration and immediate feedback. Visual aids, real-life examples and practical tasks were seen as particularly effective for understanding coding concepts. Conversely, purely theoretical content or group work with minimal guidance was viewed less favorably by some.

Learning preferences varied, with visual and kinesthetic (learning-by-doing) styles being the most common. Many students emphasized the importance of structured exercises, tutorials and opportunities to apply concepts directly. Repetition and incremental learning were highlighted as key strategies to build confidence and mastery in programming skills. Overall, the feedback underscored the need for a flexible and supportive learning environment tailored to diverse backgrounds and skill levels.

5.3.2 Post-Class-Questionnaire

Students reported improvement in foundational web development skills, including HTML (from 4.8 to 3.3), CSS (from 5.2 to 3.6), JavaScript (from 5.5 to 4.7) and CMS systems (from 4.4 to 3.3) Many appreciated the opportunity to build a website from scratch, which was seen as a challenging but rewarding experience. While the course successfully covered the basics, some students felt that JavaScript was underemphasized due to time constraints and suggested allocating more focus to this topic in future iterations. Most participants indicated that their expectations were met or even exceeded. The combination of theoretical learning through videos and scripts with practical application in class exercises and projects was particularly valued. Even students with no prior knowledge expressed satisfaction with the course structure and were surprised by how much they have learned.

Motivation to engage with the course content increased for many students (2.4), largely due to the hands-on nature of the assignments and the structured approach. The course topics aligned well with personal (2.0) and professional goals (2.3) for most students, though a few noted that their engagement decreased due to external factors such as workload or a lack of initial interest in the subject. The flipped classroom model, combining preparatory video tutorials with in-class coding sessions, was widely appreciated. Students found the videos helpful for revisiting complex topics at their own pace, while in-class collaborative exercises allowed immediate feedback and reinforced learning. Some students suggested breaking down the project into smaller tasks to reduce the perceived workload of the final assignment.

Supplementary materials, including video tutorials, detailed scripts and external resources like W3Schools, were highlighted as particularly effective. The ability to revisit resources outside class was highly valued. Despite the positive feedback, some students struggled with the workload and managing the project alongside other academic and personal commitments. Additionally, varying levels of preparation among students sometimes led to uneven progress in class, which a few found challenging.

5.3.3 Offical course evaluation

Table 4 compares student feedback between the traditional classroom approach in Summer Semester of 2023 and the flipped classroom approach in Summer Semester of 2024. The feedback of Class 1 was largely negative regarding content overload, the balance between theory and practice and preparation resources, though teacher interaction was rated positively. In contrast, Class 2 received mostly positive feedback in these areas, with the flipped classroom enhancing the overall learning experience. Both classes gave mixed feedback on the quality of feedback and the ease of following lessons. Overall, the flipped classroom led to higher student satisfaction.

Table 4: Comparison of Class 1 and Class 2 regarding open questions in the evaluation.

Key Points	**C1**	**C2**
Feedback on Amount of Content	-	+
Balance Between Theory and Practice	-	+
Sufficiency of Preparation Time	-	∼
Availability of Supporting Materials	-	+
Availability of Pre-Class Preparation	X	+
Suitability for Students with Non-Technical Backgrounds	-	∼
Encouragement of Active Participation	-	∼
Emphasis on Hands-On Learning	-	+
Teacher Interaction Outside of Class	+	+
Detail and Quality of Feedback	∼	∼
Overall Student Satisfaction	∼	+

+ = Positive, - = Negative, ∼ = Mixed,
X = Not Available, C = Class

A further perspective is presented in the Table 5, which provides a detailed comparison of assessment scores, highlighting adjustments and improvements made. Between the classes, the course was improved by creating a 120-page script for studying theory, including coding examples and producing lecture videos for the flipped classroom to provide additional resources for students. The results show that Class 2 consistently received better evaluation scores than Class 1, particularly in areas like workload, course structure and the effectiveness of teaching methods. These improvements reflect the positive impact of

the adjustments and additional resources provided between terms.

Table 5: Comparison of Feedback of Class 1 and Class 2.

Key Points	C1	C2
Information on objectives, content, methods was adequately provided.	1.77	1.25
Performance and evaluation criteria were adequately communicated.	1.54	1.08
The workload is appropriate.	2.62	1.92
The length of the teaching blocks is appropriate.	2.42	1.67
The time intervals between the teaching blocks are appropriate.	2.74	1.25
The course content is well structured.	1.93	1.42
The material provided helps to achieve the learning objectives.	1.74	1.17
The lecturer points out how the content could be applied in practice.	2.01	1.00
The lecturer answers topic-related questions in a competent manner.	1.91	1.34
The lecturer uses course media appropriately.	2.16	1.17
How to rate the course overall?	2.31	1.75

Scale: 1 = excellent, 5 = poor

6 DISCUSSION

This study aimed to examines how the flipped classroom approach impacts learning outcomes for non-technical students in web development courses at universities. By analyzing the data collected, including grades, participation levels and student feedback, the findings provide compelling evidence that the flipped classroom approach offers advantages over the traditional classroom approach for non-technical students in higher education.

6.1 Improved Learning Outcomes

The flipped classroom approach led to better academic performance, as evidenced by higher median grades across projects, reports and class participation. Specifically, students in Class 2 (flipped classroom) achieved higher project scores (median: 0.76 vs. 0.72) and report scores (median: 0.95 vs. 0.83) compared to Class 1 (traditional classroom). Additionally, participation levels were notably higher and more consistent in Class 2, with a median of 1, indicating maximum engagement for at least half the students. These results highlight that the flipped classroom model fosters not only better understanding but also more active involvement in learning activities.

6.2 Enhanced Student Engagement and Confidence

The flipped classroom model allowed students to engage deeply with theoretical material at their own pace before attending class, leading to a stronger foundational understanding. This was reflected in the FAM results, where students' interest increased from 3.96 to 4.55 and their perceived probability of success improved from 3.19 to 3.62. These findings suggest that the pre-class preparation materials, including videos and scripts, effectively supported student confidence and motivation.

However, the FAM analysis also revealed a rise in fear of failure (from 3.41 to 3.87), indicating that while students felt more capable, they also experienced higher levels of anxiety as the course progressed. This underscores the importance of balancing challenging tasks with emotional support to maintain a productive learning environment.

6.3 Connection Between Engagement and Performance

An analysis of the data reveals a correlation between active participation, high-quality project submissions and increased interest. Students who excelled in their project work (>80% of the grade) also demonstrated full participation in class activities and high-quality reports (>90% of the grade). These students reported an increased sense of challenge, as reflected in the FAM results, indicating that they found the tasks both engaging and demanding. Conversely, students who performed lower (<80% of the grade) often did not complete the asynchronous learning paths or demonstrated lower participation levels in class.

6.4 Comparison to Existing Literature

The findings align with existing studies that emphasise the benefits of the flipped classroom approach in fostering active learning and higher engagement. Pre-class preparation enables students to develop a strong foundational understanding, which facilitates deeper learning during class sessions (Bishop and Verleger, 2013; O'Flaherty and Phillips, 2015). Additionally, the flipped classroom's focus on real-time feedback and immediate error correction has been shown to enhance comprehension and retention (Calderon et al., 2024; Hernàndez-Sabaté et al., 2024).

Furthermore, the results support the notion that flipped classrooms are particularly effective for non-technical students, as they provide opportunities

for personalised learning and self-paced study (Gumaelius et al., 2024; Al-Nasra, 2013). The higher levels of student engagement observed in this study are consistent with findings that suggest flipped classrooms promote active participation and collaborative learning environments (Cieliebak and Frei, 2016).

Moreover, Vellappan and Lim's (2021) study was confirmed, the results of which also indicate the effectiveness of the flipped classroom in web development classes. By proactively addressing challenges like resource access and insufficient support from the outset, this study was able to build upon and expand their findings.

6.5 Future Work

Future research could explore integrating new assessment methods with immediate feedback to further support student learning. For instance, implementing real-time quizzes or coding challenges during classroom sessions could provide students with instant insights into their understanding and progress. Additionally, the incorporation of gamification elements, such as badges, leaderboards and progress tracking, could enhance motivation and engagement by adding a layer of interactive and enjoyable learning experiences. Chatbots and AI-driven assistance tools could also be introduced to provide students with on-demand help and guidance, ensuring that real-time feedback is accessible even outside of class hours. These innovations could create a more dynamic, engaging and supportive learning environment, catering to diverse student needs and preferences.

Nevertheless, the study is not without limitations. The research was conducted with a small sample size, involving only two classes, which may limit the generalizability of the findings. Additionally, further research is needed to explore the impact of the flipped classroom approach with more diverse data, including prior academic records, professional experiences and background knowledge of the students. Such an expanded dataset could provide deeper insights and validate the observed trends across broader contexts.

7 CONCLUSION

Teaching technical content, such as web development, in non-technical university programs presents unique challenges due to varying levels of prior knowledge and engagement among students. This study highlights the importance of selecting appropriate teaching methods to address these challenges effectively. By comparing traditional teaching with the flipped classroom model, two distinct course designs were implemented and evaluated in separate classes.

The evaluation involved a multi-faceted approach, including an analysis of grades, results from the FAM questionnaire, additional open-ended questions and the official course evaluation provided by the university. The findings consistently demonstrate that the flipped classroom model positively impacts web development classes in higher education, fostering greater engagement, motivation and improved learning outcomes. These results underline the potential of innovative, student-centered teaching strategies like the flipped classroom to enhance the effectiveness of technical education in non-technical study programs.

ACKNOWLEDGEMENTS

The author would like to thank the University of Applied Sciences Burgenland, the University of Vienna and the UniVie Doctoral School Computer Science (DoCS) for supporting this research. Special thanks go to DeepL and DeeplWrite for their support with the partial translation and proofreading in terms of spelling and grammar as well as ChatGPT as a reliable sparring partner during the creation process.

REFERENCES

Al-Nasra, M. (2013). Improved teaching techniques in technical education. *Journal of Studies in Education*, 3(3):49–56.

Aničić, K. P. and Stapić, Z. (2022). Teaching methods in software engineering: A systematic review. *Ieee software*, 39(6):73–79.

Bishop, J. and Verleger, M. A. (2013). The flipped classroom: A survey of the research. In *2013 ASEE annual conference & exposition*, pages 23–1200, Atlanta, United States. American Society for Engineering Education.

Brown, J. (2006). Teaching web applications development in a fully online environment: Challenges, approaches and implementation. In *CSREA EEE*.

Calderon, I., Silva, W., and Feitosa, E. (2024). Active learning methodologies for teaching programming in undergraduate courses: A systematic mapping study. *Informatics in Education*, 23(2):279–322.

Cieliebak, M. and Frei, A. K. (2016). Influence of flipped classroom on technical skills and non-technical competences of it students. In *2016 IEEE global engineering education conference (EDUCON)*, pages 1012–1016. IEEE.

Connolly, R. W. (2019). Facing backwards while stumbling forwards: The future of teaching web development. *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*.

Dam, R. F. (2024). The 5 stages in the design thinking process. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process [Accessed: 06.08.2024].

Eteng, I. E., Akpotuzor, S., Akinola, S. O., and Agbonlahor, I. (2022). A review on effective approach to teaching computer programming to undergraduates in developing countries. *Scientific African*.

Felder, R. M. and Brent, R. (1996). Navigating the bumpy road to student-centered instruction. *College teaching*, 44(2):43–47.

Gumaelius, L., Skogh, I.-B., Matthíasdóttir, Á., and Pantzos, P. (2024). Engineering education in change. a case study on the impact of digital transformation on content and teaching methods in different engineering disciplines. *European Journal of Engineering Education*, 49(1):70–93.

Hernàndez-Sabaté, A., Albarracín, L., Ramos, O., Gil, D., Sánchez, C., and Martí, E. (2024). From traditional teaching to flipped classroom: Impact on learning in engineering degrees. *Journal of Technology and Science Education*, 14(3):798–814.

IDEO (2015). *The Field Guide to Human-centered Design: Design Kit*. IDEO.

Idris, A. and Rajuddin, M. R. (2012). The influence of teaching approaches among technical and vocational education teachers towards acquisition of technical skills in kano state-nigeria. *Journal of education and practice*, 3(16):160–165.

Jacques, L. (2023). Teaching cs-101 at the dawn of chatgpt. *ACM Inroads*, 14(2):40–46.

Jevremovic, A., Ristic, N., Veinovic, M., Shimic, G., and Stanisic, N. (2018). Wide: Centralized and collaborative approach to teaching web development. *Journal of Internet Technology*, 19(4):1003–1014.

Lee, L. S., Hackett, R. K., and Estrada, H. (2015). Evaluation of a flipped classroom in mechanics of materials. *Evaluation*, 6:14.

Liang, Z. and Martell, M. A. C. (2018). A top-down approach to teaching web development in the cloud. In *2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)*, pages 32–39. IEEE.

Mammadova, N. (2019). Interactive teaching methods in a university classroom. *Knowledge International Journal*.

Margaret, R., Vinod, A., and Tejonidhi, M. R. (2016). A practical approach to teach web programming course. *Journal of Electrical Engineering & Technology*, 30:99–102.

Noga, H. (2014). Applying chosen teaching methods in technical education. *International Journal of Engineering Pedagogy*, 4(4).

O'Flaherty, J. and Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The internet and higher education*, 25:85–95.

Pawelczak, D. (2017). Comparison of traditional lecture and flipped classroom for teaching programming. In *Proceedings of the 3rd International Conference on Higher Education Advances*, pages 391–398. Editorial Universitat Politècnica de València.

Petrikoglou, A. and Kaskalis, T. H. (2019). Full stack web development teaching: Current status and a new proposal. In *WEBIST*, pages 218–225.

Prince, M. (2004). Does active learning work? a review of the research. *Journal of engineering education*, 93(3):223–231.

Rheinberg, F., Vollmeyer, R., and Burns, B. D. (2001). Fam: Ein fragebogen zur erfassung aktueller motivation in lern- und leistungssituationen. *Diagnostica*, 2(2):57–66.

Sailer, P. (2024). Learning web technologies: Overcoming educational challenges. In *EdMedia+ Innovate Learning*, pages 466–475, Brussels, Belgium. Association for the Advancement of Computing in Education (AACE).

Stolley, K. (2011). Teaching sustainable methods of web design and development. *2011 IEEE International Professional Communication Conference*, pages 1–3.

Vellappan, U. and Lim, L. L. (2021). Students' learning experience in a web design course using flipped classroom approach in higher education. *International Journal of Education, Psychology and Counseling*.

Zhou, H. G., Li, J., and Zhong, J. L. (2020). Cultivating personal capabilities based on problem-based learning: a practice in web development. In *2020 15th International Conference on Computer Science & Education (ICCSE)*, pages 379–382. IEEE.