DOI https://doi.org/10.30525/2592-8813-2026-spec-4

INTEGRATING FRONT-END DEVELOPMENT INTO PROFESSIONAL TRAINING FOR DESIGNERS: A COMPARATIVE ANALYSIS OF EDUCATIONAL PROGRAMMES

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Abstract. This article examines the specific features of integrating front-end web development into the professional training of future designers at higher education institutions in Ukraine and abroad. The relevance of this research stems from the need to produce competitive professionals capable of working in an environment characterised by digital transformation and interdisciplinary collaboration. The research methodology is based on an analysis of educational programmes, syllabuses and teaching components of the 022 «Design» specialisation, as well as a comparison of Ukrainian and international experience in training designers for front-end development. The key components of such training have been identified: HTML, CSS, JavaScript, UI/UX design, responsive layout, prototyping and team collaboration. It has been established that foreign programmes combine design and technical training in a more systematic manner, focusing on practical activities and work in interdisciplinary teams. The feasibility of introducing the parallel study of the disciplines «UI/UX design» and «Front-end design» in the professional training of future designers has been substantiated.

Key words: Front-end development; UI/UX design; design education; web design; interdisciplinary teams; digital competencies.

Introduction. The current development of the digital society, the rapid spread of web technologies and the transformation of the labour market are driving the need to develop new professional competencies for future designers. One of the key trends in contemporary design education is the integration of front-end web development skills into the professional training of design specialists. In today`s environment, designers are no longer limited to creating the visual concept of a product; increasingly, they are involved in designing the digital environment, developing interfaces and collaborating with web development teams. This requires a basic knowledge of HTML, CSS, JavaScript, the principles of UI/UX design, and an understanding of the processes involved in the implementation of a digital product (Cross, 2006).

At the state level, the relevance of developing digital competences is confirmed by Ukraine`s regulatory and legal documents, in particular the Law of Ukraine «On Higher Education», the Concept for the Development of Digital Competences until 2025, and the Strategy for the Development of Higher Education in Ukraine for 2022–2032 (Verkhovna Rada of Ukraine, 2014; Ministry of Digital Transformation of Ukraine, 2021). These documents emphasise the need to modernise vocational education in line with the needs of the digital economy, to integrate innovative technologies into the learning process, and to develop competitive professionals capable of working in a global digital environment.

The issue takes on particular significance in the field of design education, where the modern labour market requires specialists not only to possess artistic and design competencies, but also the ability to work in interdisciplinary teams and interact with programmers, business analysts and product managers. According to N. Cross, design activity is based on a specific type of thinking – «designerly ways of knowing» – which combines synthesis, modelling and the practical construction of solutions (Cross, 2006). K. Dorst views the design process as the co-evolution of the problem space and the design solution, which is particularly relevant to digital design and the development of web interfaces (Dorst, 2001).

The development of digital literacy and the use of information technology in vocational education have been studied by Ukrainian researchers V. Bykov, N. Morze, O. Spirin, N. Aristova, I. Kostikova, T. Yarmolchuk and others. The researchers emphasise that the digitalisation of society is changing the requirements for the professional training of future specialists, and proficiency in digital technologies is becoming an essential component of modern professional competence (Bykov, 2019; Morze & Spirin, 2020; Yarmolchuk et al., 2021).

The specific issues of web design and web development in the professional training of specialists are addressed in the works of D. Borodaiev, who considers a website as an object of graphic design and identifies its communicative and visual features (Borodaiev, 2012). The relevance of the web designer profession and the requirements for a modern specialist are analysed by R. Opanasenko and O. Orel, who emphasise the integration of design and technological competencies in professional practice (Opanasenko & Orel, 2020). The issue of using recommendation systems for studying web technologies has been investigated by S. Popereshniak, M. Kutsenko and A. Antonenko, who emphasise the importance of adaptive educational approaches in web development training (Popereshniak et al., 2021).

Foreign researchers have also made a significant contribution to research into web development teaching methods. For instance, K. Tzafilkou, T. Protogeros and A. Chouliara demonstrate the effectiveness of experimental web development teaching based on real-world examples and practice-oriented tasks, which helps to increase student motivation and develop professional skills (Tzafilkou et al., 2022). Research by G. Zhou, J. Li and J. L. Zhong demonstrates the effectiveness of problem decomposition and multiple-solution methods for developing critical thinking in the process of studying web development (Zhou et al., 2021). The researchers also pay particular attention to the psychological and pedagogical aspects of student training. In particular, Z. Liang analyses students» motivation, confidence and attitudes towards studying web development (Liang, 2020), whilst T. P. Lau and I. King investigate the readability of digital text materials in a web-based educational environment (Lau & King, 2009).

Issues of interdisciplinary collaboration in design education are explored in the works of Meredith Davis and S. Melamed, who emphasise the need to develop future designers` skills in teamwork, communication and the integration of design solutions into technological processes (Davis, 2017; Melamed, 2019). In today`s context, front-end development is becoming a vital component of a designer`s professional practice, as it bridges the gap between interface design and its functional implementation.

Of particular relevance to this study are the works of H. Chemerys, which examine the training of future computer science undergraduates in the development of user interfaces (Osadcha & Chemerys,

2018; Chemerys et al., 2019; Chemerys, 2020: Chemerys et al., 2021). These studies are methodologically consistent with the present work, as they justify the need to integrate design, technological and UX competencies into the professional training of specialists in the digital sector; however, the author`s main focus is specifically on the training of computer science undergraduates, rather than designers.

Despite a significant body of research, the issue of integrating front-end web development into the professional training of future designers at higher education institutions in Ukraine remains under-researched. The content of educational programmes, the specifics of developing relevant competencies, and the potential for utilising international experience in domestic design education require further analysis. It is precisely this that determines the relevance of the study and defines its objective: to analyse Ukrainian and international experience in the professional training of future designers for front-end web development.

Methods. The study employed a range of general and specialised research methods aimed at examining the characteristics of the professional training of future designers in front-end web development at higher education institutions in Ukraine and abroad. The main research method was a comparative analysis of educational programmes and syllabuses for specialisation 022 «Design» (B2 «Design») at Ukrainian and foreign higher education institutions. The analysis made it possible to identify the presence within the structure of professional training of components related to front-end development, namely: HTML, CSS, JavaScript, UI/UX design, web technologies, responsive design and prototyping. Particular attention was paid to the content of educational components, the formulated learning outcomes, the practical focus of courses, and the development of digital competences among future designers. The study employed a content analysis method to systematise the content of syllabuses and curricula at Ukrainian higher education institutions: the Lviv National Academy of Arts, Zaporizhzhia National University, Cherkasy State Business College, Western Ukrainian National University and others. This made it possible to identify the level of integration of front-end technologies into the professional training of designers and to determine the main trends in the development of design education.

To study international experience, a method of generalising and systematising information regarding the educational programmes of Parsons School of Design, University of the Arts London, RMIT University, Drexel University, CODE University of Applied Sciences and other institutions that train specialists in the field of web and UX/UI design was employed. The analysis was conducted according to the following criteria: course content, use of front-end technologies, interdisciplinary interaction, practical training, and project-based learning.

Discussion. Current international practices in the professional training of designers show a trend towards integrating design, digital technologies and front-end development into a single interdisciplinary educational system. Leading higher education institutions in the US, the UK, Germany, Australia, the Netherlands and other countries focus their training of designers not only on developing artistic and design skills, but also on fostering technological thinking, teamwork skills and an understanding of the processes involved in creating a digital product.

One of the distinctive features of overseas programmes is the combination of UI/UX design with the study of front-end technologies. For example, Parsons School of Design (The New School, USA) offers Communication Design / Web & App Design programmes, within which students study the creation of digital interfaces, responsive design, prototyping and front-end development. The curriculum focuses on developing practical skills in creating websites and digital products using HTML and CSS, as well as developing their own professional portfolios. A key component is the practical nature of the training, where students undertake individual projects that closely resemble real-world professional tasks.

A similar approach is implemented at the University of the Arts London (UAL, UK), where the Interaction Design Arts programme covers UX/UI design, web interactivity, front-end development,

animation, HTML/CSS and JavaScript. A distinctive feature of the programme is the use of modern digital design tools, notably Figma and Adobe XD, as well as a focus on creating interactive digital environments. The educational process is based on lectures, seminars, workshops and group discussions, whilst assessment is carried out through practical projects, presentations and portfolios of work. This approach helps students develop not only technical skills but also critical thinking and the ability to engage in professional reflection.

The Master`s programme in UX Design at UAL deserves special attention, as it involves active collaboration with the UX industry and leading studios such as ustwo, Made by Many and AKQA. The curriculum focuses on studio practice, teamwork and tackling real-world project challenges. Future designers acquire skills in user research, prototyping, evaluating digital products and developing interactive solutions. This training model demonstrates the close link between education and the professional environment.

The Australian experience is represented by RMIT University`s Web Design and Development programme, which combines creative web design with front-end technologies. A distinctive feature of the programme is its modular approach to updating the curriculum in line with changes in the digital industry. The educational process is aimed at developing the ability to adapt to new technologies, rethink digital media and work with various types of digital content. The programme covers web design, mobile app design, motion graphics, sound design, interactive environments and digital production.

In the US, one example of the integration of front-end technologies into design education is Drexel University. The web design programme focuses on developing skills in HTML, CSS, JavaScript and UX/UI design. At the same time, significant attention is paid to interdisciplinary collaboration and preparation for working with programmers, graphic designers and content managers. The educational process includes creating wireframe mock-ups, responsive design, working with graphic editors and practical programming of web applications. In this way, the designer is viewed not merely as a visual specialist, but as a participant in the comprehensive process of creating a digital product.

A key trend in contemporary design education abroad is the growing emphasis on interdisciplinarity. At Vrije Universiteit Amsterdam (Netherlands), students on the Master`s programme in Web Technologies and Design study web programming, UX and interface design, combining the technical and creative aspects of the profession. A similar approach is implemented at École de design Nantes Atlantique (France), which houses the Human Machine Design laboratory, where students work with interface prototypes, web forms, and issues of usability and adaptability.

Of particular interest is the Digital Design & Innovation programme at CODE University of Applied Sciences (Germany), which combines design, programming and innovative digital technologies. The curriculum includes modules on interface design, animation, composition, UX research, brand design and the use of artificial intelligence in creative processes. Significant attention is paid to working with artificial intelligence tools, critically understanding digital technologies, and developing a human-centred approach to design. As part of the programme, students learn to create digital solutions that not only meet technological requirements but also take into account ethical, social and communicative aspects.

International experience also demonstrates a high level of integration between front-end training and UX/UI design at leading universities worldwide, including the Massachusetts Institute of Technology (MIT), Carnegie Mellon University, the University of Toronto, the University of Helsinki, the University of Michigan and others. The educational programmes at these institutions cover HTML, CSS, JavaScript, React, Figma, Adobe XD, Sketch, as well as UX research methods and the creation of interactive web applications. In many cases, training is delivered through project-based learning, team-based studios and real-world case studies from the digital industry.

Systematised data on the experience of integrating front-end web development into the educational practice of future designers is presented in Table 1.

Table 1

Analysis of foreign experience in training designers for front-end development

Higher education institution	Country	Specialization / direction	Front-end technologies	UI/UX and digital tools	Features of preparation
Parsons School of Design	USA	Communication Design / Web & App Design	HTML, CSS	Figma, Adobe XD, digital prototyping	Responsive web design, digital product creation, personal portfolio
University of the Arts London (UAL)	Great Britain	Interaction Design Arts	HTML, CSS, JavaScript	Figma, Adobe XD	UX/UI design, web interactivity, animation, interactive environments
RMIT University	Australia	Web Design and Development	HTML, CSS, JavaScript	UX/UI, digital media tools	Modular system for updating course content, adapting to digital changes
Drexel University	USA	Web Design	HTML, CSS, JavaScript	Adobe Photoshop, UX/UI tools	Responsive design, wireframes, web applications
Vrije Universiteit Amsterdam	Netherlands	Web Technologies and Design	Web programming	UX/UI design	Combining web programming and interface design
Nantes Atlantic School of Design	France	Interaction Design	Web forms, adaptive systems	Human Machine Design Lab	Usability, adaptability, interface prototyping
CODE University of Applied Sciences	Germany	Digital Design & Innovation	Front-end projects, web technologies	Figma, AI tools, interface systems	Integrating AI into design, a human-centric approach
Carnegie Mellon University	USA	Front-End Engineering and UX Design	HTML, CSS, JavaScript, React	Figma, Adobe XD, Sketch	UX/UI design, front-end engineering
Massachusetts Institute of Technology (MIT)	USA	Front-end & UX Design	HTML, CSS, JavaScript, React	UX research tools	Interactive interfaces, UX research
University of Toronto	Canada	UI/UX Design Specialization	HTML, CSS, JavaScript, Python	Figma, Adobe XD, Sketch	UX/UI design and web development
University of Helsinki	Finland	Full Stack Web Development	HTML, CSS, JavaScript, React	UX research	Modern web frameworks and front-end systems
University of Michigan	USA	UX Concentration	HTML, CSS, JavaScript	Figma, Adobe XD	UX/UI design and interactive applications
University of California, San Diego (UCSD)	USA	Cognitive Science with Design and Interaction	Interactive systems	Data-driven UX, Unity	UX analytics and cognitive design
Baltic International Academy	Latvia	Digital Design / Web Design	Interactive systems	Figma, Adobe XD, UI/UX systems	Integration of web design, digital communications and front-end training
Harvard Extension School	USA	Front End Web Development Graduate Certificate	HTML5, CSS3, JavaScript, jQuery	GitHub, Sublime Text	Accessibility, internationalization of websites
Cornell University (eCornell)	USA	Web Design and Development Certificate	HTML, CSS, JavaScript	UX/UI tools	Basics of front-end and UX/UI design

An analysis of international experience has identified common features of contemporary professional training for designers in front-end web development, namely: most programmes combine interface design with the study of basic front-end technologies such as HTML, CSS and JavaScript; the training is distinctly practical in nature and is based on the creation of digital projects, portfolios and prototypes; an important component is the development of skills in interdisciplinary collaboration and teamwork. Fourthly, significant attention is paid to UX research, responsive design, usability and user-centred design. Thus, international experience demonstrates a comprehensive approach to the professional training of designers, in which front-end development is not a separate technical discipline but an integral part of modern digital design education. This approach ensures the training of competitive professionals capable of working in an interdisciplinary environment and participating in the full cycle of digital product creation.

To investigate the state of Ukrainian experience in integrating front-end web interface development into the professional training of future designers, we will analyse the syllabuses of bachelor`s-level courses in specialisation 022 «Design» (current code B2 «Design»), to identify programmes that cover the front-end development components we have defined in the training of designers (Table 2.).

Table 2

Analysis of Ukrainian experience in training designers for front-end development

Higher education institution	Discipline	HTML	CSS	Java Script	UI/UX	Features of preparation	Practical orientation
Kosiv Institute of Applied Decorative Arts LNAM	«Interface Design»	–	–	–	+	Developing skills in creating clear and intuitive interfaces	User interface design
Lviv National Academy of Arts	«Front-end development»	+	+	+	+	Learning HTML, CSS, responsive layout, component approach and CMS	Working with web pages, team projects
Cherkasy State Business College	«UI/UX-design»	–	–	–	+	Basics of UX design, website and mobile application design	Practical design exercises
Western Ukrainian National University	«Web technologies and web design»	+	+	+	+	HTML, JavaScript, CMS Joomla and Drupal, mobile web applications	Web content creation and web programming
Zaporizhia National University	«UI/UX design»	–	–	–	+	Domain analysis, wireframe, interface prototyping	Working at Figma, UX research
Zaporizhzhia Polytechnic University	«Web technologies and Web design»	+	+	+	+	HTML4/HTML5, CSS3, JavaScript, block layout	Website layout and design
Odessa Technological University «STEP»	«Web Technologies and Design», «Theory and Practice of UI/UX Design»	+	+	+	+	A comprehensive combination of web design and front-end technologies	Practical web development
European University (Kyiv)	«Web design and website development»	+	+	+	+	Combining design and web development	Website creation
Ternopil National Pedagogical University	«Web design», «Design and ergonomics of user interfaces»	+/-	+/-	–	+	Focus on web design and interface ergonomics	Interface design

An analysis of educational programmes at Ukrainian higher education institutions reveals the gradual introduction of front-end training components into the professional education of future designers. At the same time, the level of integration of web technologies into the curriculum remains uneven and largely piecemeal. Most educational programmes focus primarily on developing UI/UX design skills, creating graphic layouts, prototyping, and working in Figma, Adobe XD or other digital interface design environments.

A comparative analysis of academic disciplines shows that some Ukrainian higher education institutions are already integrating front-end components into the professional training of designers. The most comprehensive approach can be seen at the Lviv National Academy of Arts, the Western Ukrainian National University, Zaporizhzhia Polytechnic, the Odesa Technological University «SHAG» and the European University, where students study HTML, CSS, JavaScript, web technologies, responsive layout and web content creation. In these programmes, front-end training is combined with UX/UI design and practical web development, bringing the teaching model closer to the modern needs of the digital industry.

At the same time, a significant proportion of educational programmes remain focused primarily on the graphic aspect of web design without sufficient mastery of the technical component. Thus, in a number of programmes, the emphasis is placed on creating wireframe mock-ups, usability, interface composition and UX research, yet there is no systematic study of HTML, CSS and JavaScript. This creates a situation where a future designer is capable of creating visually appealing interfaces but lacks a sufficient understanding of the principles of their technical implementation in a front-end environment.

A lack of comprehensive training leads to a disconnect between the design phase and the actual web development process. Designers who work exclusively in Figma or Adobe XD without knowledge of the specifics of front-end layout often fail to take into account the technical limitations and principles of web interface construction. In particular, problems arise with adherence to the modular grid, adaptability, content scaling, the logic of the component structure, and the behaviour of elements in a responsive environment. As a result, the final implemented web design may differ significantly from the initial mock-up due to the inability to correctly implement individual blocks or the incompatibility of design decisions with the requirements of front-end development.

Particularly critical is the problem of designers` lack of understanding of the principles of structuring information in a web environment. It is not uncommon for created layouts to contain elements that are difficult or impossible to implement without compromising adaptability or layout logic. This complicates communication between the designer and the front-end developer, increases the number of revisions, slows down the process of creating a digital product, and negatively impacts the quality of the final web resource.

The modern digital industry requires specialists who are capable not only of creating graphic solutions but also of understanding the process of their technical implementation. This is precisely why front-end training should be viewed not as an additional skill, but as an integral part of a modern designer`s professional education. A basic knowledge of HTML, CSS, JavaScript, the principles of responsive layout and the component-based approach enables designers to create realistic, technically sound and functional interfaces suitable for effective integration into the web environment.

An analysis of Ukrainian experience indicates the need to implement a comprehensive model for training designers in front-end web development. Such a model should provide for the integration of UI/UX design and front-end disciplines within a single educational environment, a combination of artistic-design and technical training, as well as the development of interdisciplinary collaboration between designers and programmers. It is advisable to teach the subjects «UI/UX Design» and «Front-end Development» in parallel during the final years of study, which will enable students to develop a holistic understanding of the process of creating a digital product – from concept and prototype to the implementation of the web interface in code.

Conclusions.

The study analysed the current state of professional training for future designers in front-end web development in Ukraine and abroad. It was established that the digitalisation of society, the development of web technologies and the transformation of the digital industry`s structure necessitate the modernisation of design education and the integration of front-end competencies into the professional training of designers.

An analysis of Ukrainian educational programmes revealed that most higher education institutions focus the training of future designers primarily on UI/UX design, the creation of graphic mock-ups, and working in the digital environments of Figma and Adobe XD. At the same time, a comprehensive study of HTML, CSS, JavaScript, responsive layout and the principles of front-end development is only included in a few educational programmes. This indicates an insufficient level of integration of the technological component into the structure of professional design education.

The study revealed that designers` lack of a basic understanding of front-end technologies creates a disconnect between the interface design stage and its practical implementation in a web environment. Designers who work exclusively at the level of graphic layout often fail to take into account the specifics of responsive layout, modular grids, component-based structures and the technical capabilities of front-end implementation. This leads to distortions in the final web design, complications during the layout process and an increase in the number of technical revisions during the development of a digital product.

A comparative analysis of international experience has shown that leading universities in the US, the UK, Germany, Australia, Canada, the Netherlands, Finland and other countries adopt a comprehensive interdisciplinary approach to training designers. International educational programmes integrate UI/UX design, front-end development, web programming, UX research and team-based digital collaboration into a single professional training system. Key features of such programmes include a practical focus, project-based learning, working with real-world case studies, creating digital products and developing interdisciplinary collaboration skills.

It has been established that a modern designer must possess not only artistic and compositional skills, but also a basic understanding of front-end technologies, the principles of responsive web design, information architecture and digital interaction. Front-end training enables designers to create technologically realistic interfaces, interact more effectively with web developers and participate in the full cycle of digital product creation.

Based on the analysis conducted, the feasibility of introducing a comprehensive model for the professional training of designers in front-end web development at higher education institutions in Ukraine has been substantiated. Such a model should provide for the integration of UI/UX design and front-end development disciplines, the combination of artistic-design and technical training, the use of project-based learning, and the development of interdisciplinary collaboration between designers and programmers.

Prospects for further research lie in the development of a structural and functional model for training future designers in front-end web development, the identification of pedagogical conditions for its implementation, and the creation of methodological support for the integrated teaching of UI/UX design and front-end technologies within the higher education system.

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