An Open Learning Platform for WPI

An Interactive Qualifying Project (IQP) Report
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Abstract

The Internet has democratized global access to information, yet university curricula remain restricted to enrolled students due to traditional structures in higher education. This fosters a lack of accountability and an exclusive culture, concealing the true quality and content of a university's education. At WPI, surveys of students and faculty revealed a strong demand for broader access to course materials. While Learning Management Systems (LMS) digitize and organize content, they lack the capability to make materials openly accessible. To address this, we developed openlearning.wpi.edu, a platform that uniquely bridges the gap between LMS and open access. By enabling faculty to easily share their courses, this platform advances educational equity and furthers WPI's global impact.

Executive Summary

This project aims to establish a centralized repository for courses taught at WPI, allowing faculty to effortlessly import classes from Canvas, WPI's Learning Management System (LMS), to the platform. With our platform, faculty retain full control over the content they share and can control access and licensing of their content. The initiative seeks to provide valuable course resources to enrolled and prospective students, while enhancing public visibility and credibility for both faculty and the institution. Canvas is the most widely used LMS in North America, holding a 41% market share in higher education (Hill 2023), positioning our platform for adoption at many universities in the United States.

Central to this project is the model of Open Educational Resources (OER), which are freely accessible, openly licensed educational materials that can be used for teaching, learning, and research. These resources include a wide range of materials, such as textbooks, lecture notes, multimedia, and complete courses, serving as a powerful tool to reduce educational costs and improve global access to learning opportunities. While some universities choose to freely publish their course content, others opt to release it with an associated fee, enabling them to charge for the courses and offer certificates of completion. The integration of freely released course content with seamless LMS integration sets this project apart, offering a distinct advantage over other online learning platforms provided by universities.

WPI, known for its distinctive project-based education and emphasis on global impact through its Global Projects Program, is uniquely positioned to lead the development of this platform and will likely benefit significantly from its implementation. By providing a platform for faculty to publicly release their courses, this initiative not only amplifies WPI's global reach but also showcases the university's innovative curricula. Unlike open learning platforms at other universities, which are typically controlled by administrators, this project puts the power of open access directly in the hands of faculty. By doing so, it empowers educators to share their knowledge freely, advancing WPI's mission of global impact and academic excellence.

While the need for an open learning platform at WPI was clear, it was crucial to assess the interest of both staff and students in such a system. Two primary groups were targeted: students and faculty. The student survey aimed to evaluate the accessibility of course materials, focusing on whether students could readily find the resources they needed to make informed decisions when registering for a particular course. These materials included syllabi, course schedules, lecture slides, homework assignments, projects, sample exams, sample quizzes, and pre-recorded video lectures. Meanwhile, the faculty survey explored instructors' willingness to share course materials online, provided they had access to a user-friendly platform

that supported customization of visibility and proper licensing for uploaded content.

To meet the diverse needs of users, the platform was designed with cutting-edge web technologies. The front end utilizes Next.js, Tailwind CSS, and Shadcn UI, creating a user interface that is performant and visually striking. Ease of use for faculty was a top priority in the design of the user interface. Faculty members can easily import courses into the platform while retaining the flexibility to deeply customize their courses. This includes setting visibility preferences and selecting appropriate Creative Commons licenses to ensure proper attribution. On the back end, the system is powered by a PostgreSQL relational database, Prisma ORM for database integration, and Express.js for secure and efficient API communication. Key features include secure data retrieval, insertion, and modification, ensuring the platform remains robust and reliable. To authenticate users, the platform employs the OAuth2 standard through WPI's Single Sign-On (SSO) service, providing a seamless and secure login experience. Both the front end and back end are written in TypeScript, a strongly typed superset of JavaScript.

With the platform implemented, a separate set of surveys was conducted to evaluate how effectively it could meet the needs of the university. The findings from these surveys highlight a significant overlap between student interest in accessing course materials and faculty willingness to share them. Before utilizing the platform, many faculty members were uncertain about releasing course content. After using the platform, faculty members expressed satisfaction with its user interface and noted the ease with which they could import courses from Canvas. Many expressed a need for more control over their courses on the platform and requested guidelines detailing what content could be published. Addressing the concerns of these faculty members, whether through more incentives from the university to publish OER content or additional control over published content, could help bridge the gap between their own views and student expectations. Reconciling this difference is critical to the platform's success and is a requirement to help promote OER at WPI.

To promote the adoption and long-term sustainability of this platform in supporting Open Educational Resources (OER), we recommend the university adopt the following initiatives:

1. **Establish OER Guidelines**

   There are no institutional guidelines for creating, curating, and maintaining OER materials at WPI. Faculty may be uncertain about which materials are eligible to be shared as OER. Establishing an institutional OER policy will help ensure the quality, accessibility, and long-term viability of these resources within the university.

2. **Promote the Benefits of OER to Faculty**

Highlight the advantages of engaging with OER, such as increased visibility and impact of their work, opportunities for collaboration, and the ability to reach a global audience. Emphasize how open-sourcing content aligns with the university's values while supporting students and advancing WPI's mission.

3. **Expand Surveys to Broader Student and Faculty Groups**

   Expanding the scope of surveys to include a broader range of students and faculty will provide valuable insights into their perspectives on OER. Gathering more feedback from students about the importance of accessible materials will help effectively communicate the demand for OER to faculty, demonstrating its potential to enhance both teaching and learning experiences.

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Authorship

Daniel Gorbunov, Hubert Liu, and Matthew Alex all contributed to the research and writing of this report. The following is a summary of how the report was written.

- Daniel Gorbunov was responsible for the abstract, executive summary, introduction, background, and application images chapters. He also contributed to the findings and analysis, conclusion, and software design chapters.
- Hubert Liu contributed to portions of the software design, findings and analysis chapters, as well as the bibliography and appendices.
- Matthew Alex was responsible for the executive summary and methodology chapters, portions of the findings and analysis chapter, and the conclusion chapter.

All three authors collaborated on the revision and editing of the report.

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1 Introduction

The United States consistently leads in global university rankings, hosting seven of the top ten global universities (Times Higher Education 2024; US News 2024), and 25 of the top 100 global universities in 2024 (Symonds 2024). These rankings, from *Times Higher Education*, *Quacquarelli Symonds*, and *US News* are among some of the most esteemed and influential public rankings (Zha 2016). University rankings are used by students, families, and academia to evaluate an institution's quality. These rankings have increasingly played a significant role in the public perception of universities, especially in the landscape of competitive college admissions. With the annual release of these rankings, there is a growing demand for more accuracy within them, with increasingly transparent mechanisms. Since institutions use these rankings as marketing tools, we must ensure that rankings remain unbiased, accurate, and fair year after year. Unfortunately, rankings fail to achieve almost all of these goals, primarily because they lack a rigorous method for evaluating an institution's quality in a fair and universal manner.

The primary factor rankings used to determine university quality is research productivity, which includes metrics like faculty citation count and research funding. This is by far the easiest statistic to collect, as most of this data is publicly available. Rankings also use reputation, like *QS* and *Times Higher Education*, which both survey a small number of academics around the world for their opinions on universities (Altbach 2010). Using reputation as a metric in a ranking formula helps schools, frequently seen at the top of these surveys, stay at the top, leading to little change in the overall rankings year after year. Using research activity and reputation as primary metrics for these rankings is not a viable strategy, because it ignores one of the primary functions of a university — teaching.

The *Times Higher Education* has identified this issue, and attempted to incorporate metrics for teaching quality into its surveys, including student-faculty ratios, and once again, reputation (Altbach 2010). These additional metrics, while a worthwhile attempt, still fail to measure teaching quality, because they are indirect measurements of a complex, highly personal educational experience that includes instructional engagement, pedagogical effectiveness, and personalized learning support. The other rankings platforms mentioned have adopted similar strategies as the *Times Higher Education*, and have had similar results. The research and reputation-focused metrics used by these rankings inherently favor schools with established reputations and strong graduate research programs.

While these rankings may provide some insight into graduate programs, they are largely ineffective for evaluating undergraduate programs, which primarily focus on teaching. In 2022, 15.4 million under-

graduate students were enrolled at U.S. degree-granting institutions, compared to just 3.2 million graduate students (Hanson 2024). With nearly five times more undergraduate students than graduate students, the need for accurate undergraduate program rankings becomes evident. To achieve this, a robust methodology for assessing teaching quality must be developed — one that emphasizes transparency and accountability in teaching across global higher education institutions.

Historically, higher education has lacked transparency and accountability in teaching. Universities have kept access to their teaching materials behind walls of exclusivity through student-only content, and rising tuition costs. Over the past two decades, tuition has steadily increased, making higher education less accessible for students worldwide (Wood 2024). This increase can be attributed to many factors, including inflation, rising staffing costs, and higher operational overheads, but the result has been a system where access to education has become limited to those who can afford its high price tag. Open Educational Resources (OER) present an opportunity to address this inequity by offering high-quality educational materials freely to learners across the globe, reducing barriers created by cost.

In addition to rising costs, the increasingly competitive and ranking-driven landscape of U.S. universities has led to declining acceptance rates over time (Bound, Hershbein, and Long 2009). While exclusivity may appeal to rankings, it limits opportunities for students. Universities seeking to attract talented applicants could better achieve this by sharing more about their programs, including open access to sample syllabi, course content, and teaching methodologies. Transparent teaching practices would not only help prospective students make informed decisions but also showcase the university's commitment to accessibility and innovation in education.

Despite the increasing need for transparency, many universities have prioritized marketing over teaching openness. In 2019, Southern New Hampshire University spent $144M on marketing alone, the highest of any university that year (Getman 2024). Such marketing focuses on highlighting the uniqueness of the institution — its programs, faculty, and research — yet often falls short of providing tangible insights into the quality of education. By reallocating resources to support initiatives like OER, universities can enhance their reputation while genuinely improving access to education. Open teaching materials serve as both a recruitment tool and a demonstration of academic excellence, offering a more meaningful and sustainable approach than traditional marketing strategies.

Historically, universities have been reluctant to publicly share their teaching materials, viewing them as resources exclusive to tuition-paying students. This perspective has contributed to a system where access to education remains limited by financial barriers. However, in 2001, the Massachusetts Institute of Technology (MIT), disrupted this model by launching MIT OpenCourseWare. This initiative provided free

access to syllabi, lecture slides, exams, and other course materials, revolutionizing access to higher education. MIT's decision was rooted in its mission to expand the reach of knowledge, a move that not only enhanced global access to education but also strengthened its reputation and global ranking. (Lewis 2021).

Inspired by MIT's success, some universities have begun to explore the potential benefits of transparency in education. While many remain hesitant, citing concerns over intellectual property and exclusivity, others are recognizing that openly sharing educational resources can attract a broader audience and reinforce institutional credibility. By adopting Open Educational Resources (OER) as part of their academic strategy, universities have the opportunity to balance accessibility with innovation, breaking down barriers while advancing their global missions.

WPI is uniquely positioned to lead in the adoption of Open Educational Resources (OER) due to its unique focus on the undergraduate learning experience. The university emphasizes experiential and hands-on education through its project-based learning approach (Worcester Polytechnic Institute 2025b). This teaching methodology, which centers on real-world problem-solving and collaboration, is at the core of WPI's mission to equip students with practical skills for successful careers.

As a STEM-focused institution (Science, Technology, Engineering, and Math), WPI has earned a reputation for academic rigor and innovation. However, its recognition remains largely regional, despite being consistently ranked among the top 100 universities in the United States (Reiter 2024). Embracing OER provides WPI with a unique opportunity to showcase its distinctive project-based curricula to a global audience, expanding its influence and appeal far beyond the Northeast United States. Sharing WPI's pioneering teaching practices and course materials aligns with its commitment to advancing education and fostering global impact through initiatives like its Global Projects Program (Worcester Polytechnic Institute 2025a), making it an ideal university to champion OER.

While many faculty members at WPI support the idea of making course content open and accessible to the public, several concerns have surfaced. The most significant concern is related to intellectual property, with some faculty members apprehensive about their academic work being freely accessible online without adequate protections. Additionally, some worry that sharing their materials without financial compensation could undermine their contributions to academia.

To address such concerns, universities have adopted various strategies to balance openness with faculty interests. For example, the University of British Columbia provides incentives such as grants, recognition during promotion and tenure reviews, and awards for contributions to open education initiatives (OER Fund 2024). Other institutions have embraced hybrid approaches, offering partial open access by sharing select

portions of course materials while restricting access to more comprehensive resources for enrolled students. Platforms like EdX and Coursera have popularized this model, allowing universities to offer a taste of their courses to the public while maintaining exclusivity for those who enroll.

Another emerging strategy is the introduction of value-added services. In this model, the core educational content is provided for free, but additional offerings — such as personalized tutoring, interactive learning experiences, or certifications — are made available for a fee. This approach not only supports the principles of open access but also creates opportunities for faculty and institutions to benefit financially from supplemental services.

Despite these strategies, a significant challenge persists: the time and effort required for faculty to create and manage publicly accessible courses. Many faculty members already face demanding schedules, making it difficult to dedicate additional time to developing high-quality OER. This represents a critical gap that none of the existing platforms we examined have addressed. Our platform has the potential to fill this void by streamlining the process, reducing the workload for faculty, and enabling broader participation in open learning initiatives.

To explore whether faculty would find value in such a solution, the team conducted surveys to gauge interest in an open learning platform integrated with WPI's Learning Management System (LMS), Canvas. The results indicated that many faculty members were willing to share select course materials, provided they had the tools to maintain control over what they published and how it was accessed. This feedback affirmed the need for a platform that empowers faculty while respecting their concerns about intellectual property and time constraints.

With this input, we moved forward with the development of a platform designed to publicly host information about classes taught at WPI. The platform allows faculty to seamlessly import their Canvas courses while retaining full control over the content they choose to share and the audience they wish to reach. This initiative aims to provide valuable course information to enrolled and prospective students, enhance the public visibility of WPI's distinctive curricula, and bolster the credibility of both the institution and its faculty. By addressing the barriers to participation, this platform positions WPI to take a leading role in advancing open education and fostering greater transparency in higher learning.

2 Background

Open Educational Resources (OER) is a term that refers to freely accessible, openly licensed educational materials that can be used for teaching, learning, and research. These resources range from textbooks and lecture notes to multimedia and full courses, making them an essential tool in reducing educational costs and improving global access to learning materials. The OER movement began in the early 2000s as a response to the rising costs of educational materials and a desire to make high-quality learning resources more widely available. With advances in digital technology and increasing global access to the internet, universities started adopting OER to enhance educational equity (Tsan 2021). The first university to launch an OER program was MIT in April 2001, with the launch of its OpenCourseWare (OCW) website. L. Rafael Reif, the former president of MIT, said that "OpenCourseWare is based on a simple but revolutionary idea: That MIT can advance its mission by sharing nearly all of its course content online, for free" (Reif 2016). As of 2016, MIT OCW has listed 2340 courses, with 66% of their tenure track faculty participating. Their website has been visited 200 million times, and their YouTube channel was visited more than 100 million times (Massachusetts Institute of Technology 2016).

After the launch and success of MIT OCW, many universities started to launch their own OER programs, including Stanford, Carnegie Mellon, and the University of Michigan (Alex 2017). Many of these platforms offered incentives to encourage faculty participation in their projects. One of the most common forms of motivation identified was faculty recognition, where professors received acknowledgment for their contributions, which could enhance their professional profiles. Other incentives often included institutional support, such as recognition in tenure and promotion evaluations or grants for developing course materials (Nagashima and Hrach 2021).

Rather than freely publishing course content, many other universities opted to release their own paid, LMS-like platforms. Learning Management Systems (LMS) refer to software platforms designed to deliver, manage, and track educational courses and content online (Bradley 2021). This allowed them to charge for the courses, and offer certificates of completion. As of October 2024, Stanford's online learning platform, Stanford Online, has listed 550 courses, with only 74 being free. The remaining courses cost $995 each. The University of Michigan offers a similar service, with an expanded array of certificates offered (Stanford University 2024). Both of these platforms integrate with existing popular Learning Management Systems like Coursera and EdX. Carnegie Mellon's Open Learning Initiative offers a different model, focused on providing textbook-replacement courseware. When an instructor opts to use one of these courses, students must pay a fee, between $20-$80, to enroll in the course and gain access to the online textbook. Carnegie

Table 1: Comparisons on currently available OER resources

University	Cost	Faculty Incentives	Licensing	Number of courses	Target Audience
Massachusetts Institute of Technology	Free	Prestige, internal funding for course development	Creative Commons	2500+	Students, educators, and self learners globally
Stanford University	$995 per course	Some recognition for digital resources, internal funding for innovative teaching practices	Varies by resource	∼600	Primarily Stanford students, but also available to the public
Carnegie Melon University	$20-80 per course	Recognition as part of innovation in teaching. Grants available for developing new content, Stipends or teaching credit offered for significant contributions	Creative Commons	∼50	Students, educators, and institutions
University of Michigan	Free for students	Recognition through Open Michigan initiative, internal funding and external grants	Creative Commons	300+	Michigan students and educators, the general public has limited access
University of British Columbia	Free	Recognition through UBC OER Fellows program and other open education initiatives. Faculty can also receive stipends or teaching credits for contributing to OER	Creative Commons	∼100	University of British Columbia students and educators, and public learners

Mellon's service also offers certificates, and they offer 41 out of 57 courses on their site free for independent learners (Carnegie Mellon University 2024).

2.1 Licensing

Licensing is critical in distributing educational materials by defining how content can be accessed, shared, and reused. It ensures faculty retain control over their work while allowing others to benefit from it under specified conditions. By establishing clear permissions, licensing helps protect intellectual property, promote collaboration, and encourage wider dissemination of knowledge.

To address faculty concerns and encourage participation, the platform allows faculty to select a Creative Commons (CC) license for their course materials. These licenses provide flexibility, enabling faculty to retain copyright while specifying how their materials can be used. This ensures that educators feel protected while fostering openness and collaboration in line with the principles of OER.

Creative Commons licenses are available in seven distinct forms, each offering different levels of

openness and restrictions to meet the needs of both creators and users:

- **CC0 (Public Domain Dedication)**

  This tool enables creators to waive their copyright entirely, dedicating their work to the public domain. It allows reusers to distribute, remix, adapt, and build upon the material in any medium or format without restrictions.

- **CC BY (Attribution)**

  This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format, as long as attribution is given to the creator. The license allows for commercial use.

- **CC BY-SA (Attribution-ShareAlike)**

  This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format, as long as attribution is given to the creator. The license allows for commercial use. If the material is adapted, the modified material must be licensed under identical terms.

- **CC BY-NC (Attribution-NonCommercial)**

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  (Creative Commons 2023).

3 Methodology

Although a clear need for an open learning platform was apparent at WPI, it was essential to determine the interest of staff and students in this kind of tool. To this end, surveys were conducted on both faculty and students.

The student survey aimed to assess the accessibility of course materials and determine whether students could easily find the resources needed to make informed enrollment decisions. It focused on specific types of class materials, including syllabi, course schedules, lecture slides, homework assignments, projects, sample exams, sample quizzes, and pre-recorded video lectures.

Beyond accessibility, the timeliness and relevance of these materials were critical to the study. Many online teaching resources, particularly those hosted on faculty websites, are outdated, making it difficult for students to rely on them for course selection. As a result, evaluating whether students had access to up-to-date information became a key aspect of the study, as outdated materials hinder their ability to prepare for classes effectively.

The faculty survey aimed to assess faculty willingness to share class materials online if given an easy-to-use platform for the distribution of these materials. With a focus on simplicity of use and intellectual property rights, this survey sought to understand apprehensions held by instructors regarding the distribution of their course materials.

3.1 Surveying

The pre-platform implementation surveys and the post-platform implementation surveys were conducted using the Qualtrics survey platform. Each survey was independently analyzed, ensuring that the results of the faculty and student surveys were not linked or cross-referenced with any other survey data. This allowed for a clear and unbiased interpretation of the responses from each group. Due to time constraints in survey distribution, the post-implementation survey dataset is smaller than ideal. However, the data is presented as it offers valuable insights into changes in student and faculty opinions. All surveys are located in Appendix A.

3.1.1 Pre-Implementation

Before the project was implemented, two surveys were released, one targeting students and another targeting faculty.

The student survey started by asking questions about each respondent's class year and major, which allowed for deeper analysis of the resultant data across these groups. The respondents were then asked if "having these class materials accessible to them would be useful, even if they are not taking the class", and asked to rate each of these materials, syllabi, course schedules, lecture slides, homework assignments, projects, sample exams, sample quizzes, and pre-recorded video lectures, either "Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, or Strongly Agree". These responses were then assigned a score from -2 (strongly disagree) to 2 (strongly agree) to be used for analysis later on.

They were then asked whether they encountered difficulties in locating specific information about courses of interest, and asked if the lack of availability/accessibility of course materials would limit their ability to make informed decisions. Finally, respondents were asked if they would be interested in using a platform at WPI that provided all of these features. Each of these final three questions utilized the same rating scale as the original question.

The faculty survey started with demographic questions asking about the faculty member's titles and departments. The survey then asks if the faculty member has their own website, and if so, if it accurately reflects what would be currently taught in the course. For the rest of the questions, the survey utilizes the "Strongly Disagree, Somewhat Disagree, Neutral Somewhat Agree, Strongly Agree" format used in the student survey. Faculty were asked questions about what they thought of students, including whether student expectations matched what was taught in their course if students were prepared to take the course, and if students dropped their course because they weren't prepared.

The survey then goes on to ask if they were willing to publish course materials (the same ones listed in the student survey) to WPI students and if they were willing to share those same materials with the public. Lastly, faculty were asked if they were willing to publish information about their courses and if they believed their students would be better prepared with this information.

3.1.2 Post-Implementation

As with the pre-implementation survey, two surveys were distributed to students and faculty following the platform's release. The student survey started by asking questions about each respondent's class year and

major, which would allow for deeper analysis of the resultant data across these groups.

The student survey started by asking questions about each respondent's class year and major, which would allow for a deeper analysis of the resultant data across these groups. The survey then goes on to ask about the student's experience with the platform, asking if they could find specific course information about classes if using the platform would better prepare them for classes and if they would feel more confident registering for courses with this platform. It then asks about how useful it would be to have course materials (the same ones as mentioned previously in the pre-implementation section) always accessible. All of these questions are rated from "Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree", excluding the demographic information.

The faculty survey starts with demographic questions asking about the faculty member's titles and departments. The survey then goes on to ask questions about their experience on the platform, including if they are willing to host their courses on this platform, if they are willing to update their courses regularly if the platform was easy to use, and how well it worked. It then asks about their willingness to upload course materials (the same ones as mentioned previously in the pre-implementation section) for use with WPI students and the greater public. All of these questions are rated as "Strongly Disagree, Somewhat Disagree, Neutral, Somewhat Agree, Strongly Agree", excluding the demographic information.

3.1.3 Sampling

A sampling approach to data collection was selected for several reasons. These surveys were non-intrusive, facilitating the collection of feedback without disrupting the professors' and students' daily activities. Participants had the opportunity to complete the surveys at their convenience, providing thoughtful and honest responses. Anonymizing survey responses also helped ensure candid feedback, as it allowed participants to share their true opinions without fear of repercussion.

Distribution of surveys was performed in different ways for faculty and students. When contacting students, surveys were sent out through a variety of channels, including advertising the survey in public forums, including various department and student club newsletters. When sending the survey to faculty, department heads were contacted and asked to help distribute the survey to faculty in their department. This ensured a diverse sample of faculty from various departments, resulting in a more representative dataset.

3.1.4 Possible Biases

Despite the insights gained, several sources of bias exist in the surveys. First, self-selection bias may have influenced the results—faculty members already open to OER might have been more likely to participate, leading to an overrepresentation of those willing to share materials. Second, sample representativeness is a concern; many departments were underrepresented or not represented at all due to a lack of responses. Student responses may also reflect aspirational rather than practical preferences—while they express a need for many materials, the student's actual usage of said materials remains to be seen. Future studies should consider follow-up interviews or usage data from similar platforms to validate student interest. Finally, as mentioned above, the post-implementation surveys have very limited data, and there is a high probability that those who responded already had an interest in the platform, which can skew the results.

4 Software Design

This section of the paper is dedicated to the creation of both the front end and back end of the project, as well as the development tools used to support its construction.

4.1 Software Development Environment

In the software development environment of the platform, three packages were utilized to assist in the development lifecycle: Yarn, Turbo, and Nodemon.

Yarn (4.5.1) is a fast, secure, and reliable package manager use within this project, developed by Meta as an alternative to NPM. It is utilized within this project to manage dependencies, install packages, and handle versioning with minimal issues. A key reason on why it was chosen is that it enforces dependency version deterministically, making the development experience smoother (Yarn 2025).

Turbo (2.2.3), also known as Turbo Repo, is a build system that speeds up development by only compiling parts of the code that were changed rather than the entire monorepo by caching and reusing build artifacts throughout the project (Vercel 2025).

Nodemon (3.1.7) is a utility that helps streamline development in Node.js applications by automatically restarting the server when code changes are detected. Nodemon was used in this project to avoid manually restarting the entire development server any time edits were made, speeding up the testing process (Npm 2025).

4.2 Front End

The front end of a software-related project refers to the part of the application where users directly interact with the system. It is often referred to as the client side because it is executed on the user's device, such as a browser or mobile app. This layer serves as the interface between the user and the underlying functionalities provided by the back-end systems.

In this section, we explore the technologies, design choices, and implementation details that shaped the front-end development of the platform. We describe our methodologies and approach to user interface and user experience design.

4.2.1 Terminology

1. **Static Website**

   A website where content is fixed and delivered as-is to the user without requiring processing on the server for each request. Static sites are typically simple and fast but lack interactivity (Figma 2025a).

2. **Dynamic Website**

   A website that generates content dynamically based on user inputs or real-time data. This approach allows for personalized and interactive experiences (Figma 2025a).

3. **JavaScript**

   A programming language that enables interactive and dynamic features on web pages, such as animations, form validations, and real-time updates (MozDevNet 2025).

4. **TypeScript**

   A strongly typed programming language that builds on JavaScript by adding static types. It helps developers catch errors during development and improves code maintainability (TypeScript 2025).

5. **React.js**

   A JavaScript library for building user interfaces using a component-based architecture. React enables developers to create reusable UI elements and efficiently update the page when data changes (React 2025).

6. **Next.js**

   A framework built on React that adds performance-focused features like server-side rendering and static site generation, simplifying the development of fast and scalable web applications (Vercel 2024b).

7. **Component**

   A reusable, self-contained building block in frameworks like React that encapsulates the structure, behavior, and styling of a specific UI element (Vercel 2024b).

8. **Tailwind CSS**

   A utility-first CSS framework that allows developers to apply pre-defined styles directly in HTML or JSX (React components), enabling rapid design and development with consistent results (Tailwind CSS 2024).

4.2.2 Technologies and Frameworks

The front end of the platform is built using Next.js, Shadcn UI, and Tailwind CSS, technologies that provide a modern, performant, and scalable foundation for front-end development, all while reducing development time.

Historically, websites were built using strictly HTML for structure and CSS for styling. This approach was suitable for static websites, where content was predefined and delivered as-is to users. Such websites offered simplicity but lacked flexibility, making it challenging to implement interactive features or respond dynamically to user inputs. As web applications evolved, the need for more sophisticated client-side interactivity led to the adoption of JavaScript frameworks like React.js.

React.js transformed front-end development by introducing a component-based architecture, allowing developers to create reusable, modular UI elements. This paradigm shift made it possible to build highly interactive, data-driven applications efficiently. However, React focuses primarily on client-side rendering, which, while powerful, can present challenges for performance in larger applications.

To address these challenges, we used Next.js (15.0.2), a framework that builds upon React by integrating server-side rendering and static site generation. These features allow developers to optimize performance by pre-rendering pages when possible while still supporting dynamic content updates. Additionally, Next.js offers built-in routing and API integration, simplifying development workflows and enhancing scalability. (Vercel 2024b)

Tailwind CSS (3.4.1) complements these frameworks by providing a utility-first approach to styling. Unlike traditional CSS frameworks, which rely on pre-designed components, Tailwind allows developers to craft custom designs quickly and efficiently by applying utility classes directly in HTML or JSX (React components). This approach reduces switching between CSS and JSX during development. It helps ensure consistent, responsive designs across the platform. (Tailwind CSS 2024)

Shadcn UI (2.1.8) further enhances the platform's front end by offering a library of accessible, customizable UI components. Built with modern design principles, Shadcn UI simplifies the implementation of consistent, visually appealing interfaces while allowing for extensive customization to meet specific project needs. By integrating seamlessly with Tailwind CSS, Shadcn UI enables rapid prototyping and a streamlined development process. (Shadcn 2024)

Together, Next.js, React, Tailwind CSS, and Shadcn UI form the technological backbone of the platform's front end. These tools provide a powerful, flexible foundation that facilitates the seamless in-

tegration of complex back-end functionality with a user-centric, interactive interface. This foundation sets the stage for a fast and thoughtfully designed user interface and user experience, discussed in the following sections.

4.2.3 User Interface Design

Before implementing the user interface, the overall style of the platform was carefully established. We prioritized minimalism to create a clean and uncluttered design, responsiveness to ensure the platform functions seamlessly across devices of all sizes, and a strong connection to WPI to foster familiarity and school spirit. Key elements such as typography, colors, and iconography were defined to create a cohesive visual identity and unified design language, as seen in Figure 1. Particular elements such as the colors and fonts used on the website came from WPI's Marketing Guidelines (Worcester Polytechnic Institute 2022). The logo was also designed in accordance with the marketing guidelines.

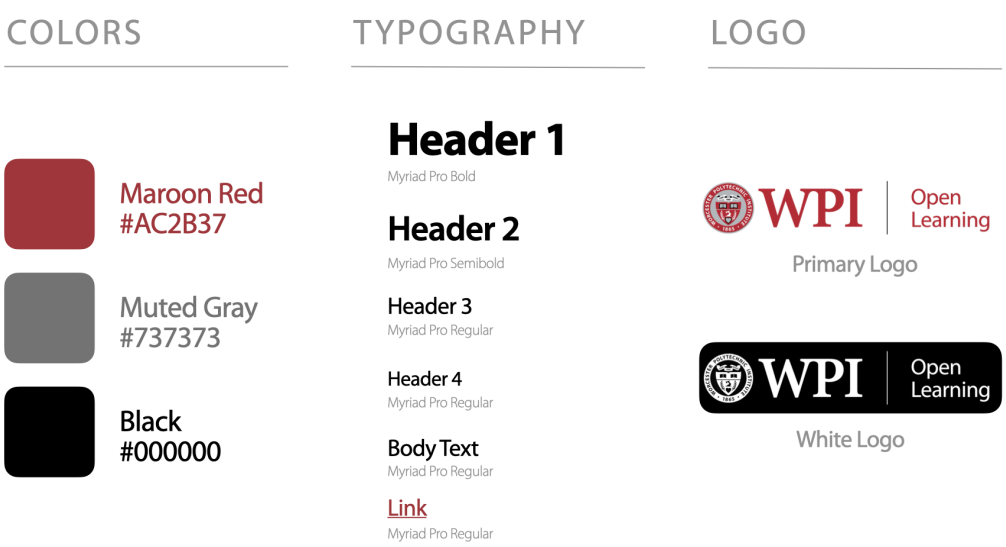

Figure 1: Website style guide

Once the style guide was established, initial designs of pages were created in Figma, a web application widely used for designing and prototyping user interfaces. These designs served as a blueprint for the layout, functionality, and overall aesthetic of the platform, allowing for iterative refinement before moving to implementation (Figma 2025b). Many pages have since changed their layout as a result of usability testing and evolving project requirements, ensuring the final design better aligns with user needs and improves

overall functionality.

The Figma mockups were instrumental in establishing the design of key pages, particularly the home page and course page. Both pages feature large images of campus paired with bold, prominent text to introduce their content effectively. A focus on minimalism and visually striking images of the campus was central to creating an engaging and inviting aesthetic. The mockups also included the navigation bar, which has remained largely unchanged since its initial design.

Instead of creating our own component library, Shadcn UI's components were used in the application, many of which were modified to suite our needs. Shadcn UI Cards are the most widely used component in the application, serving as the primary method for presenting content, as can be seen in Figure 2 to display courses. These cards are employed across all pages to effectively separate content from the background, enhancing clarity and creating a visually organized layout. Their consistent use reinforces the platform's minimalist design principles while maintaining a clean and cohesive user experience. Other components used frequently throughout the application include Shadcn UI's Button and Accordion. Using these components allowed us to quickly develop and iterate on the user interface design.

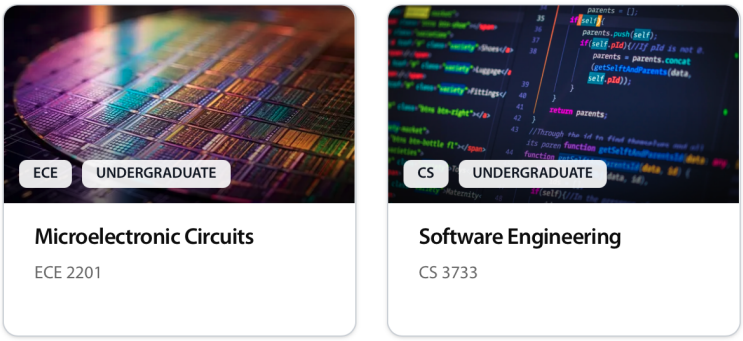

Figure 2: Course cards

Many custom components were built on top of Shadcn UI's component library to ensure ease of use across multiple pages within the application. This approach included creating reusable components, such as course and section cards, as seen in Figure 2, which simplified the process of maintaining a cohesive design. By utilizing a unified component structure for these elements, any design or functionality changes could be implemented globally, ensuring a consistent look throughout the platform while reducing development effort. Other components, like the course section file browser, as seen in Figure 3, were created entirely from scratch.

Ease of development and the elimination of redundant code were critical for our application. To achieve this, a custom Tailwind class system was developed to standardize spacing, sizing, and margins

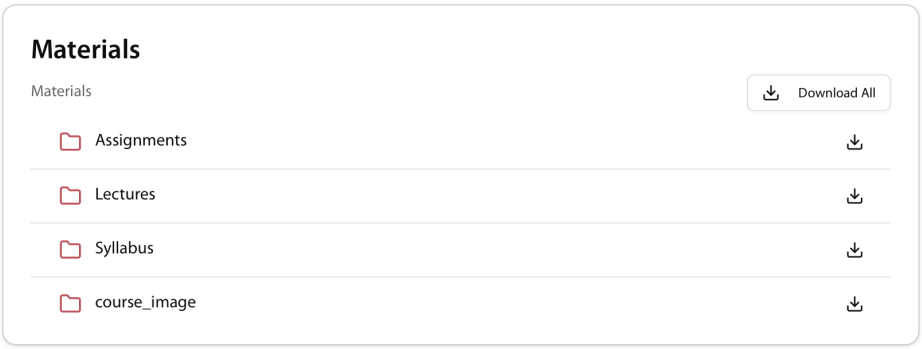

Figure 3: Course section file browser

across all pages, ensuring a consistent visual design. Additionally a default color palette was established, which was uniformly applied to all components, reinforcing the cohesive aesthetic of the platform.

Responsiveness was another key priority in the design of the user interface. Every page was rigorously tested on a variety of mobile device sizes, as shown in Figure 4, to ensure a seamless and consistent user experience across different screen resolutions. By prioritizing maintainability and responsiveness, a scalable and user-friendly interface was created that meets the diverse needs of users while simplifying future development efforts.

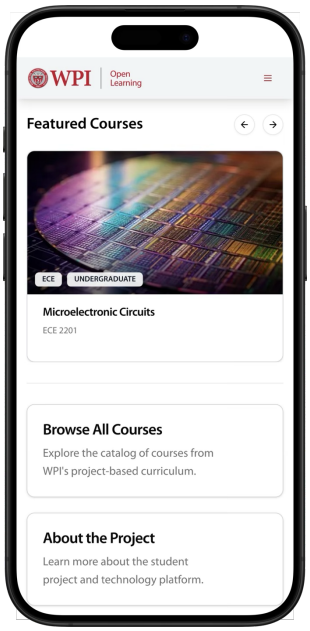

Figure 4: Home page mobile view

4.2.4 User Experience Design

A seamless user experience across the site was ensured by prioritizing a clean, uncluttered user interface. For faculty users, however, the user experience required additional attention to balance simplicity with functionality. By applying the same minimalist principles to the user experience as we did to the user interface, the platform was made as intuitive as possible. Simplifying the experience for faculty was essential to increase the likelihood that they would engage with the platform and import their courses.

To achieve this simplicity, the faculty user experience is centered around just two pages. The first is the Account Dashboard, where faculty can view and manage their imported courses, configure course settings, and view their public profile. The second is the Course Import Page, shown in Figure 17. This page is pre-populated with a list of courses retrieved from Canvas. Faculty simply select the course they wish to import and configure several settings, including basic course information, visibility, and licensing options. The workload for faculty was minimized by pre-filling the form with information parsed directly from Canvas, such as course titles and descriptions. In most cases, faculty only need to set the course visibility and optionally select a license, reducing friction and streamlining the process.

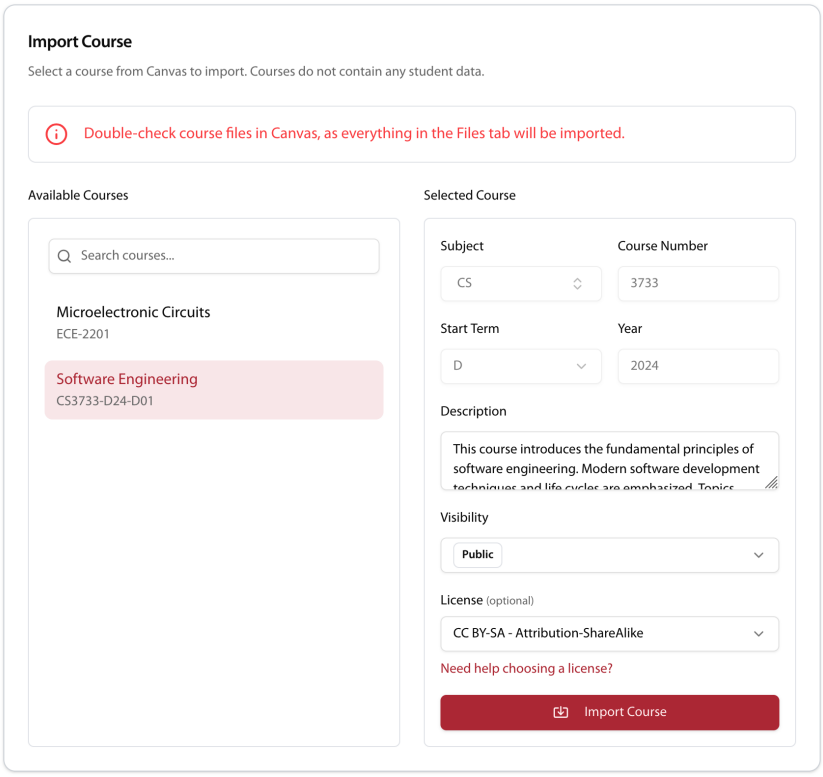

Figure 5: Course import page

One of the more complex tasks for faculty is selecting a Creative Commons license for their course materials. For those unfamiliar with licensing or Creative Commons, this process can initially feel overwhelming. To address this, we developed an Interactive License Picker, shown in Figure 6. This tool guides users through up to three simple questions to help them choose the appropriate license for their content. By breaking down the decision-making process into clear, manageable steps, the license picker ensures faculty can confidently select a license without confusion.

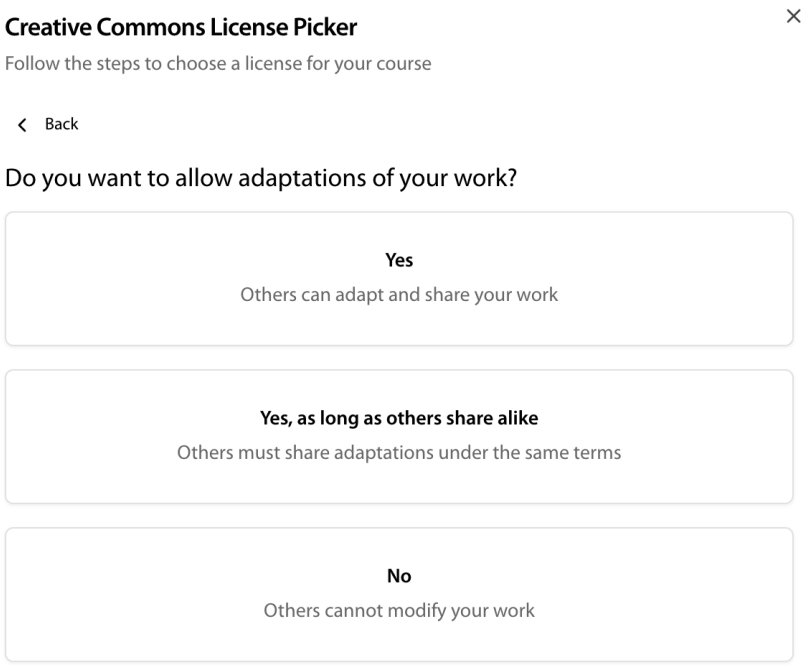

Figure 6: Creative Commons license picker

By focusing on simplicity and automation, the platform significantly reduces the time and effort required for faculty to publish their courses. These design decisions not only enhance the user experience but also encourage greater participation, supporting the platform's goal of expanding access to high-quality educational materials.

4.2.5 Performance Considerations

Next.js played a key role in enhancing performance by supporting server-side rendering and static site generation. These features allowed us to pre-render pages on the server, reducing the time needed to generate content dynamically in the browser. This approach significantly improved page load speeds and ensured a smooth user experience, particularly for content-heavy pages like the home and course pages, which

load many images. The platform leverages Next.js's built-in image optimization to serve images in modern formats and at sizes appropriate for the user's device. This feature minimized the bandwidth required to load large banner images and other visual assets while preserving their quality (GeeksforGeeks 2024).

Backend integration was designed to support efficient data fetching and minimize latency. Next.js API routes provided a seamless way to connect the front end to the back end, enabling server-side computations and secure data handling. By utilizing server-side rendering for dynamic content, the platform reduced the need for frequent client-side API calls, enhancing both speed and scalability. In scenarios where client-side rendering was required, caching mechanisms were employed to minimize redundant network requests and improve responsiveness.

Next.js's built-in pre-fetching capabilities for links ensured that users experienced near-instant navigation between pages. Pages were preloaded in the background when links appeared in the viewport, reducing perceived load times. Combined with browser-level caching for frequently accessed resources, this strategy enhanced the platform's performance across sessions.

4.3 Back End

The 'back end' of a software-related project refers to the parts of the project that allow it to operate and are not accessible by the user. Most data and operating information is stored within the back end of the project. The software used to help manage data, communicate with the front end and authenticate users are mentioned here.

4.3.1 Terminology

1. **HTTP**

   The Hypertext Transfer Protocol, a set of rules that govern how data is transferred on the internet. HTTP Requests are how data is transferred through the web (Cloudflare 2024).

2. **API**

   An Application Programming Interface is a generally used term that describes connectivity interfaces between two software components using a set of definitions and protocols(Amazon 2024).

3. **JSON**

   A human-readable format for storing and encoding data.

4.3.2 Development Language

Typescript was the programming language used in the development of this platform. It was chosen over JavaScript, a similar programming language, due to its ability to significantly increase development speed. Typescript offers features such as strongly typed objects, Enums, Interfaces, and compile-time error handling. These features help developers catch errors during development and improve code maintainability.

4.3.3 Important Packages

Prisma (5.21.1) is an open-source ORM (Object-Relational Mapping) tool designed to simplify application database access. It acts as a database client for Node.js and TypeScript projects, allowing developers to interact with databases using an intuitive API that maps database schemas directly to objects in the code. Prisma streamlines database workflows by automating SQL generation, and schema migrations, and providing a powerful query engine, making it easier to work with PostgreSQL (Prisma 2025).

Express.js (5.0.0) is a fast, minimalist web application framework for Node.js, commonly used to build RESTful APIs and web applications. It provides a lightweight foundation for handling HTTP requests, routing, middleware management, and server-side rendering. Express was used for its simplicity and flexibility (Express 2025).

4.3.4 Endpoints

An endpoint in the context of this project refers to specific URLs or URIs (Uniform Resource Identifiers) used to access resources or services in a networked application, typically through an API. This project has three main categories of endpoint it uses to communicate, namely back end to canvas, back end to the PostgreSQL database, and back end to front end communication.

The API used in communication for this project is known as a RESTful API (referred to as a REST API throughout this paper). "When a client request is made via a RESTful API, it transfers a representation of the state of the resource to the requester or endpoint. This information, or representation, is delivered in one of several formats via HTTP: JSON (JavaScript Object Notation), HTML, XLT, Python, PHP, or plain text." (Red Hat 2020)

The application establishes communication with Canvas's Learning Management System (LMS) via its REST API to access and retrieve course data on behalf of users. This interaction initiates once the user logs in and an authentication token (auth key) is obtained, granting the application permission to access

the user's specified course data. The back end utilizes this token to make authenticated requests to Canvas, fetching a range of course-related data (besides student files and grades) which is then processed for storage and further use in the application.

The back end's interaction with the PostgreSQL database is organized into three primary operations, each serving a unique role in managing course data within the application:

- **Inserting Course Data :** Once course data is fetched from the Canvas API, the back-end processes and prepares it for insertion into the PostgreSQL database. This process includes validating and structuring the data to align with the database schema, ensuring it can be efficiently queried and accessed later. The stored data includes comprehensive details about each course, allowing the application to provide a seamless experience without needing to repeatedly query Canvas, which can reduce API call frequency and improve performance.
- **Retrieving Data :** The application frequently retrieves data from the database to send it to the front end. Using Express.js, the back end queries the database and structures the results in JSON format. When sent to the front end, this JSON data enables dynamic user interfaces that update in real-time with course-specific information, ensuring a responsive experience.
- **Updating and Modifying Data :** The final aspect of database communication involves data modification, which occurs primarily when a teacher initiates a request to update or remove course-related information. Through the front-end interface, a teacher can make specific changes, such as removing files they don't wish to be shown on the back end and modifying course descriptions. These requests are processed by the back end, which ensures that only authorized users can perform such modifications. Upon validation, the back end updates the relevant entries in the PostgreSQL database, maintaining data integrity and reflecting the teacher's requested changes across the system.

4.3.5 Database

PostgreSQL is a powerful, open-source relational database management system (RDBMS) known for its stability, robustness, and adherence to SQL standards. Often chosen for handling complex queries and large datasets, PostgreSQL supports advanced features such as ACID compliance, extensibility, and powerful indexing and data integrity options. It's also highly customizable and supports JSON, making it suitable for both relational and document-oriented data, which is ideal for this platform (PostgreSQL 2024).

- **Category:**

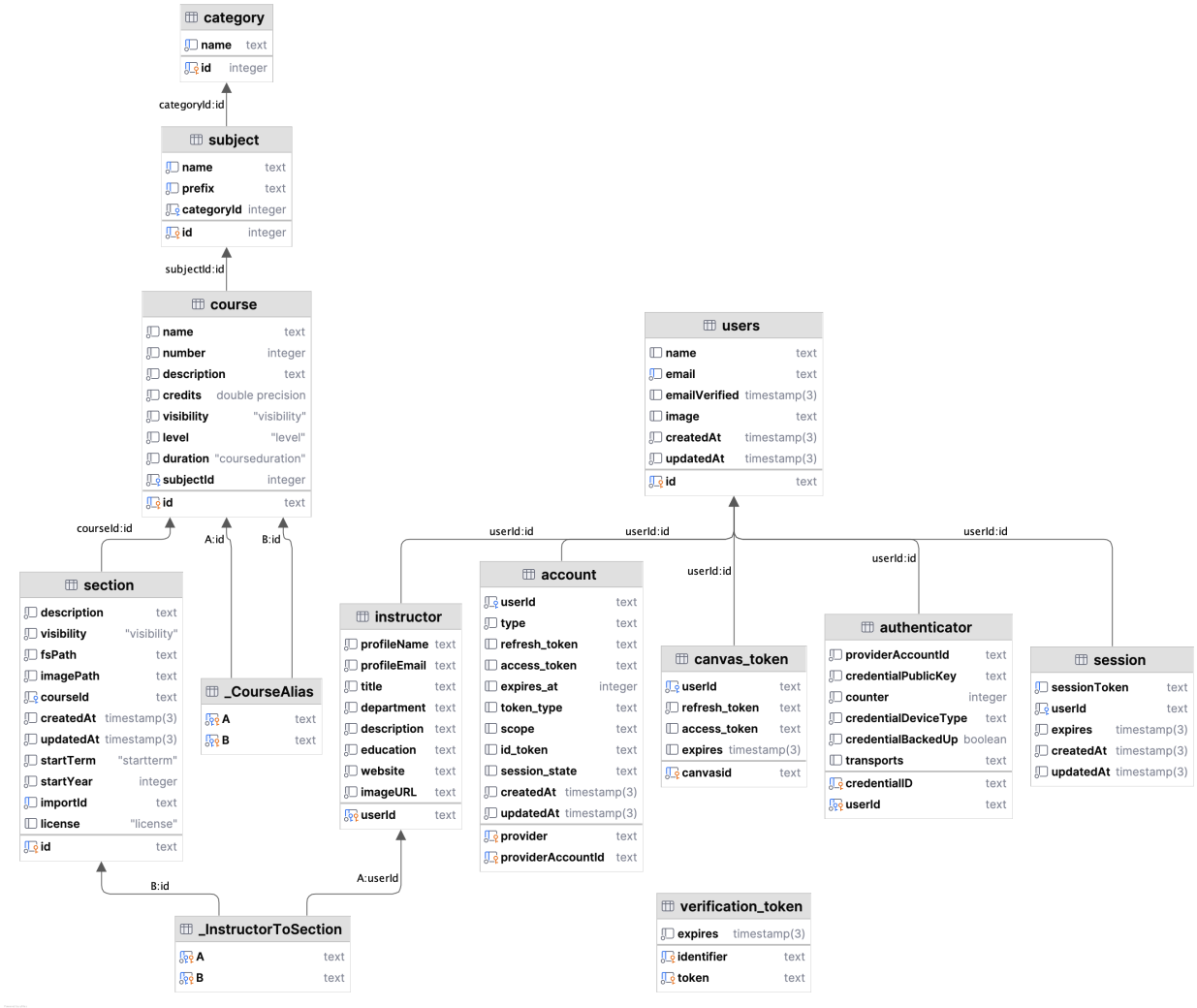

Figure 7: Database entity relationship diagram

The Category entity represents the major divisions within an educational institution, such as Arts and Sciences, Engineering, and Business. Each Category is defined by a unique id (integer) and a name (text). The id attribute serves as a primary key, ensuring each school record is unique and linking it to the Department entity. This structure allows multiple departments to be associated with each school, reflecting the organization within an institution where a single school may encompass various departments (for example, the Category for Engineering might include departments like Electrical Engineering and Mechanical Engineering).

- **Subject:**

  The Subject entity represents the various academic subjects within a school. Each subject has a name, a prefix (such as “CS” for Computer Science), a unique ID, and a schoolId that connects it to a specific

school. This setup organizes courses within each subject, enabling users to browse courses based on academic areas.

- **Course:**

  The Course entity holds information about the specific courses each department offers. Each course has attributes such as a course number, description, visibility status (public or private), number of credits, and level (undergraduate or graduate). Enums are used for visibility and level to maintain consistent values across the platform, ensuring data accuracy and standardization. Courses are linked to subjects through the SubjectToCourse table, which manages a many-to-many relationship. This allows a single course, such as "Intro to Biology" , to be part of multiple departments, such as Biology and Biochemistry. This setup allows departments to share or cross-list courses without duplicating data.

- **Section:**

  The Section entity represents specific instances of a course, each taught by different instructors, at different times, or with a unique format. Each section has attributes such as a unique ID, section number, description, visibility, a file path for resources, and a courseId linking it to the course. The file path (fsPath) organizes specific materials for each section, such as lecture slides or assignments.

- **Instructor:**

  The Instructor entity represents teachers for these courses and sections. Each instructor has a login email, profile link, description, display email option (indicating whether their email is visible to students), a title, and a unique ID. Instructors are linked to both departments and sections, allowing them to have access across multiple departments and courses.

- **User:**

  The User entity represents any individual that has signed in with Canvas. Each User has an email, a name, and a profile image. The User entity is linked to Instructors, Accounts, Sessions, Authenticator, and Canvas Access Tokens, and acts as a parent to each of them.

- **Account:**

  The Account entity stores the user-id to associate it with a User, its login token, and associated information for recalling and updating the token. It also holds information on the Account's current Session.

- **Session, Authenticator, Verification Token:**

The Session, Authenticator, and Verification Token entities are created as part of the Prisma Adapter for AuthJS.

- **Canvas Token:**

  The Canvas Token entity is created when a user links their account to Canvas, and stores relevant information to help maintain the token.

The database uses primary keys (unique identifiers) and foreign keys (links between entities) to maintain organization and prevent redundancy. Enums for fields like visibility and level ensure that data remains consistent and error-free, especially for values with limited options.

Associative tables, such as SubjectToCourse, SubjectToInstructor, and InstructorToSection, make this design flexible and scalable. These tables allow new relationships and connections to be added without changing the core structure, supporting platform growth. The model also accommodates different visibility levels for information, essential for a platform with both public users (such as general visitors) and internal users (faculty and staff).

This design creates a structured, easy-to-navigate platform for managing educational resources, providing a foundation that is adaptable for future growth and changes.

4.3.6 OAuth2

OAuth2 is the industry standard protocol that allows a third-party application to obtain limited access to an HTTP service to perform actions on behalf of another user (Hardt 2012). It offers secure, token-based authorization while ensuring that sensitive user credentials are never shared directly with the third-party application. For this project, we use OAuth to perform two functions:

Authentication: It is essential to ensure that users' identities are both known and verifiable. OAuth is used to delegate this responsibility to a trusted third party. The platform uses Microsoft Entra ID as the OAuth provider for this task.

Canvas Integration: This application needs to perform multiple tasks on behalf of the user, such as getting a list of sections taught, starting a course export, and retrieving data from a completed course export. Using OAuth, the user can authorize our application to perform these actions.

4.3.7 Deployment

To deploy the platform, modern web technologies are leveraged to ensure high performance, scalability, and maintainability. The platform's front end is built using Next.js, which provides server-side rendering and static site generation capabilities. These features allow for the creation of highly performant web pages, as HTML, CSS, and JavaScript files are pre-rendered and optimized before being delivered to the user's browser. Additionally, JavaScript is compiled, and browser bundles are minified using the Next.js Compiler, which enhances performance and ensures compatibility with all modern browsers (Vercel 2024a).

The back end is powered by TypeScript, which is transpiled into JavaScript during deployment. By removing type information during the compilation process, the resulting JavaScript files have a reduced memory footprint, improving the efficiency and speed of the platform. The use of TypeScript in both the front end and back end also eases development.

The platform itself is hosted on a bare-metal Ubuntu VM running Apache web server, a reliable and widely used web server. Apache was chosen for its versatility, robust feature set, and proven track record in serving web applications. Using bare-metal over a cloud provider proved to be quite a challenge, as a network, firewall, and Apache settings were required to be setup ourselves. Now that these configurations are in place, the platform is are prepared to scale to a container-based architecture in the future. This would allow for improved resource allocation, easier updates, and seamless scaling to accommodate increased user demand.

4.3.8 License

The project is licensed under the GNU Affero General Public License v3 (AGPLv3) license. This license was chosen for this project to ensure that the platform remains open and accessible to all, while protecting its core principles of collaboration and transparency. AGPLv3 is particularly well-suited for web-based software because it extends the requirements of the GNU General Public License (GPL) by mandating that source code be made available not only when software is distributed, but also when it is accessed over a network (Free Software Foundation 2007).

This feature is critical for the platform's mission, as it ensures that any modifications or improvements made by others remain open and available to the community. By adopting AGPLv3, the project safeguards its open-source nature, encourages contributions from a global audience, and prevents proprietary forks that could undermine the ideals of open source.

5 Application Images

This section presents screenshots of the application, located at openlearning.wpi.edu, showcasing its clean user interface, intuitive user experience, and integration with Canvas. The screenshots capture full-page views of the platform to ensure all key features and sections are visible. The platform is designed to function seamlessly across various device sizes, including mobile devices. The content in the screenshots including the courses, sections, and faculty members, are generic and do not reflect the current content on the platform.

5.1 Main Pages

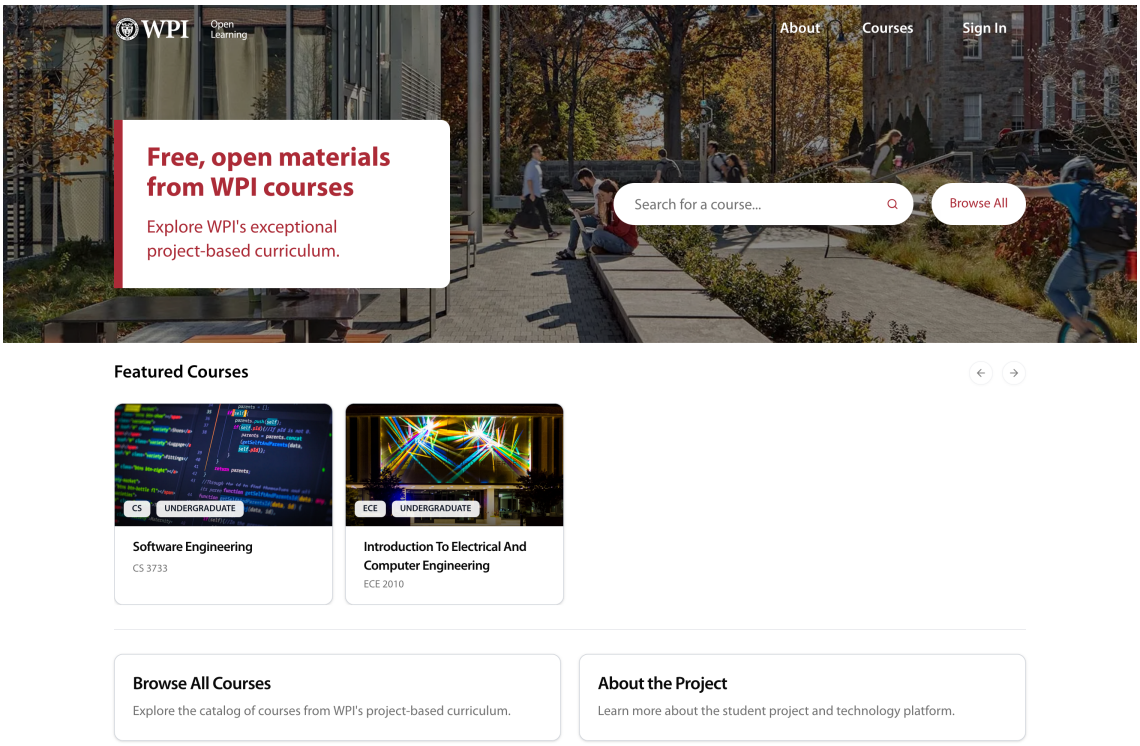

Figure 8: Home page

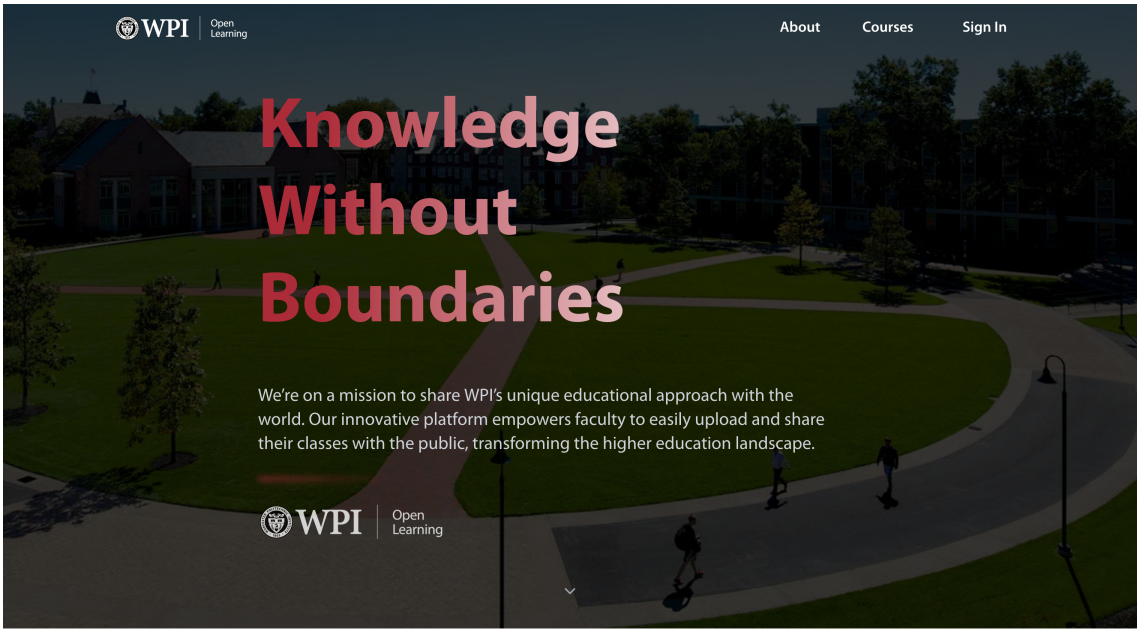

Figure 9: About page — first half

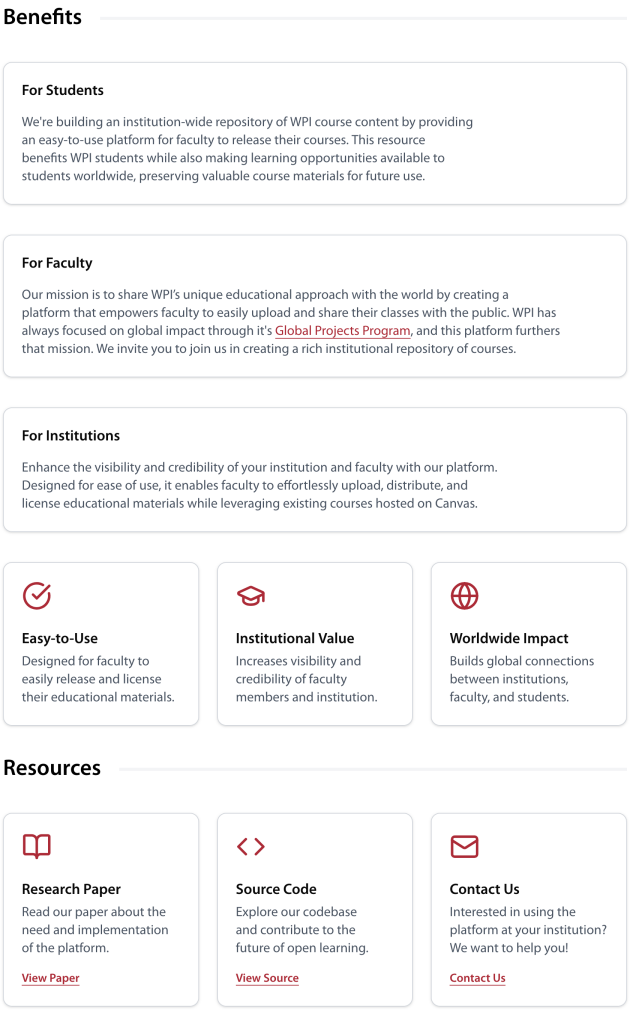

Figure 10: About page — second half

FAQ

- What is this?
- What content can I find?
- Do I need to login?
- Is this made by WPI?
- Are there terms of use?
- How can I submit feedback?

For Faculty

- Why should I use this?
- Getting started
- Importing courses
- Choosing a license
- Visibility options
- Editing course sections
- Courses vs. sections
- Profile pages
- Support

For Institutions

- How will this benefit my institution?
- How do I implement this at my institution?
- Is the platform open source?

Figure 11: Help page

5.2 Course Pages

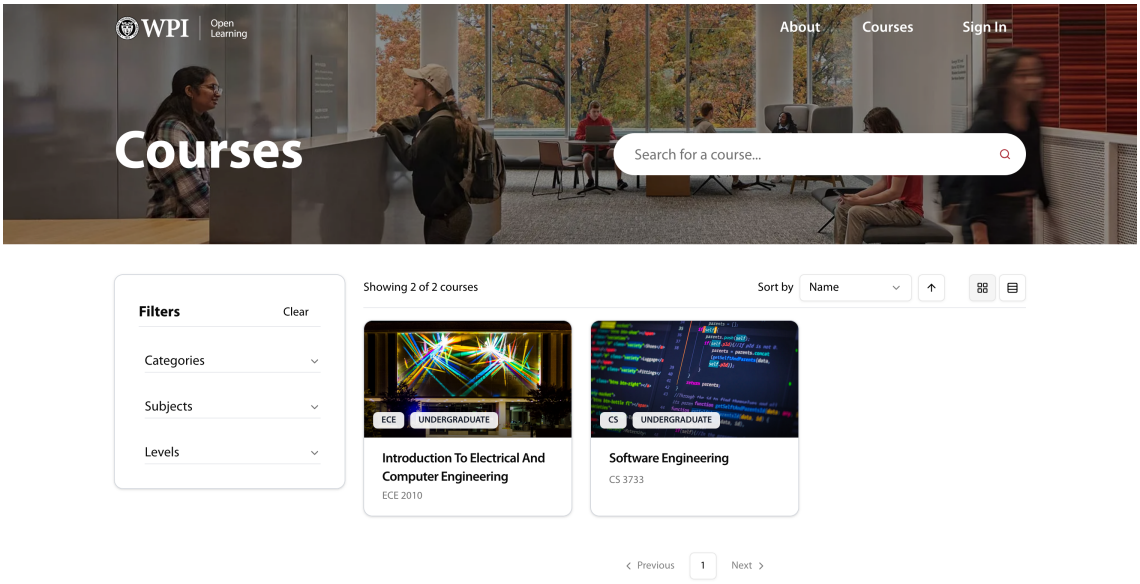

Figure 12: Courses page

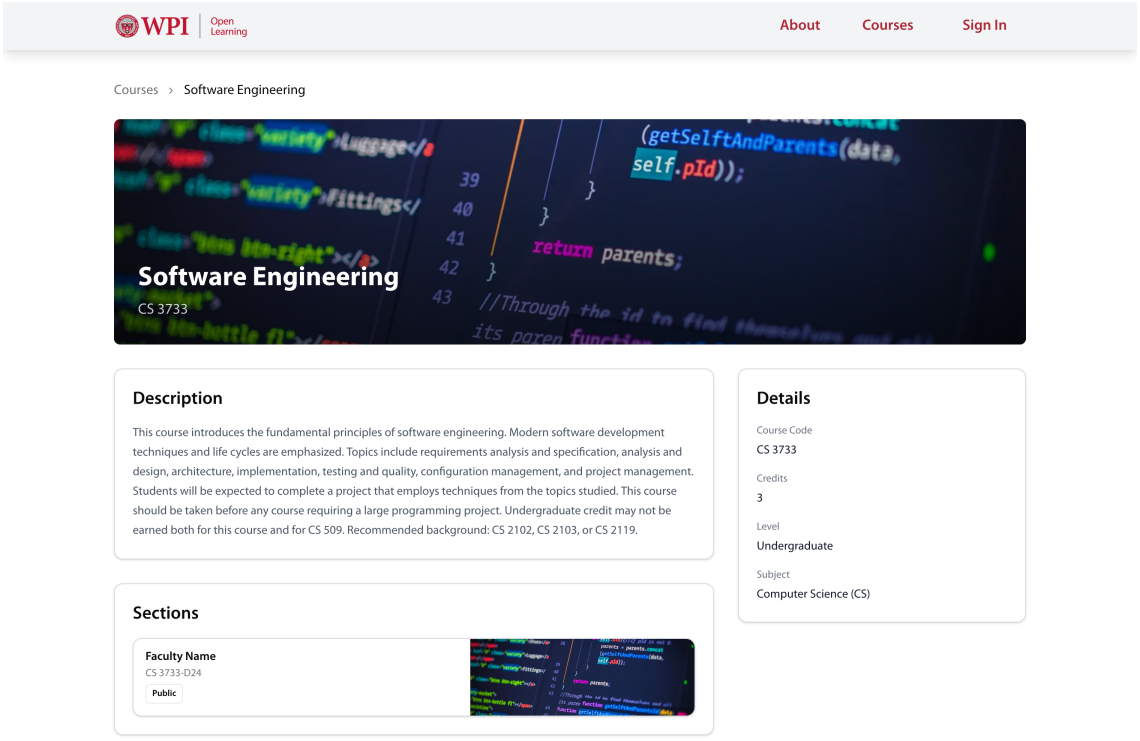

Figure 13: Course page

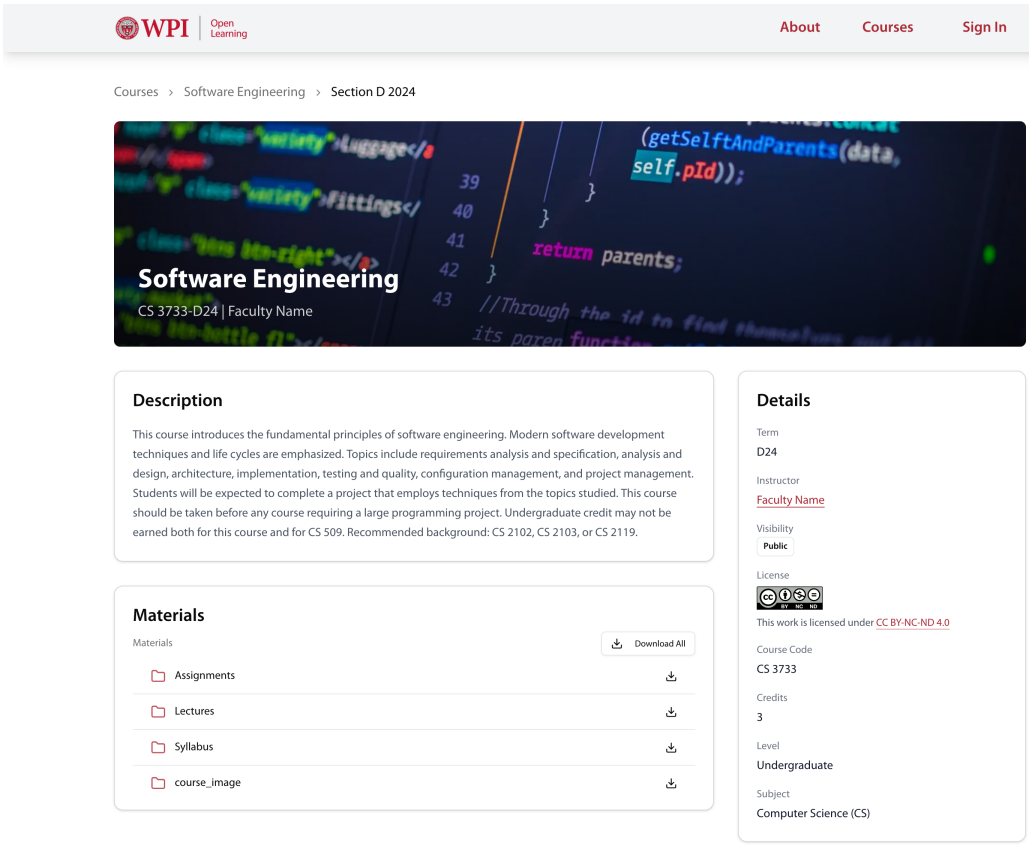

Figure 14: Course section page

5.3 Pages for Faculty

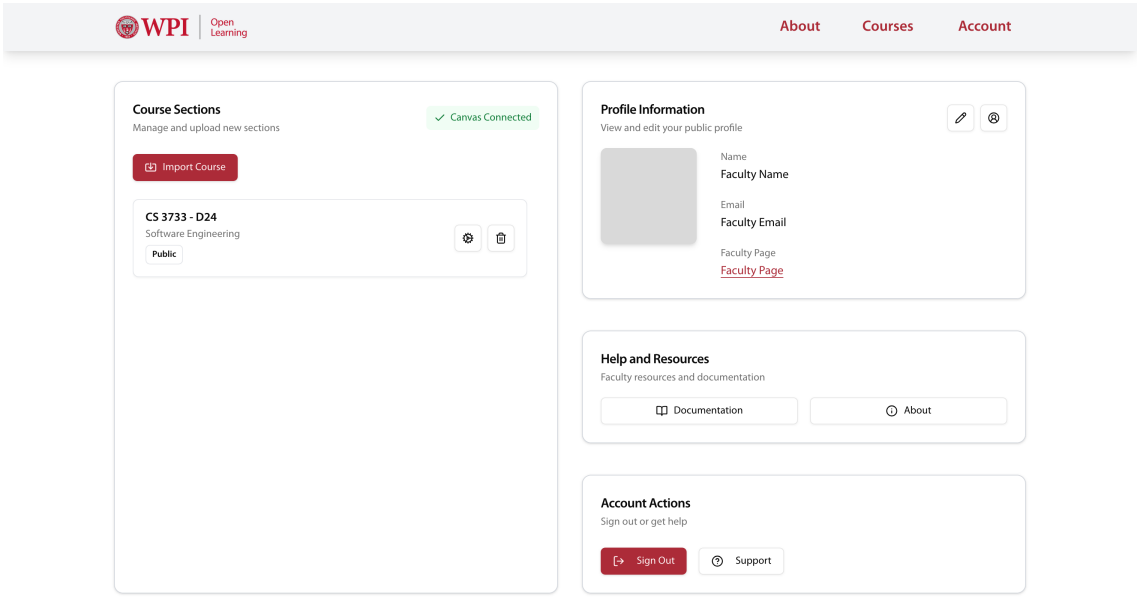

Figure 15: Faculty account dashboard

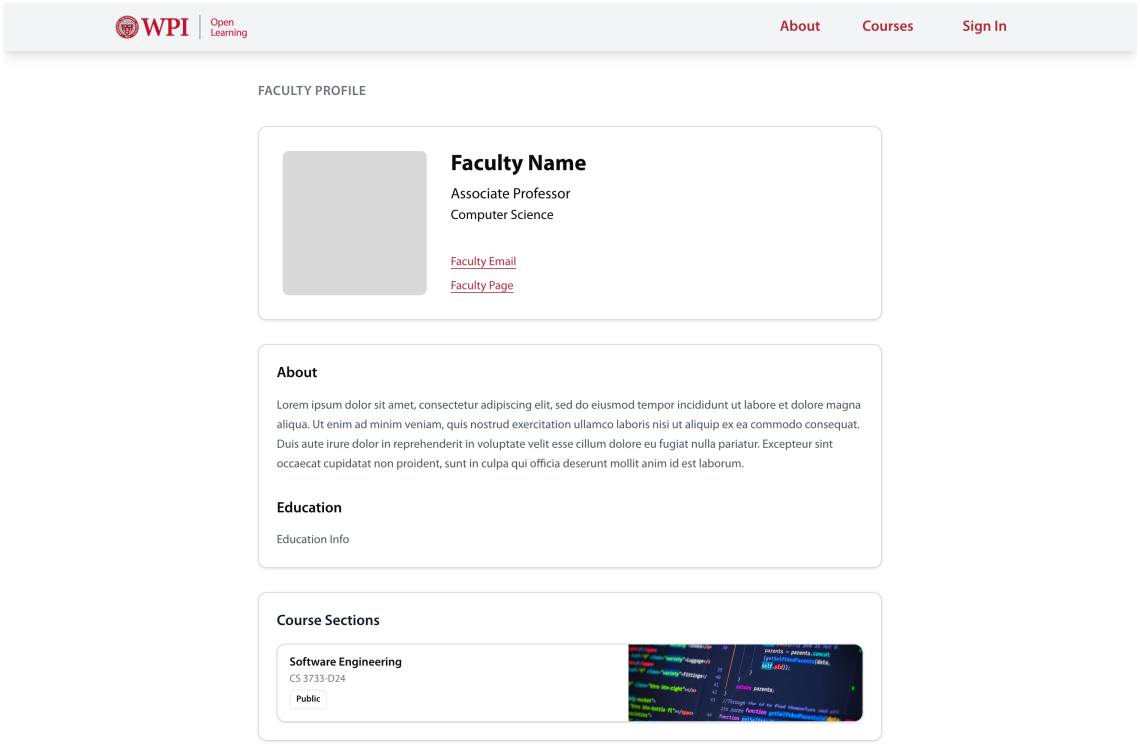

Figure 16: Faculty profile page

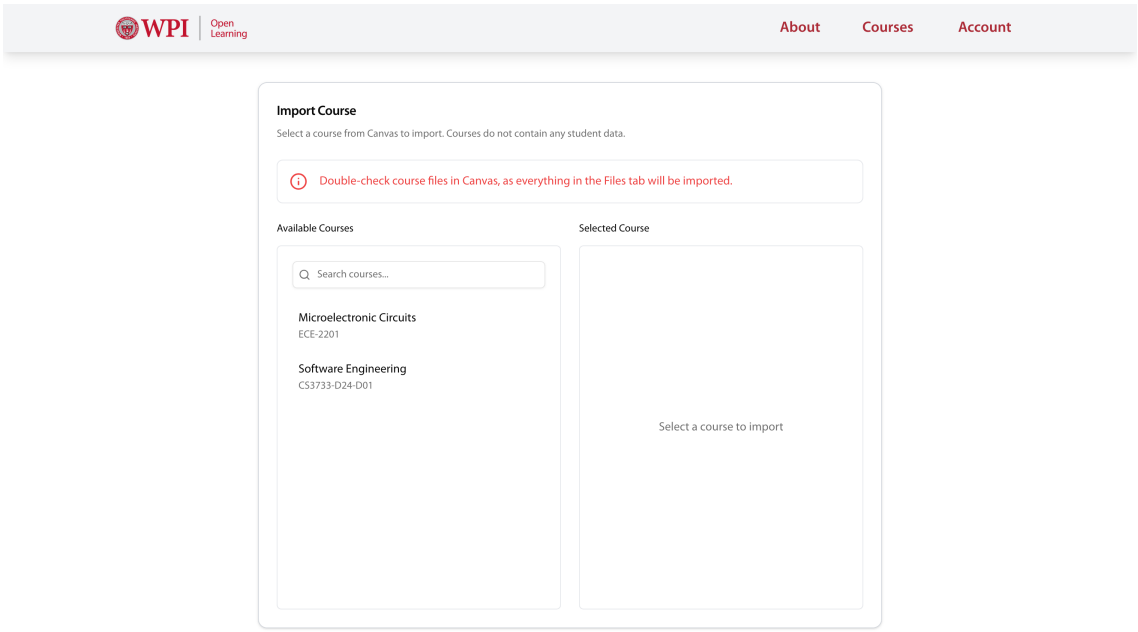

Figure 17: Course import page

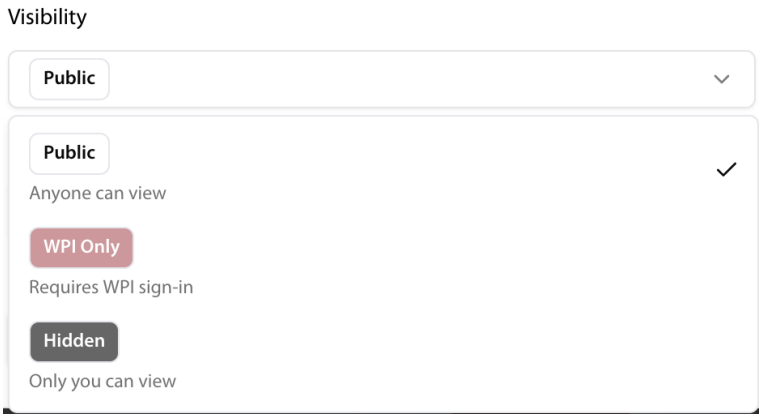

Figure 18: Section visibility options

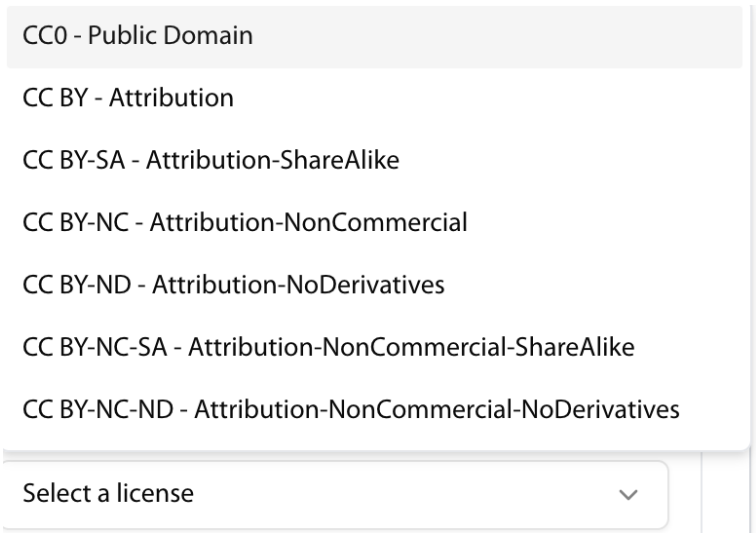

Figure 19: Creative commons license options

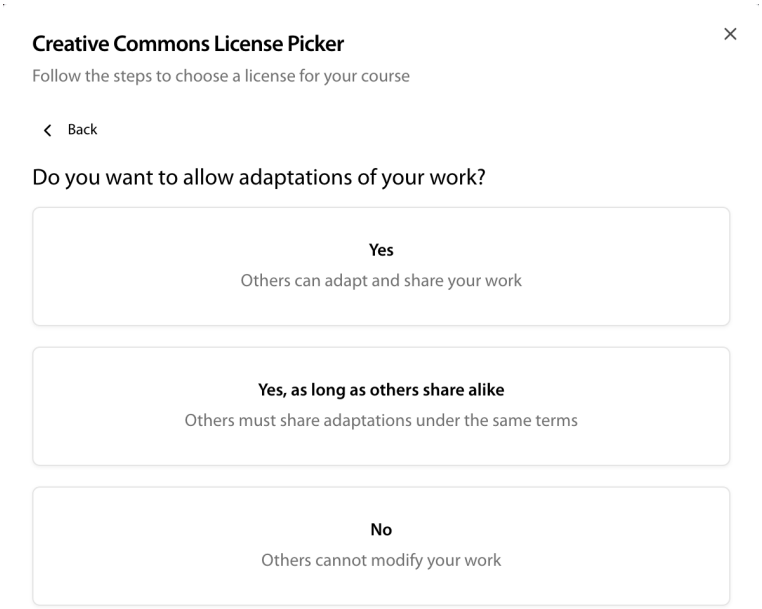

Figure 20: Creative Commons license picker — prompt

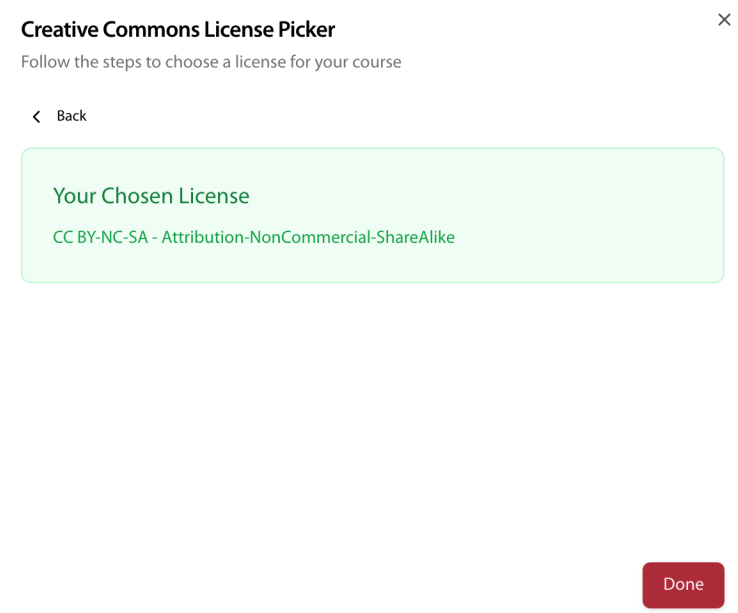

Figure 21: Creative Commons license picker — completion

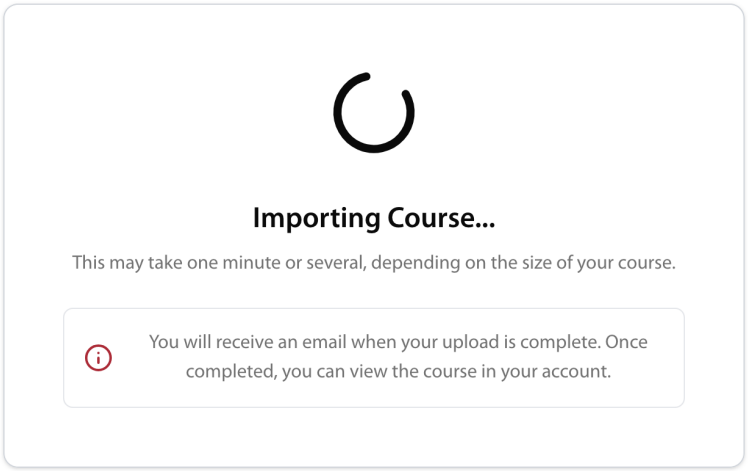

Figure 22: Course import in progress

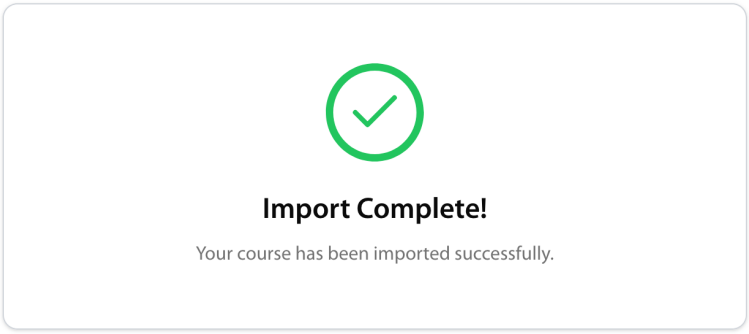

Figure 23: Course import completed

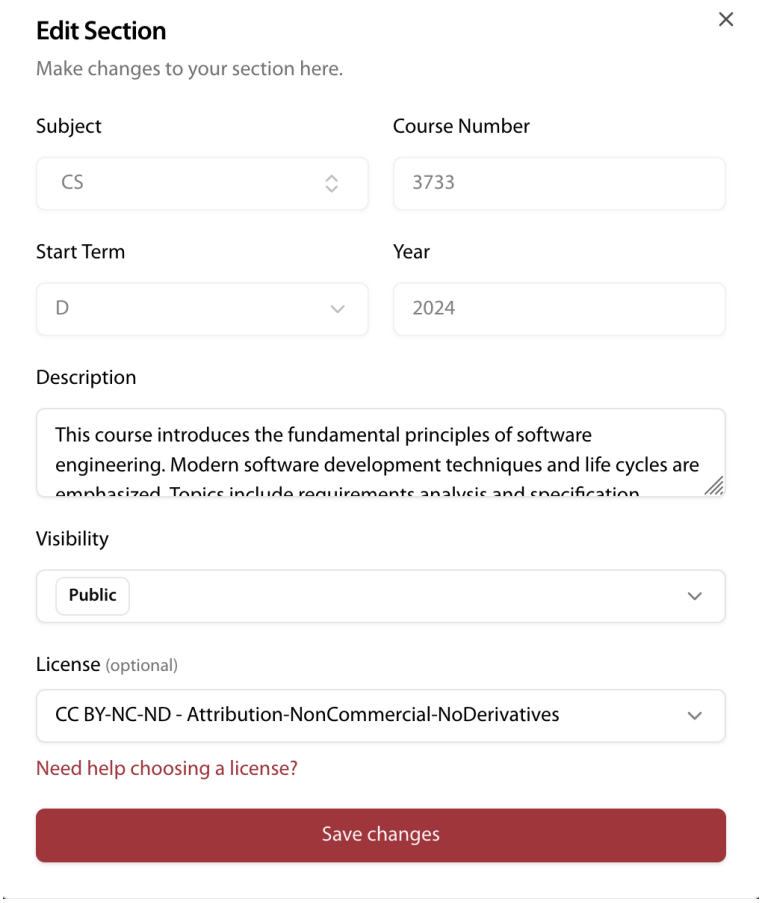

Figure 24: Section editing options

6 Findings and Analysis

6.1 Findings

This chapter is divided into a "Findings" section and an "Analysis" Section. The Findings section will focus solely on presenting data and explaining the meaning of it, while the analysis section will dive deeper into patterns shown within the data.

Respondents were given a list of opinion-based statements and asked to rate how much they agreed with the statement. A Likert scale was used to quantify participant opinions. This scale allows respondents to express their agreement or disagreement with each statement on a numerical scale, where:

- **-2:** Strongly Disagree
- **-1:** Slightly Disagree
- **0:** Neutral
- **1:** Slightly Agree
- **2:** Strongly Agree

6.1.1 Initial Student Survey Findings

A total of 51 students responded to the initial survey. The demographics of the survey respondents closely match the distribution of the larger student body.

Table 2: Distribution of student responses to the initial survey, by class year

Class year	Responses
2024	2
2025	13
2026	11
2027	16
2028	10

For Table 3, students were asked the following question: "For each of the following types of class information, having this information always accessible to me would be useful, even if I'm not in the class". The question was followed by a list of different course materials. Student responses are averaged by category.

For Table 4, students were then asked many standalone questions. The shorthand for the questions are listed in the table, and the full questions are provided in Appendix A. Student responses are averaged by category.

Table 3: Student agreement on the importance of access to course materials by class year

Category	Overall Avg	2024	2025	2026	2027	2028
Syllabi	1.57	0.00	1.50	2.00	2.00	2.00
Course schedule	1.26	1.50	1.27	1.10	1.21	1.40
Lecture slides	1.53	2.00	1.55	1.30	1.79	1.30
Homework/projects	1.40	2.00	1.27	1.30	1.79	1.00
Sample exams/quizzes	1.45	2.00	1.64	1.02	1.71	1.00
Pre-recorded videos	1.23	2.00	0.73	1.50	1.79	0.60

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

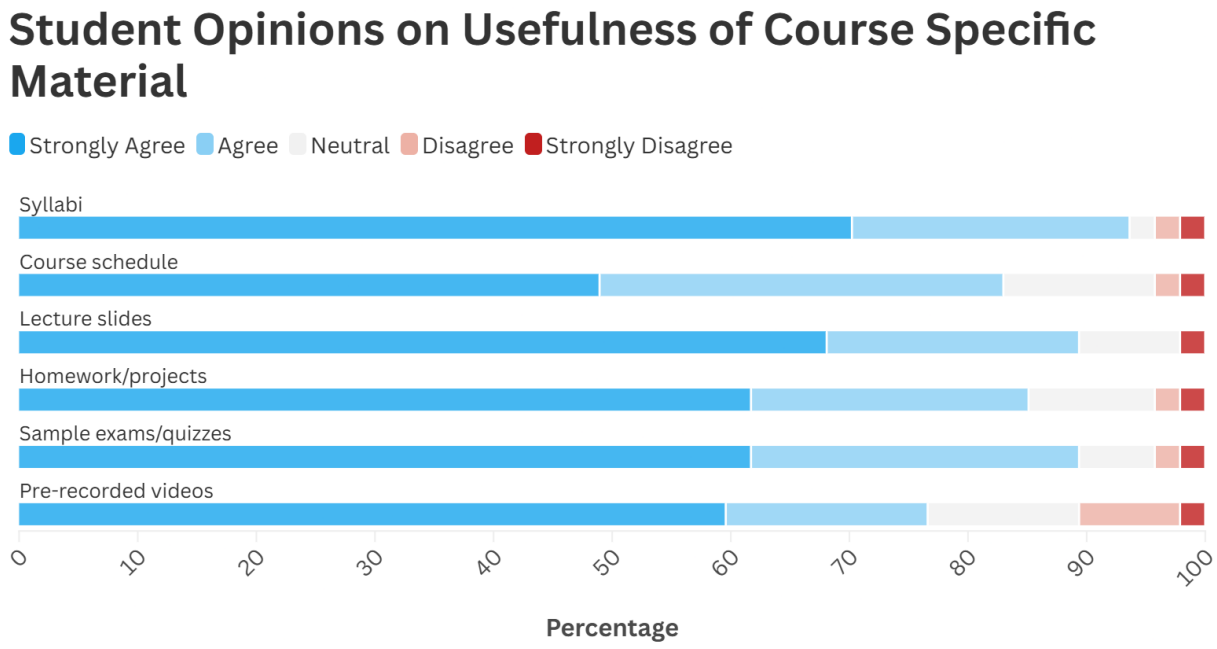

Figure 25: Student opinions on access to course materials

Table 4: Student responses to survey questions by class year

Category	**Overall Avg**	**2024**	**2025**	**2026**	**2027**	**2028**
Difficulty finding course information	1.13	2.00	0.50	2.00	2.00	2.00
Lack of course information hinders course decision-making	1.38	2.00	1.27	1.00	1.00	1.00
Interest in using this platform	1.79	2.00	1.82	1.7 9	1.89	1.99
Usefulness of having this information available	1.75	2.0	1.73	1.59	1.50	1.50

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

6.1.2 Initial Faculty Survey

The number of respondents for the initial faculty survey totaled 16 respondents: 7 from the Mathematical Sciences Department, 7 from the Humanities and Arts Department, 5 Professors, and 3 Assistant Professors of Teaching.

The data presented in Tables 5 and 6 summarizes category averages across various metrics, comparing overall scores with specific fields of study (Mathematical Science and Humanities and Arts) and faculty titles (Professor and Assistant Professor). The survey did not contain enough information on members of other departments/titles, so the data is omitted. Each metric provides insight into different aspects of academic performance, resource usage, or course-related expectations, with scores reflecting responses or outcomes across these categories. The data is organized to highlight similarities and differences between disciplines and titles, offering a comprehensive view of the dataset without any further interpretation or analysis.

Table 5: Faculty survey question averages by department and title

Metric	**Overall Avg**	**MATH**	**HUA**	**Prof.**	**Assist. Prof. of Teaching**
Student expectations of my course align with the content covered.	1.06	1.29	0.57	0.20	1.20
Students are prepared to take my course.	0.50	0.57	-0.14	0.40	0.60
Students drop my course because they are not prepared.	-0.69	-0.71	-0.71	-0.80	-1.20
WPI students - Syllabi	1.07	1.83	1.17	1.00	0.40
WPI students - Course schedule	1.00	1.83	1.17	0.75	0.40
WPI students - Lecture slides	0.07	0.17	0.00	0.75	-0.80
WPI students - Homework/projects	-0.13	0.17	-0.50	0.00	0.00
WPI students - Sample exams/quizzes	-0.40	0.33	-0.33	0.00	-1.00
WPI students - Pre-recorded videos	-0.13	0.5	0.16	0.25	-0.80

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

Table 6: Faculty survey question averages by department and title (cont.)

Metric	Overall Avg	MATH	HUA	Prof.	Assist. Prof. of Teaching
Public use - Syllabi	0.73	1.5	0.83	1.00	0.00
Public use - Course schedule	0.60	1.50	0.83	0.25	0.20
Public use - Lecture slides	-0.53	-0.17	-0.17	0.00	-1.00
Public use - Homework/projects	-0.47	0.00	-0.50	-0.50	-0.20
Public use - Sample exams/quizzes	-0.87	0.00	-0.50	-1.00	-1.00
Public use - Pre-recorded videos	-0.53	0.00	-0.17	0.00	-0.80
I would be interested in using this platform to publish information about my courses.	0.80	1.50	1.33	1.50	-0.40
I believe students will be better prepared for my classes with this information.	0.27	1.00	0.83	0.25	-0.40

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

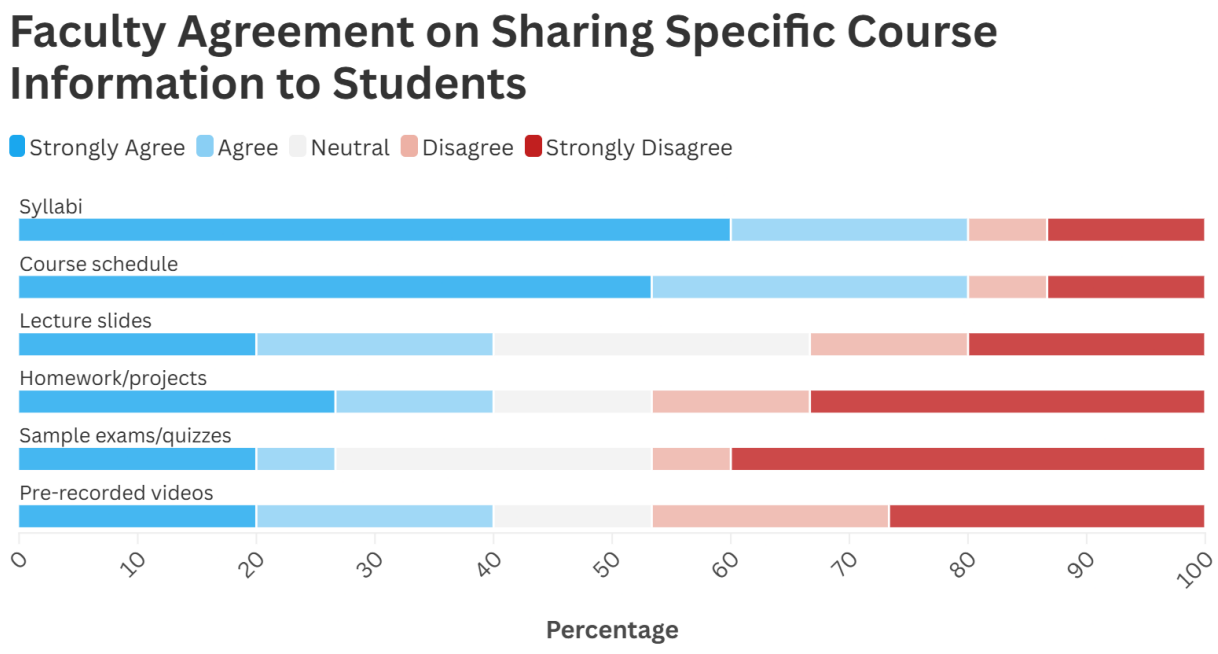

Figure 26: Faculty agreement on sharing course information to students

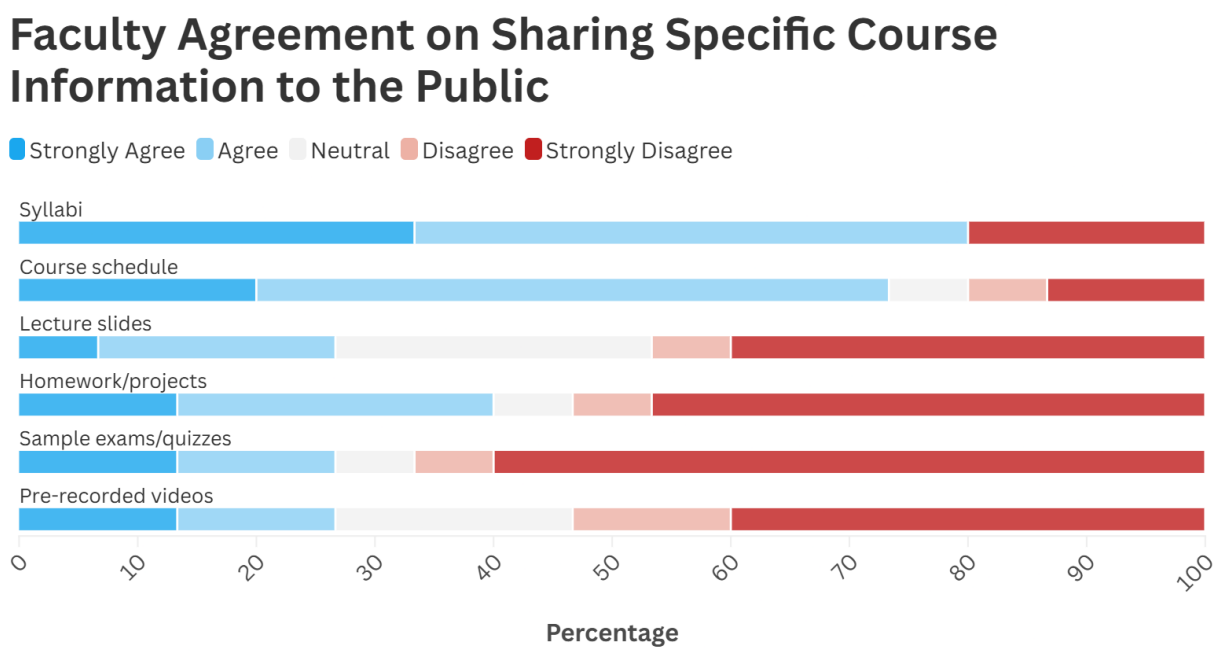

Figure 27: Faculty agreement on sharing course information publicly.

6.1.3 Post-launch Student Survey Findings

A total of ten students responded to the post-implementation survey, with six from the class of 2027, three from the class of 2026, and one from the class of 2025. Due to the relatively small sample size, the resulting data may not be representative of the opinions of the entire WPI student body.

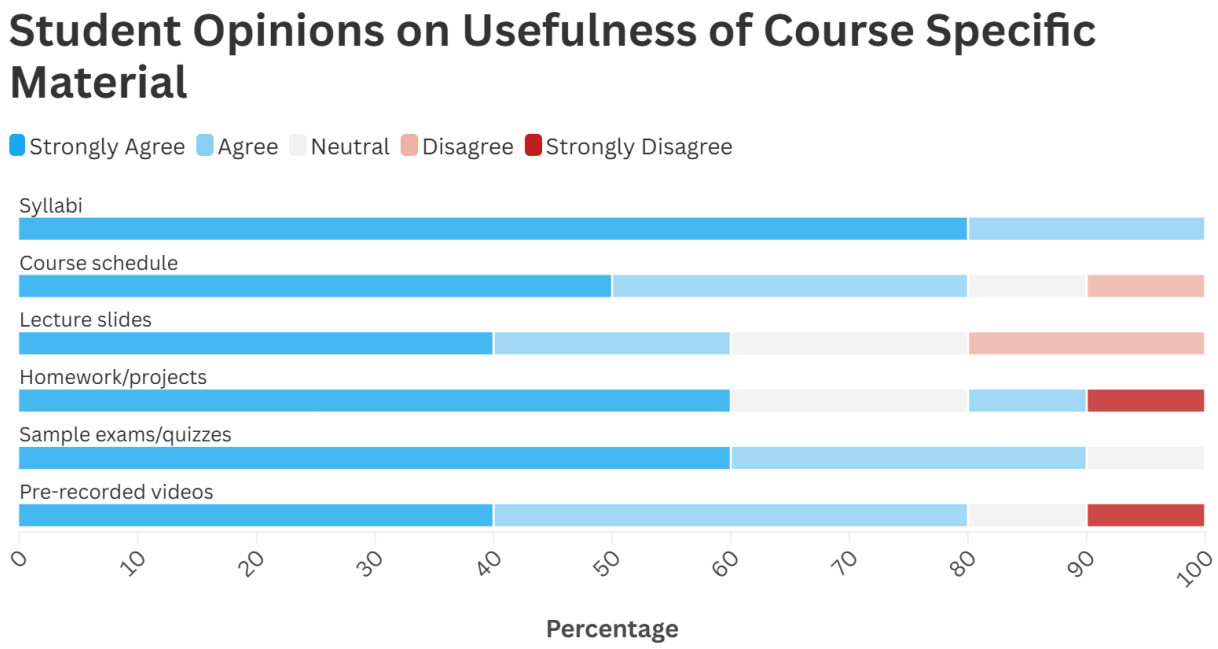

Figure 28: Student opinions on access to course materials after platform launch

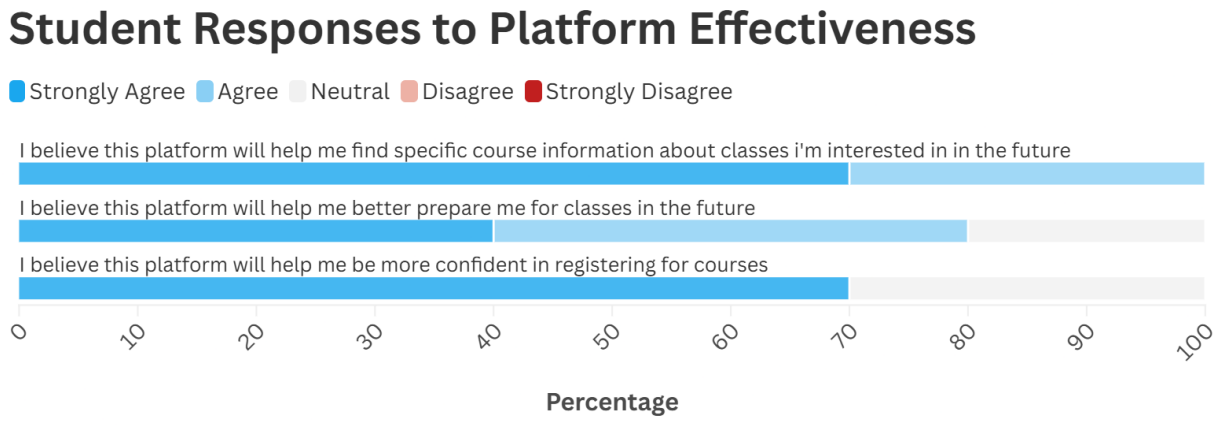

Figure 29: Student opinions on platform effectiveness

6.1.4 Post-launch Faculty Survey Findings

A total of six faculty members responded to the post-implementation survey. Due to the relatively small sample size, the resulting data may not be representative of the opinions of the entire WPI faculty.

Table 7: Faculty willingness and perceptions of platform use

Statement	**Rating**
I'm willing to host my course on this platform.	1.80
I'm willing to update my course on this platform.	1.40
The platform is easy to use.	1.80
The platform works well.	1.60
I would encourage other faculty to use the platform.	1.60

(Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree)

Table 8: Faculty agreement on sharing course information to students before and after platform launch

	Syllabi	Course Schedule	Lecture Slides	Hw/Proj.	Sample Exams	Videos
Pre-implementation	1.07	1.0	0.07	-0.13	-0.4	-0.13
Post-implementation	1.67	1.33	0.83	0.5	0	1.0

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

Table 9: Faculty agreement on sharing course information to the public before and after platform launch

	Syllabi	Course Schedule	Lecture Slides	Hw/Proj.	Sample Exams	Videos
Pre-implementation	-0.07	0.0	-0.93	-1.13	-1.4	-0.93
Post-implementation	1.07	0.67	-0.27	-0.4	-0.13	0.67

Scale: -2 = Strongly Disagree, 0 = Neutral, 2 = Strongly Agree

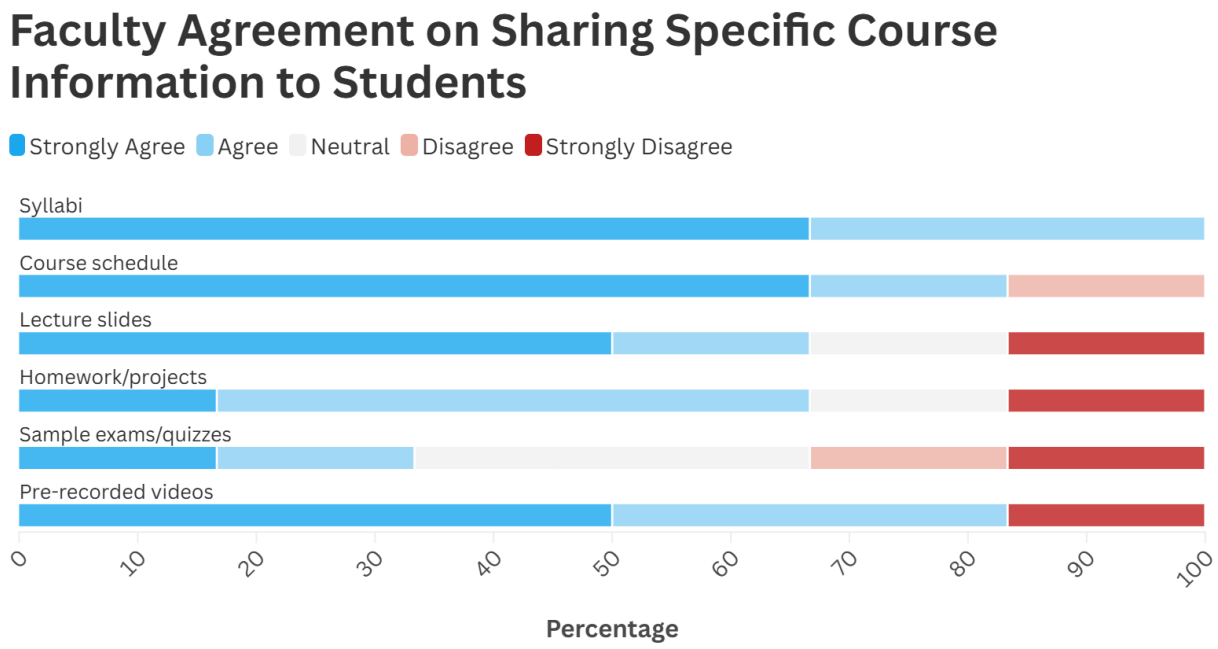

Figure 30: Faculty agreement on sharing course information to students after platform launch

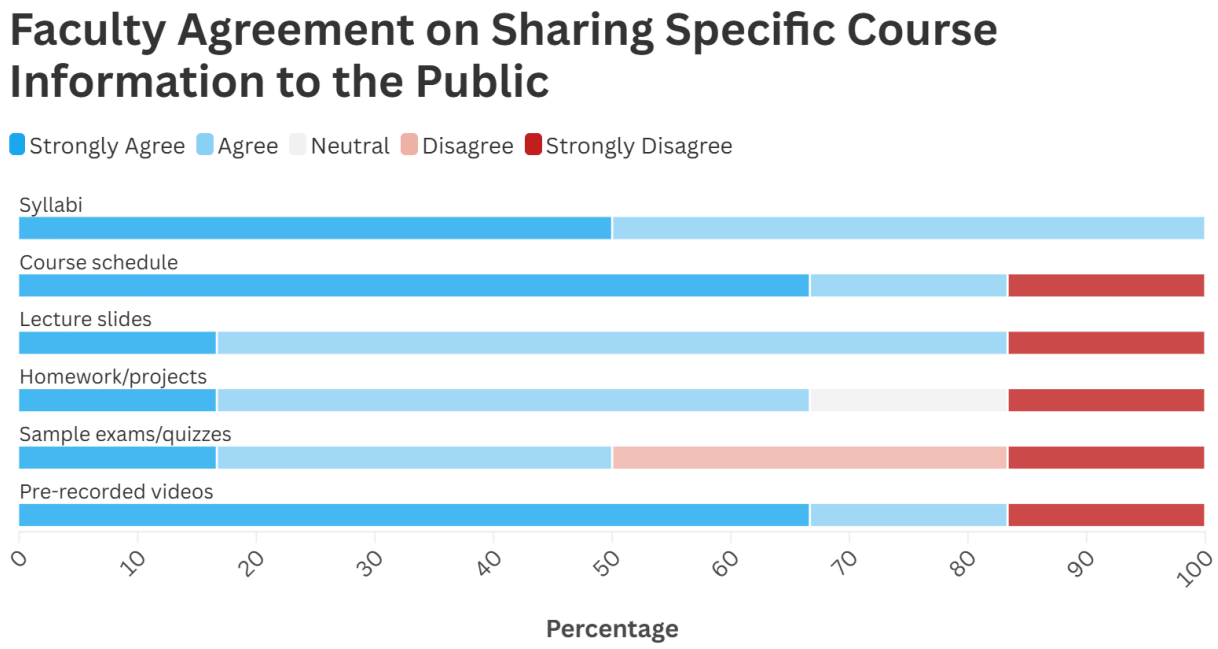

Figure 31: Faculty agreement on sharing course information to the public after platform launch

6.2 Analysis

The initial student survey indicates that most students strongly support having access to course information, with every information type having a rating of 1.20 or higher. An outlier does exist for the class of 2024, with their average rating for syllabi being 0.00, but this is most likely due to a low number of respondents for the category. Many students also showed concerns about difficulty finding course information, with an average of 1.13 across all years. There was even larger concern about how the lack of information affected their ability to decide which courses to take, with an average of 1.38. At almost a 1.80 average, students were very supportive of the platform and would be willing to utilize it.

While students found it difficult to access course information and felt that this hindered their ability to make informed decisions, many faculty members believed that students' expectations upon entering a course aligned with the material being taught. However, many faculty were also unsure whether the majority of their students were adequately prepared for their classes.

Students placed a high value on access to syllabi (1.57), lecture slides (1.53), and sample exams (1.45). Faculty generally supported making syllabi (1.07) and course schedules (1.00) available to WPI students but were less inclined to share lecture slides (0.07) and exams (-0.40). Faculty skepticism about student preparation (0.50) aligns with student concerns that restricted access to course materials hinders their decision-making process (1.38).

Faculty members also showed some reservations about sharing information with both WPI students and the public, but they were more inclined to share information with WPI students. Most supported sharing syllabi and course schedules with everyone, but preferred to limit access to lecture slides, homework, sample exams, and prerecorded videos to students only. A handful of faculty members were open to publishing all course materials to the public.

Among the two faculty groups with sufficient respondents for analysis, Mathematics faculty showed significantly greater interest than Humanities faculty in using the website and publishing their course materials, averaging 0.5 points higher in every category except for lecture slides.

Although the post-implementation surveys included only a small number of students and faculty, making them weaker sources of evidence, they still indicate a need for this platform. Many surveyed faculty members approved of the platform and expressed a willingness to continue using it in the future. The observed increase in faculty willingness to share course materials on our platform (Tables 8 and 9) may be attributed to the platform's granular control over content visibility and the diverse range of licensing options

available to faculty, allowing them to tailor access and usage rights to their preferences. Student support for the platform was very strong. They agreed that the platform would be instrumental towards finding specific course information (1.7), making informed decisions during course registration (1.4), and preparing for future classes (1.2).

The post-implementation faculty survey contained a section for faculty to leave comments on the platform. Multiple faculty members asked for the ability to modify and delete files after importing a course. Others requested guidelines detailing what content could be published without encountering legal trouble, and the presence of an administrative role to keep content up to university standards. Addressing these concerns could lead to faster adoption of our platform by students, faculty, and the institution.

6.2.1 Future Work

Addressing these faculty concerns is a top priority for the platform. Moving forward, we plan to implement several key improvements based on faculty feedback to enhance usability and increase adoption. We will introduce functionality that allows faculty to modify and delete files after importing a course. This feature will provide greater flexibility and control over course materials.

Code improvements are another priority, as refining and optimizing the existing codebase will ensure a more maintainable system in the future. This includes addressing excess or redundant code, improving file representation on the front end for better user experience, and streamlining backend operations to enhance overall performance.

Another key area of development is the creation of an administrative role to manage anomalous data and system inconsistencies. This role would be responsible for handling issues such as account deletion, cases where faculty members do not obtain the correct instructor privileges, and other administrative anomalies. Implementing this role would enhance the reliability and accuracy of course information displayed on the platform.

Furthermore, integrating analytical tools to assess platform effectiveness is essential. By analyzing usage patterns and student engagement metrics, it will be possible to determine how well the site meets its intended objectives. These insights can inform iterative improvements to user flow and overall system design, ensuring that the platform continues to meet the needs of both students and faculty based on real-world feedback and data-driven analysis.

Many students and faculty groups were not covered by our survey, especially after the platform launched. Getting information on their opinions on OER and our platform should be a top priority, as it

will help solidify many findings made in this paper.

7 Conclusion

After several months of dedicated research and software development, we have successfully created an open learning platform for WPI. This platform not only supports the principles of Open Educational Resources (OER) but also integrates seamlessly with Canvas, WPI's Learning Management System (LMS). By leveraging cutting-edge technologies and tightly coupling the platform with Canvas, we have created an efficient and user-friendly tool that simplifies the process for faculty to share their course materials. This technological achievement ensures a smooth transition for faculty, reducing the barriers to participation and enhancing the platform's potential impact.

Our work represents a significant advancement in promoting OER at WPI, giving the university a powerful resource to showcase its distinctive project-based learning approach and extend its influence globally. The seamless integration with Canvas is a technical achievement in its own — a first for OER. It allows faculty to effortlessly import and customize their courses, addressing one of the most significant challenges in OER adoption: ease of use. These innovations demonstrate the platform's potential to position WPI as a leader in accessible and innovative education.

However, the platform's long-term success requires more than just technological innovation. For this resource to achieve its full potential, WPI must actively prioritize and catalyze its adoption. Faculty engagement, institutional support, and widespread awareness of OER's benefits are essential for this initiative to thrive. By addressing the challenges we have identified — such as offering meaningful incentives to faculty, providing clear guidelines on licensing, and fostering a culture of openness — WPI can ensure the platform becomes a cornerstone of its educational mission.

The future of this platform is bright, but it requires a shared commitment from faculty, administrators, and students. Our integration with Canvas and focus on user-centric design have laid a strong foundation for success. If WPI builds on this work and embraces the opportunities presented by OER, it has the chance to lead the way in open education, making its cutting-edge teaching practices accessible to learners worldwide and reinforcing its mission to foster global impact through education.

To reflect on the progress made and chart a path forward, we identified the following key conclusions from our work:

1. **Faculty Engagement is Crucial**

   Faculty support is essential for the platform's success. While many faculty members expressed willingness to share course materials, concerns about intellectual property, compensation, and time constraints

remain significant barriers.

2. **Ease of Use Drives Adoption**

   Simplifying the process for faculty, through a simple and intuitive user experience, has proven to be an effective strategy to encourage participation.

3. **OER Aligns with WPI's Mission**

   Sharing WPI's distinctive project-based learning approach with a global audience directly supports the university's mission to foster global impact. By making its innovative, hands-on teaching methods accessible worldwide, WPI can amplify its influence and showcase its unique educational model as a leader in transformative education.

To promote the adoption and long-term sustainability of this platform in supporting Open Educational Resources (OER), we recommend the university adopt the following initiatives:

1. **Establish OER Guidelines**

   There are no institutional guidelines for creating, curating, and maintaining OER materials at WPI. Faculty may be uncertain about which materials are eligible to be shared as OER. Establishing an institutional OER policy will help ensure the quality, accessibility, and long-term viability of these resources within the university.

2. **Promote the Benefits of OER to Faculty**

   Highlight the advantages of engaging with OER, such as increased visibility and impact of their work, opportunities for collaboration, and the ability to reach a global audience. Emphasize how open-sourcing content aligns with the university's values while supporting students and advancing WPI's mission.

3. **Expand Surveys to Broader Student and Faculty Groups**

   Expanding the scope of surveys to include a broader range of students and faculty will provide valuable insights into their perspectives on OER. Gathering more feedback from students about the importance of accessible materials will help effectively communicate the demand for OER to faculty, demonstrating its potential to enhance both teaching and learning experiences.

These conclusions and recommendations provide a roadmap for the platform's continued growth and success. By addressing faculty concerns, building awareness, and creating a supportive environment, WPI can fully leverage the potential of this platform to lead the way in open education. With the right

investments and focus, this initiative can serve as a model for other institutions and position WPI as a global leader in fostering accessible, innovative education.

Appendices

A Appendix A: Survey Materials

A.1 Student Survey: Pre-Implementation

1. What is your major?
2. What is your class year?
3. For each of the following types of class information, having this information always accessible to me would be useful, even if I'm not in the class.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos
4. How strongly do you agree or disagree with the following statements?
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) I find it difficult to find specific course information about classes I'm interested in.
   (ii) Not having access to this information hinders my ability to make informed decisions when registering for courses.
   (iii) I would be interested in using a platform that provides some or all of the previously mentioned information about courses at WPI.
   (iv) I would find this information useful.

A.2 Faculty Survey: Pre-Implementation

1. What is your title?
2. What department/program are you a part of?
3. Do you have a course website?
   (Yes/No)
4. If yes, does the information on the course website accurately reflect what is currently being taught in the course?
   (Yes/No)
5. How strongly do you agree or disagree with the following statements?
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Student expectations of my course align with the content covered.
   (ii) Students are prepared to take my course.
   (iii) Students drop my course because they are not prepared.
6. For each of the following types of class information, I would be willing to post this information for use by WPI students.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos
7. For each of the following types of class information, I would be willing to post this information for use by the public.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos
8. I would be interested in using this platform to publish information about my courses
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
9. I believe students will be better prepared for my classes with this information.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)

A.3 Student Survey: Post-Implementation

1. What is your major?
2. What is your class year
3. How strongly do you agree or disagree with the following statements?
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) I can find specific course information about classes I'm interested in.
   (ii) I believe using this platform will help me better prepare for courses.
   (iii) I will feel more confident when registering for courses.
4. For each of the following types of class information, having this information always accessible to me would be useful, even if I'm not in the class.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos

A.4 Faculty Survey: Post-Implementation

1. What is your title?
2. What department/program are you a part of?
3. How strongly do you agree or disagree with the following statements?
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) I'm willing to host my course(s) on this platform.
   (ii) I'm willing to update my course(s) regularly through this platform.
   (iii) The platform is easy-to-use.
   (iv) The platform works well.
   (v) I would encourage other faculty to use the platform.
4. For each of the following types of class information, I would be willing to post this information for use by WPI students.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos
5. For each of the following types of class information, I would be willing to post this information for public use, with a license of my choosing.
   (Scale from 1-5; 1 = Strongly Disagree, 5 = Strongly Agree)
   (i) Syllabi
   (ii) Course schedule
   (iii) Lecture slides
   (iv) Homework/projects
   (v) Sample exams/quizzes
   (vi) Pre-recorded videos
6. Are there any comments, concerns, or feature requests you have?

B Appendix B: Version Numbers

B.1 Workflow

- Yarn : 4.5.1
- NPM: 1.2.0
- ESLint: 8
- TypeScript: 5.6.3
- Turbo: 2.2.3
- Nodemon: 3.1.7

B.2 Back End

- Express.js: 5.0.0
- Prisma: 5.21.1

B.3 Front End

- React: 18.3.1
- Next.js: 15.0.2
- Tailwind CSS: 3.4.1
- Auth.js: 5.0.0-beta.25
- Axios: 1.7.7

C Appendix C: Raw Data

C.1 Initial Student Survey

Table 10: Demographics of surveyed students

Class Year	CS	ECE	Math	Other	Total
2024	1	1	0	0	2
2025	9	2	0	2	13
2026	8	0	0	3	11
2027	8	0	2	6	16
2028	5	0	1	4	10
Total	31	3	3	15	52

Table 11: Student opinions on whether course material should always be accessible

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	1	1	1	11	33
Course schedule	1	1	6	16	23
Lecture slides	1	0	4	10	32
Homework/projects	1	1	5	11	29
Sample exams/quizzes	1	1	3	13	29
Pre-recorded videos	1	4	6	8	28

Table 12: Student opinions on course information accessibility and open learning platform

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Difficulty finding course information	1	2	5	21	18
Lack of course information hinders course decision-making	1	0	3	19	24
Interest in using this platform	1	0	0	6	40
Usefulness of having this information available	1	0	1	6	39

C.2 Initial Faculty Survey

Table 13: Titles of surveyed faculty members

Title	Count
Professor	6
Assistant Professor	1
Professor of Teaching	1
Assistant Professor of Teaching	3
Assistant Teaching Professor	3
Instructor	1
Other	3

Table 14: Departments of surveyed faculty members

Department	Count
Computer Science	2
Fire Protection Engineering	1
Humanities & Arts	7
Mathematical Sciences	7
Physical Education	1

Table 15: Number of faculty with and without course websites

Yes	No
11	7

Table 16: Number of faculty whose course websites are up to date

Yes	No
9	2

This question was only shown to faculty who responded "yes" to the previous question

Table 17: Faculty opinions on student preparedness

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Student expectations of my course align with the content covered.	1	0	3	5	9
Students are prepared to take my course	1	2	4	6	5
Students drop my course because they are not prepared	5	4	7	1	1

Table 18: Faculty willingness to share course materials with students

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	2	1	0	3	10
Course schedule	2	1	0	4	9
Lecture slides	4	2	4	3	3
Homework/projects	6	2	2	2	4
Sample exams/quizzes	7	1	4	1	3
Pre-recorded videos	5	3	2	3	3

Table 19: Faculty willingness to share course materials with the public

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	3	0	0	7	6
Course schedule	2	1	1	8	4
Lecture slides	7	1	4	3	1
Homework/projects	8	1	1	4	2
Sample exams/quizzes	10	1	1	2	2
Pre-recorded videos	7	2	3	2	2

Table 20: Faculty interest in open learning platform

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
I would be interested in using this platform to publish information about my courses	2	0	2	6	6
I believe students will be better prepared for my classes with this information	2	1	4	7	2

C.3 Post-Implementation Student Survey

Table 21: Demographics of surveyed students

Class Year	Count
2025	1
2026	3
2027	6
Total	10

Table 22: Student evaluation of platform

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
I can find specific course information about classes I'm interested in	0	0	0	3	7
I believe using this platform will help me better prepare for courses	0	0	2	4	4
I will feel more confident when registering for courses	0	0	3	0	7

Table 23: Student opinions on whether course material should always be accessible

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	0	0	0	2	8
Course schedule	0	1	1	3	5
Lecture slides	0	2	2	2	4
Homework/projects	1	0	2	1	6
Sample exams/quizzes	0	0	1	3	6
Pre-recorded videos	1	0	1	4	4

C.4 Post-Implementation Faculty Survey

Table 24: Titles of surveyed faculty members

Title	Count
Professor	1
Assistant Professor	1
Assistant Professor of Teaching	1
Assistant Teaching Professor	1
Instructor	2

Table 25: Departments of surveyed faculty members

Department	Count
Computer Science	3
Electrical & Computer Engineering	1
Mathematical Sciences	1
Physical Education	1

Table 26: Faculty opinions of platform

Statement	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
I'm willing to host my course(s) on this platform	0	0	0	1	5
I'm willing to update my course(s) regularly through this platform	0	0	1	3	2
The platform is easy-to-use	0	0	0	1	5
The platform works well	0	0	0	3	3
I would encourage other faculty to use the platform	0	0	1	0	5

Table 27: Faculty willingness to share course materials with students

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	0	0	0	2	4
Course schedule	0	1	0	1	4
Lecture slides	1	0	1	1	3
Homework/projects	1	0	1	3	1
Sample exams/quizzes	1	1	2	1	1
Pre-recorded videos	1	0	0	2	3

Table 28: Faculty willingness to share course materials with the public

Type	Strongly Disagree	Slightly Disagree	Neutral	Slightly Agree	Strongly Agree
Syllabi	0	0	0	3	3
Course schedule	1	0	0	1	4
Lecture slides	1	0	0	4	1
Homework/projects	1	0	1	3	1
Sample exams/quizzes	1	2	0	2	1
Pre-recorded videos	1	0	0	1	4

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