INTERNATIONAL JOURNAL OF EDUCATION AND INFORMATION TECHNOLOGIES
DOI: 10.46300/9109.2024.18.12 Volume 18, 2024

Involvement of interactive educational platforms in the training of graphic design students using the Figma platform as an example

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Received: April 19, 2024. Revised: September 15, 2024. Accepted: October 9, 2024. Published: November 13, 2024.

Abstract — The goal is to provide a rationale for choosing the optimal prototyping and UI/UX design software for teaching design students. The purpose of writing this paper is to determine the optimal tools for teaching UI/UX design students through interactive educational platforms. The research uses the methods of cross-multiple-iteration expert ranking, personal ranking of students, and comparative cross-analysis of the results of expert and user ranking. The ranking results confirmed the choice of tools such as Figma, Adobe XD, InVision, Sketch, and Marvel. The users' conclusions agree with the experts' evaluations. Still, the analysis revealed a significant difference in approaches: the gap in user evaluations is 84.6% versus 32.0% for experts, indicating the influence of user empathy and the importance of UI/UX in product perception. Figma was selected as a tool for prototyping and UI/UX design with a median rating of 57.2%, justifying its use in interactive educational programs for future designers, contributing to the development of skilled digital production specialists. Further research is focused on developing detailed educational courses for design students, as well as studying the empathic component of experience for creating ergonomic interfaces.

Keywords—educational course, empathy, prototyping, ranking, User Experience, User Interface

I. Introduction

A. Relevance

A study of industry statistics indicates that investing in UI/UX design may provide a profitability of 9900% (an investment of $1 yields a profit of $100). Companies with the best design practices grow 2 times faster than similar companies in the industry that do not invest in the development of their own design concept. It is noted that effective design solutions have a positive effect on the user experience: the first impression is 94% related to the design of the web resource, and 75% of users trust an aesthetically attractive website. A total of 74% of visitors return to a website that has effective UI/UX design and 80% of users leave a website that does not display properly on their

smartphones. Only 1% of users say that the interface of an e-commerce website meets their expectations, while 94% of people do not trust outdated websites. However, 90% of smartphone users make purchases on e-commerce websites if they have a positive experience when interacting with the design solutions of this web resource, while 67% of mobile phone users will definitely make a purchase from a company whose website has a more attractive UI /UX design, but 50% of mobile users, even if they like products and companies, leave the websites if they are not optimized for use on smartphones. That is why software development companies allocate more than 20% to the development of UI/UX design. In 2022, the global spending on the development of UI/UX design is $960.19 million, [1].

The development of design tools is an adequate response to the dynamic development of the field of UI/UX design. These include tools for prototyping (conceptualization) of design solutions, which is supported by relevant industry statistics: the market for prototyping tools had an average annual growth rate (CAGR) of 27% since 2015. In 2022, the global prototyping tools market size was estimated at $348.43 million. The prototyping software market is expected to reach approximately $532.6 million by 2028, and the Compound annual growth rate (CAGR) will be more than 11% during the forecast period, [2].

The dynamics of the development of the UI/UX design and the relevant prototyping tools determine the appropriateness of studying the methods of training design students, in particular with the involvement of interactive educational platforms. Optimizing and improving the educational process for training UI/UX design specialists will contribute to the development of their adaptive qualifications, career success, and the development of the studied industry as a whole.

B. Unexplored Issues

There is a large number of offers on the market of prototyping tools and UI/UX design software solutions, which creates an oversaturation effect for users. This results in the risks of making the wrong choice, which may entail negative consequences: a wrong marketing strategy, and loss of time, resources, and investment. Numerous industry reviews available on the web provide potential users with guidance on choosing a software tool for prototyping and UI/UX design. However, their advice is subjective and the methods for choosing the best tools are opaque and cannot claim to be thorough.

C. Aim

The aim of the study is to substantiate the choice of the optimal software tool for prototyping and UI/UX design, which will be used as a basis for developing an educational program for the qualification training of design students.

D. Objectives/Questions

The aim of the study was achieved through the fulfillment of the following research objectives:

1. Create an expert environment from relevant expert organizations to identify the available means of prototyping and UI/UX design.

2. Develop a methodology for determining optimal prototyping and UI/UX design tools to determine the most adequate solutions for the purpose of this research.

3. Determine appropriate software solutions for prototyping and UI/UX that can be implemented in the educational process of training design students as an interactive educational platform that will allow the development of appropriate educational programs.

4. Develop an educational course for the training of future specialists in UI/UX design to empirically establish the optimal means of prototyping and UI/UX design based on the results of the evaluation of the success of the course.

5. Perform a comparative analysis of the results of a cross-expert ranking and a ranking created by the students of an educational course regarding the optimal solution of prototyping and UI/UX design, which can be used as an interactive educational platform for training design students.

II. Literature Review

The analysis of relevant publications and studies gives grounds for an idea of the existing academic background in the field of educational training of UI/UX design students with the use of relevant interactive educational platforms.

According to [3] detail the results of a study of the process of developing a mobile educational platform. According to the authors, the main driver in the development of the educational platform is the principles of UI/UX design, namely the empathetic reactions of the end users of this educational resource — higher school students. Prototyping and UI/UX design tools – Figma and Miro — were used in the research.

Researchers in [4] demonstrate the process of creating a mobile educational platform for learning electrical engineering. The principle of interviewing students was used to build the educational platform, which was the basis for creating an effective UI/UX design. Android Studio, Figma, and Adobe Illustrator CS3 were used as prototyping tools in the study.

In article [5] describe the process of a UI/UX design course for higher school students. The training was conducted on the basis of the interactive educational platform Figma.

Authors in [6] studied the process of developing an organizational and educational application for monitoring the attendance of educational classes. The authors note that the most appropriate method of developing the specified application is the method of UI/UX prototyping and design thinking. The Figma software resource was used as an environment for the development of an organizational and educational application.

According to [7] cover the process of training courses for UI/UX design students based on the interactive educational platform Figma. The authors indicate that the students of the experimental educational course gained practical skills in creating effective prototypes of information systems and can clearly present their developments to interested parties.

Researchers in [8] studied the results of the educational process of learning the basics of graphic design using the

interactive educational platform Figma. The authors note that the use of Figma is favorably perceived by the students of a specially designed experimental course.

In article [9] describe a webinar on studying UI/UX design based on the interactive educational platform Figma. The course system focuses on teaching the fundamentals of UI/UX design and its methodology, as well as how to apply tools, including Figma, to website development.

According to [10] created a mobile application for learning languages. The authors emphasize that the effectiveness of mobile educational platforms largely depends on successful UI/UX design. Therefore, the researchers used the principle of design thinking and the Figma prototyping environment.

Researchers in [11] expanded the e-learning platform by developing a corresponding mobile application. At the same time, the authors used a UI/UX approach based on the analysis of users' empathic reactions. The Figma prototyping environment was used to develop the mentioned mobile application.

Authors in [12] studied the issue of blended learning with the integration of the interactive educational platform Figma in the training of UI/UX design students. The authors demonstrated how the studied educational methods, which are usually used in blended learning in its flexible model (flipped learning, gamification, storytelling, etc.), can be improved and enriched with the help of various interactive tools.

The review of relevant publications shows that researchers use limited tools for prototyping and UI/UX design for educational purposes and do not provide justification for the choice of a separate solution, which creates gaps in the academic support of the studied field.

The main motivation of this study is to meet the growing demand for qualified professionals in the field of UI/UX design, especially in the training of design students. Since UI/UX design plays a key role in creating user-friendly interfaces, it is necessary to integrate the best tools and methods into educational programs. The research aims to identify optimal software solutions for prototyping and UI/UX design to improve the training of future designers by targeting interactive platforms such as Figma. Unlike previous studies that used tools without detailed justification, this study offers a methodical approach to ranking apps based on expert and user ratings. Unlike other studies, this article offers a sound selection of UI/UX design tools based on a comprehensive comparison of expert and user evaluations.

III. Methods

A. Research Design

The study was conducted from February to April 2023 according to the procedure illustrated in Fig. 1 (Appendix).

B. Sampling

Several research sets were used in the study: a sample of expert organizations, a sample of software solutions for prototyping and UI/UX design, and a sample of students from three HEIs studying software design and development.

The sample of the expert environment was made up of 25 organizations with freely available ratings and recommendations for the use of prototyping tools and UI/UX design on their websites (Table 1, Appendix). A set of prototyping and UI/UX design solutions was formed based on the results of forming a set of personal ratings of expert organizations, which includes 35 relevant proposals (Table 1, Appendix).

The sample of the experimental environment consists of students studying software design and development from three universities: 30 students of the Design Department at the Educational and Scientific Institute of Arts of Luhansk Taras Shevchenko National University; 30 students of the Department of Computer Technologies at the Faculty of Engineering and Pedagogy of Ternopil Volodymyr Hnatiuk National Pedagogical University; 30 students of the Department of Linguistics and Humanities at the Faculty of Digital Technologies and Production Automation of Metinvest Polytechnic University LLC.

C. Methods

According to the procedure (Fig. 1, Appendix), the study employed the following methodological approaches:

1. The method of cross-multiple-iteration expert ranking, which involves the creation of an expert software set, according to which the frequency of mention of individual solutions from prototyping and UI/UX design is the selection criterion in the first iteration, and in subsequent iterations the frequency of leading positions occupied by individual mentioned software products in personal ratings of relevant expert organizations is the selection criterion.

2. The method of personal ranking of students - participants of the experimental course on studying UI/UX design based on interactive educational platforms, which involves the creation of a user ranking based on the results of the specified course training, which is based on the students' empathetic preferences of the experimental environment.

3. Comparative cross-analysis of the results of expert and user rating, which gave the grounds for drawing unbiased conclusions about the optimal interactive educational platform of prototyping and UI/UX design, which should be integrated into the educational process as a methodological basis for the training of design students.

D. Instruments

The method of cross-multiple-iteration expert rating needs a detailed explanation. According to the analysis of personal rating assessments of expert organizations, a relative ranking was formed based on the frequency of mentions of individual prototyping and UI/UX design solutions – formula 1:

$$RRMF_i = \frac{\sum_{i=1}^{n} IR_i}{FM_i}, \quad (1)$$

where $RRMF_i$ – relative ranking by mention frequency of prototyping and UI/UX design solutions; $\sum_{i=1}^{n} IR_i$ – the sum of individual ratings of each expert organization for prototyping and UI/UX design solutions; FM_i – frequency of mention of prototyping and UI/UX design solutions in an expert environment.

A relative ranking by priority is made according to the number of times each of the considered prototyping and UI/UX design solutions took the leading position according to the individual assessment of each of the independent expert organizations involved in the research – formula 2:

$$RRP_i = RRMF_i \times \left(1NTO1LP + \frac{1}{2}NTO2LP + \frac{1}{3}NTO3LP + \frac{1}{4}NTO4LP + \frac{1}{5}NTO5LP\right), \quad (2)$$

where RRP_i – ranking by priority of each of the considered prototyping and UI/UX design solutions; $NTO1LP \ldots NTO5LP$ – the number of times each prototyping and UI/UX design solution took the first... and the fifth step of the individual rating as assessed by independent expert organizations.

Using the t-test, it was possible to compare the average values of the metrics for the software prototypes. Also, it was determined whether there are statistically significant differences between software. It is determined by the formula 3:

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}, \quad (3)$$

where $\overline{X_1}$, $\overline{X_2}$ – sample mean values; n_1, n_2 – volume of samples; s_1^2, s_2^2 – pooled standard deviation.

Also, the chi-square test was applied to analyze the recall frequency compared to the expected frequency. The calculation was made according to the formula 4:

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}, \quad (4)$$

where O_i – actual number of mentions; E_i – expected number of mentions.

E. Ethical Criteria

The research uses a wide selection of expert organizations, as well as prototyping and UI/UX design solutions, ensuring the purity of the results. The formation of a research and testing environment with the participation of students from three HEIs, who joined for free, strengthens the credibility of the research, and the comparative analysis of the rankings provides unbiased recommendations for choosing the optimal interactive educational platform.

IV. Results

A variable set (input dataset) of personal (individual) ratings and impact assessments of prototyping tools and UI/UX design (in the amount of 35 solutions) is formed based on open data collected from 25 independent relevant expert organizations in accordance with the developed cross-multiple-iteration ranking methodology (Table 1, Appendix).

Taking into account the following iterative steps of the proposed research methodology, we will determine the indicators FM_i, $NTO1LP \ldots NTO5LP$, $RRMF_i$ and finally RRP_i using the tabular presentation of the results (Table 2. Dataset of cross-multiple-iteration ranking of individual ranking of expert organizations on the potential of prototyping and UI/UX design solutions

Analyzing the $\chi 2$ values for each UI/UX design tool allows us to estimate how much each tool's actual frequency of mentions differs from the expected frequency (the average value of the frequency of mentions for all tools). High $\chi 2$ values indicate significant deviations from the expected distribution, while low values indicate the closeness of the actual mentions to the expected ones.

According to the calculated dataset (Table 2, Appendix), the possibility of median approximation of individual rating estimates was formed, while certain discrepancies are observed between the functions $RRMF_i$ and RRP_i. Taking into account that individual digital technologies have obtained very low relative and priority cross-ratings, we will set the limit parameters below which corresponding digital solutions are not taken into account – formula 3:

$$RRMF_i \leq 0.037;$$
$$RRP_i \leq 0.012.$$

The use of a limit filter made it possible to single out 15 digital technologies, which received the most favourable evaluations regarding means of prototyping and UI/UX design according to the cross-multiple-iteration ranking of the conclusions of expert organizations (Fig. 2, Appendix).

The optimal list of prototyping and UI/UX design tools is determined according to the obtained values (Fig. 2, Appendix):

1. Figma with the results $RRMF = 0.090$ and $RRP = 1.420$;
2. Adobe XD with the results $RRMF = 0.090$ and $RRP = 0.967$;
3. InVision with the results $RRMF = 0.067$ and $RRP = 0.495$;
4. Sketch with the results $RRMF = 0.075$ and $RRP = 0.393$;
5. Marvel with the results $RRMF = 0.060$ and $RRP = 0.176$.

So, the analysis of the expert software set built according to the principle of cross-multiple-iteration expert ranking justifies the optimal composition of prototyping and UI/UX design tools, which can be used in the training of design students.

The elaborated methodology implies the development of an experimental educational program for training design students with the involvement of 90 students from three independent universities. It provides for the use of an optimal composition of prototyping tools and UI/UX design (determined by expert ratings) as interactive educational platforms (Fig. 3, Appendix).

According to the concept (Fig. 3, Appendix), an experimental educational course for 90 students of the experimental sample defined in the methodology section was conducted for 3 months using a blended learning system. It provided for studying the basics of UI/UX design with the involvement of interactive educational platforms based on the

obtained values and the results of an expert ranking of optimal prototyping and UI/UX design tools. A detailed description of the development of the design project was made for each of the identified solutions. It was suggested to implement the acquired skills and knowledge in students' own mobile application design projects. Upon the completion of the educational course, students were asked to make an individual ranking of the used prototyping and UI/UX design tools based on their own preferences and subjective feelings (

Fig. 4. Results *of* empathic assessment by students of a research sample of prototyping and UI/UX design tools (interactive learning platforms) used in an experimental educational course for training design students

The following structure of the user rating was determined according to the empathetic assessment of the students of the experimental sample who completed the experimental educational course (Fig. 4, Appendix):

1. Figma
2. Adobe XD
3. InVision
4. Sketch
5. Marvel

A comparative cross-analysis of the results of expert and user rankings will be performed using the appropriate percentage ratio. (Fig. , Appendix).

A comparative cross-analysis of the results of expert and user rankings (Fig. 5, Appendix) indicates that both experts and users gave preference to the category of prototyping and UI/UX design tools – Figma. The chart legend clarifies that each bar represents the respective expert and user ratings, using color coding for ease of reference. However, further conclusions of the compared ranking systems differ: according to empathic preferences, the gap from the leader to the closest competitor is 84.6%, while the expert assessment is more moderate and the similar gap is 32.0%. The difference in the assessments of the respective rankings indicates that users mostly use their own empathic (often subjective) experience, while expert organizations conduct a comprehensive assessment of the functions of software solutions, forming a generalized professional approach. However, the correlation of the leadership position (between user and expert ratings) of the studied software class (as evidenced by the maximum median rating of 57.2%) indicates a significant impact on the relevant UI/UX design. The t-test results for Fig. 5 (Appendix) indicate a statistically significant difference between expert and user ratings. The calculated t-value was 36.0, significantly exceeding the critical value of 2.101 for the significance level α=0.05 with 18 degrees of freedom. This allows for the rejection of the null hypothesis and the assertion that the observed differences in scores are statistically significant. Thus, the results confirm the impact of users' empathic preferences' impact on their UI/UX design tool evaluations. Optimized UI/UX not only promotes the popularization of software solutions, increasing their conversion, but also enables the implementing successful practices in the course of training specialists in this field. So, Figma is a well-defined optimal interactive educational platform that should be integrated into the training system of design students.

V. Discussion

A. Analysis of the Results of Conducted Research

The results of this study give grounds to make the following conclusions:

– the optimal list of prototyping and UI/UX design tools was made among 35 relevant software solutions based on the results of a cross-multiple-iteration ranking of the conclusions of expert organizations, which includes Figma, Adobe XD, InVision, Sketch, Marvel;

– a comparative cross-analysis of the results of expert and user rankings found fundamental differences: in terms of empathic preferences, the gap between the leadership and closest competing positions in the user rating is 84.6%, and a similar indicator for expert rankings is 32.0%. The differences in the compared rating systems indicate that users form an assessment based on their own impressions and experience of using software products, while expert organizations practice a comprehensive assessment of the functionality of software tools, following a generalized professional approach;

– the median rating of 57.2% gave grounds to substantiate that the interactive educational platform Figma is optimal for training design students.

B. Comparative Analysis of the Results of Relevant Publications

A comparative analysis of the results of relevant studies on the issue of using interactive educational platforms in training students who study prototyping and UI/UX design is provided below.

The results obtained in [3] confirm the findings regarding the significant impact of user empathy on the quality and effectiveness of UI/UX design, as well as the perception of interactive educational platforms and educational applications. The researchers used the Figma platform, but they didn't justify the choice of research tools in any way. Accordingly, the results of this study are more objective and thorough.

The study [4] discussed in detail the development of an educational mobile application. The researchers use Figma for the development of the UI/UX design of the mobile educational platform but do not give reasons for their choice. Despite the convergence of findings, the study [4] is significantly limited and needs clarification regarding the methodological framework.

The research [5] describes the experience of organizing a course on prototyping and UI/UX design skills among higher school students based on the interactive educational platform Figma. Although the experience of organizing such seminars and courses is of interest within the scope of this study, the authors did not explain the reason for choosing this platform.

Researchers in [6] detailed the process of creating a mobile application for the organization of the educational process (control of class attendance and other functions). Their findings correlate with the results of this study, and the UI/UX design testing experience introduced by the researchers is also interesting. Although the authors implemented their solutions in the Figma environment, the researchers did not explain their choice, creating significant limitations for the subject area and reducing the objectivity of the results.

The implementation of an educational course for the training of UI/UX designers based on the interactive educational platform Figma, organized in [7] in the form of blended and online learning, is an interesting experience. However, the authors do not justify the choice of the educational environment, which casts doubt on the objectivity of the study.

A study [8] demonstrates the organizational structure and process of a graphic design course using the Figma interactive learning platform delivered as a webinar. The conclusions of [8] correlate with the results of this study regarding the appropriateness of introducing Figma into the educational process of training future UI/UX design specialists, but cannot be perceived as objective, as other similar prototyping tools were not considered.

In article [9] covered the process of training web designers in the form of an educational webinar using the UI/UX environment of the interactive educational platform Figma. It should be noted that the research results have signs of subjectivity, as they do not include similar offers on the market of prototyping tools and UI/UX design to the subject area.

A study [10] uses Figma to develop a mobile educational platform for language learning. However, researchers focus on a single solution for prototyping and UI/UX design, setting aside similar solutions, thus questioning the objectivity of the results obtained.

According to [11] demonstrate an example of using empathic user responses to extend an e-learning platform by developing a corresponding mobile application in the Figma environment. The principles used by the authors are equivalent to those established in this study. However, the choice of research instruments casts doubt on the relevant conclusions.

In the context of this study, the findings of [12], who describe the methods of organizing the training of future designers based on the interactive educational platform Figma, are of interest. Considering the significant correlation between the findings of this study and the study [12], it can be argued that the use of additional educational models of blended learning will improve the established experimental course. However, the unjustified choice of research tools introduces significant limitations that require additional experimental iterations.

In our opinion, it is important to emphasize that the choice of tools such as Figma, Adobe XD, InVision, Sketch, and Marvel is justified. These tools have demonstrated high productivity in the process of student learning, which is confirmed by both expert and user evaluations, [13]. First of all, it is worth paying attention to the fact that the ratings of users and experts differ significantly, which indicates different approaches to evaluating tools. During the study, experts evaluated the tools comprehensively, focusing on their functionality, technical capabilities, and overall performance. At the same time, users were guided to a greater extent by personal experience of use, which reflects their empathic preferences and perception of the user-friendliness of the interface.

This difference in scores confirms the importance of integrating user experience into curricula, especially in UI/UX design. The t-test results showed that the differences are statistically significant, highlighting the importance of considering these differences when designing courses for design students, [16].

It is also worth noting that the high rating of tools like Figma is due to their popularity among users due to their ease of use, flexibility, and extensive collaboration capabilities. This confirms the expediency of their use in educational programs to develop students' practical skills. Thus, a combination of expert and user evaluations allows for a more balanced selection of tools, which ensures efficiency from both a technical and a practical point of view.

So, the analysis of relevant studies on the use of interactive educational platforms for the training of software design and development students indicates that researchers mostly use common (popular) prototyping and UI/UX solutions, while not justifying the methodology of choosing the experimental environment.

C. Recommendations

According to the research results, it is advisable to integrate the optimal interactive educational platform for prototyping and UI/UX design – Figma — into the training system of design students, the choice of which is justified and unbiased. At the same time, it is necessary to implement effective blended learning models in the studied area based on the results of students' empathic preferences.

D. Limitations

The study is limited by a chronological framework and the current state of the prototyping and UI/UX design market, which is dynamic. It is also worth noting that the developed methodology will allow to effectively update the necessary data, which makes this research effective for determining the optimal means for the development of specialized educational courses for the training of design students. The choice of expert organizations and users may influence the results, and the research may be limited to certain contexts or conditions that do not cover all aspects of UI/UX design. Thus, it is necessary to consider that the results may not be universal for all industries or types of projects.

VI. Conclusions

A. Relevance

Determining the optimal tools of prototyping and UI/UX design contributes not only to the development of an effective

interface solution for a commercial project but also helps in the formation of the optimal educational process of training design students. The integration of optimized interactive educational platforms into the training prototyping and UI/UX design students makes it possible to prepare qualified and competitive specialists, which contributes to the general development of the studied industry.

B. Research Findings

Based on the ranking of expert evaluations, an optimal list of prototyping and UI/UX design tools was determined, including Figma, Adobe XD, InVision, Sketch, and Marvel. Although the results of users are similar to those of experts, there are significant differences between them: the gap in user ratings is much larger (84.6% vs. 32.0% for experts), which indicates the influence of emotional preferences. Research has confirmed that optimized UI/UX solutions improve product perception, and Figma is the best choice for training programs that prepare competitive designers for digital manufacturing.

C. Applications

The results of the study are useful for specialists in the development of UI/UX design, as they contain information about the selection of optimal tools and the process of developing optimized interface solutions that take into account the empathic component of the user environment. It is important to note that the results can help improve training programs for design students by providing them with practical skills in using leading tools.

D. Prospects for Further Research

Further research is aimed at extending the obtained results, in particular, the development of detailed educational courses for the training of design students, which involves the integration of determined and substantiated prototyping and UI/UX design tools as interactive educational platforms into the educational process.

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Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

We confirm that all Authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of funding for research presented in a scientific article or scientific article itself

No funding was received for conducting this study.

Conflicts of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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APPENDIX

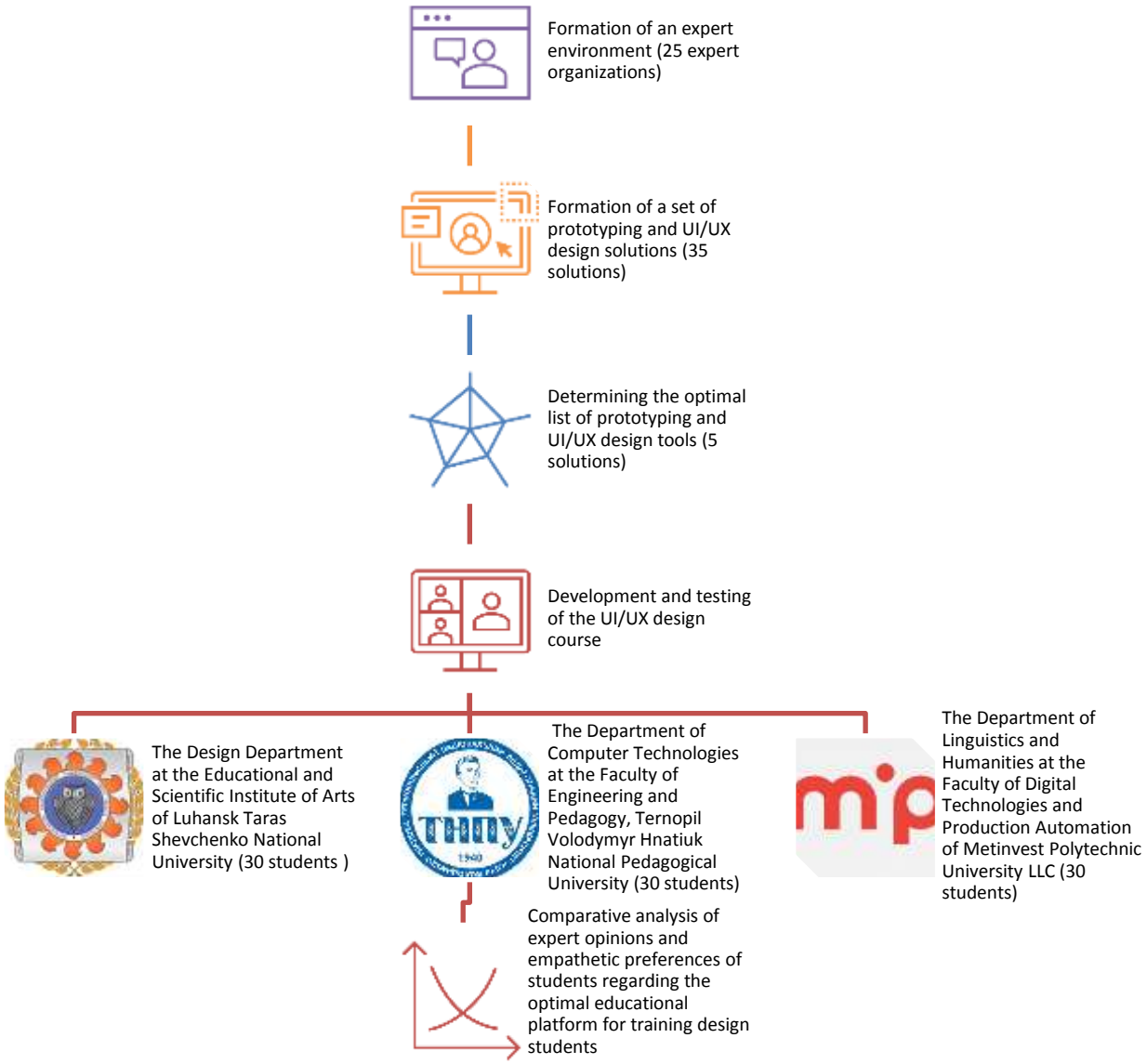


Fig. 1. Research design
Source: created by the authors

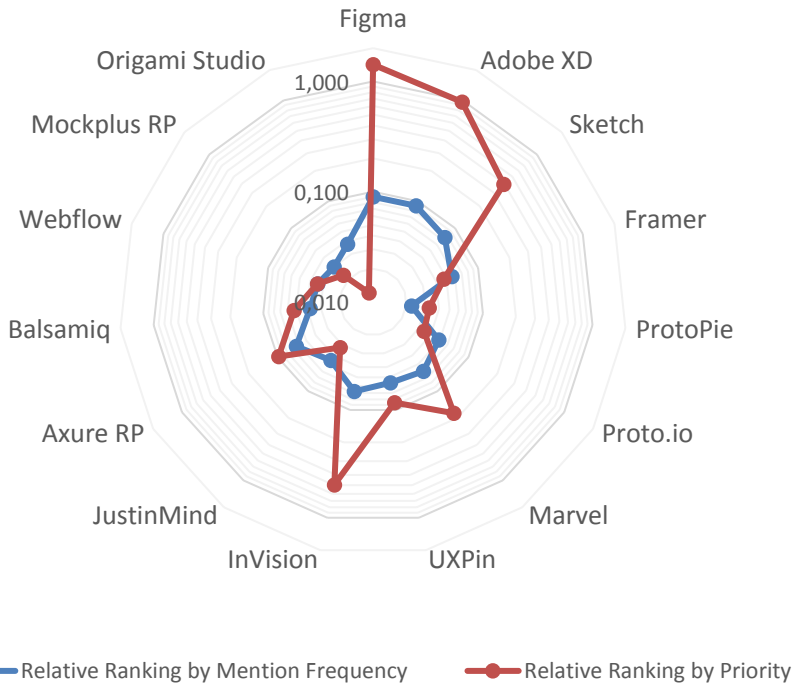


Fig. 2. Determining the optimal list of digital tools for prototyping and UI/UX design
Source: created by the authors

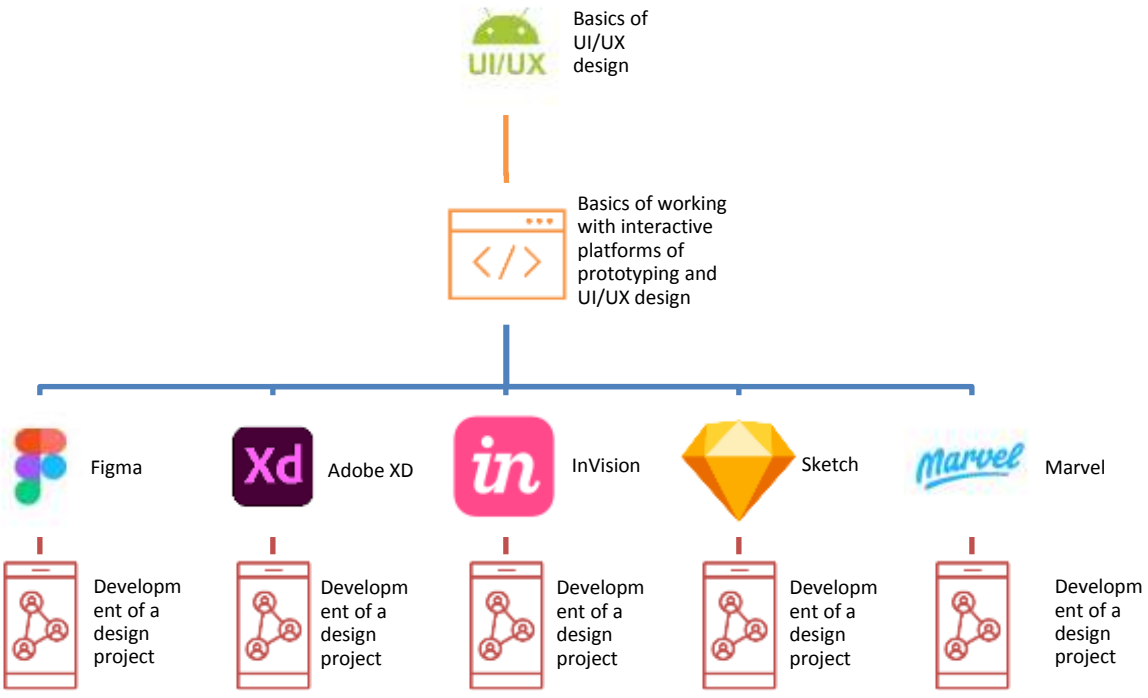
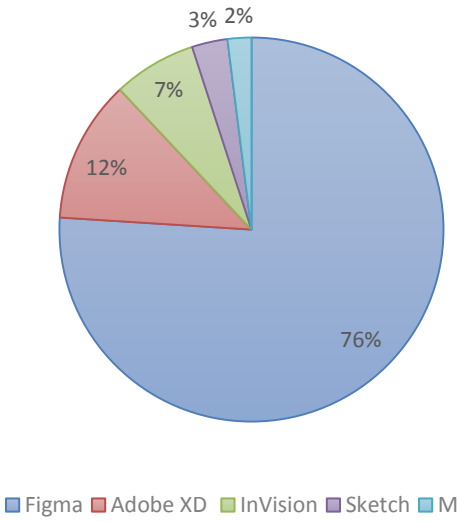
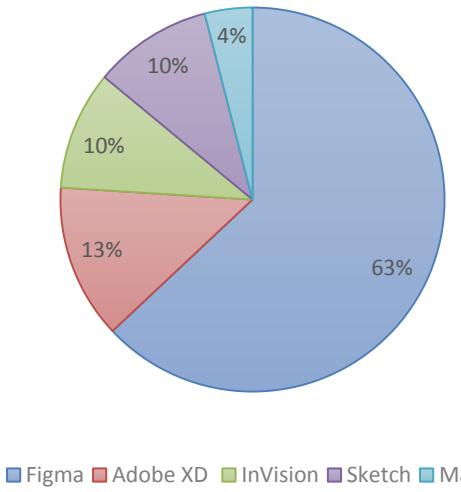


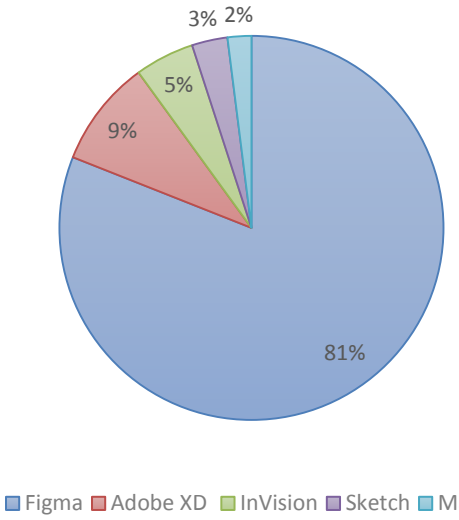
Fig. 3. The concept of an experimental educational course for the training of design students
Source: created by the authors



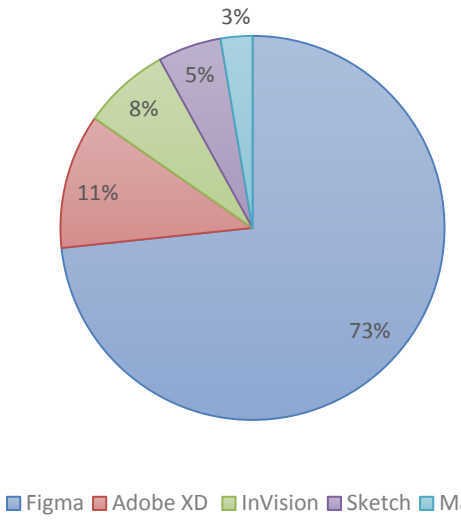
a) ranking of prototyping and UI/UX design tools made by the students of Luhansk Taras Shevchenko National University



a) ranking of prototyping and UI/UX design tools made by the students of Ternopil Volodymyr Hnatiuk National Pedagogical University

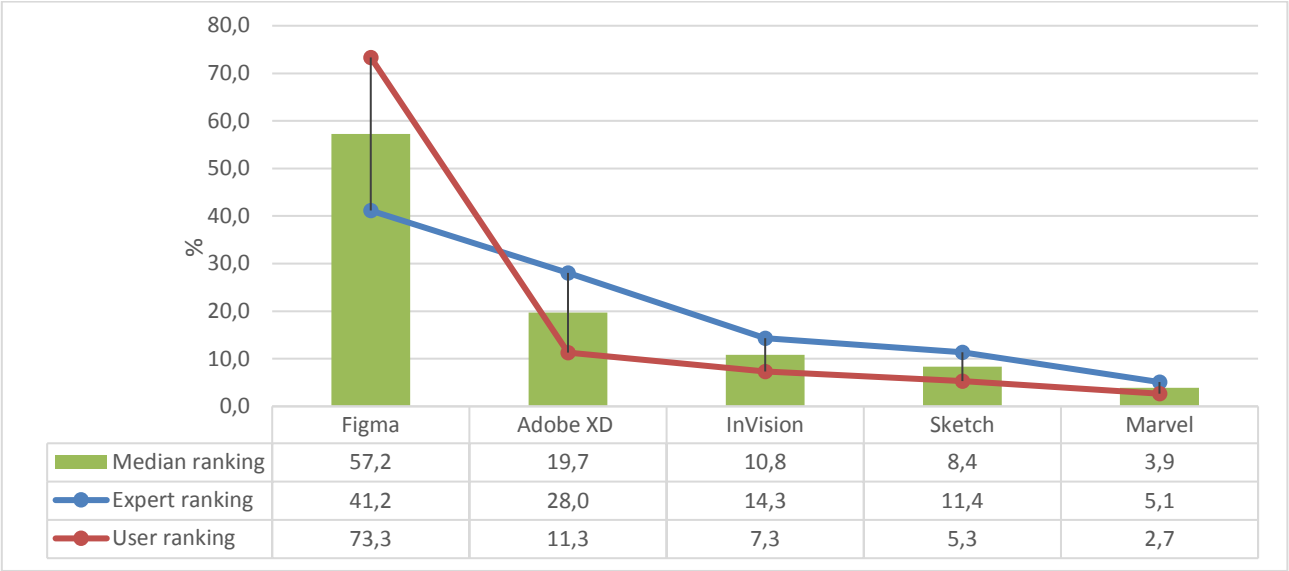


c) ranking of prototyping and UI/UX design tools made by the students of Metinvest Polytechnic University LLC



d) median rating of prototyping and UI/UX design tools made on the basis of assessment by the students of the entire sample

Fig. 4. Results of empathic assessment by students of a research sample of prototyping and UI/UX design tools (interactive learning platforms) used in an experimental educational course for training design students
Source: created by the authors



	Figma	Adobe XD	InVision	Sketch	Marvel
Median ranking	57,2	19,7	10,8	8,4	3,9
Expert ranking	41,2	28,0	14,3	11,4	5,1
User ranking	73,3	11,3	7,3	5,3	2,7

Fig. 5. Comparative cross-analysis of expert and user ranking results
Source: created by the authors

Table 1. Expert software set, including 35 prototyping and UI/UX design solutions with an individual rating of 25 expert organizations

Prototyping Software	UX Design Institute [13]	Studio by UXPin [14]	ProtoPie [15]	Software Testing Help [16]	Interaction Design Foundation [17]	Product Manager [18]	Creative Bloq [19]	Gartner [20]	Qualaroo Blog [21]	Webflow [22]	Pixso [23]	Growth-natives [24]	Medium [25]	Renaissance Rachel [26]	SoftwareSuggest [27]	Cleveroad Inc.[28]	ThemeSelection [29]	StartupTalky [30]	Infragistics Community [31]	Aalpha [32]	Startup House [33]	Software Development Hub [34]	Uxcel [35]	TrustRadius [36]	The CX Lead [37]
Figma	1	2	2	1	1	1	2	1	3	1	1	1	7	1	1		1	2	3	4	4	1	3	3	8
Adobe XD	2	3	4	3	3	5	6	2	1	3	5	2	2	2		1	2	3	4	1	1	3	2	5	5
Sketch	3		3	4	4	10		4	7	8	4		1	4		6	4	4	2	3	3	2		4	6
Framer	4	5		5		8	7	10	12	10		6	6	8			5	6	7	10					
ProtoPie	5		1				4	11																13	7
Proto.io	6	8	5	10	6	9		17	2	12					15			7			6			9	
Fluid UI	7								10	9					10			10			5			8	
Marvel	8	6		13	9		1	7	16	11		5	9	6		4	10				7		1		2
UXPin	9	1		7	8		3	6				9		10	9	11	11	5		7	8			7	
InVision		4		2	2	2		5	6	2	3		4	3	11	2		1	6	2	2			2	1
JustinMind		7		8				8	8	7		4			8	9	9					4		10	4
Axure RP		9	9	9	5		5		11	5	6	8	5	5	5	8	3	8		11				6	
Zeplin		10		15															5						
Balsamiq		11		12	7	4			15	14			3		2					6					3
Principle			6				8		14	13				11		7	13								

Prototyping Software	UX Design Institute [13]	Studio by UXPin [14]	ProtoPie [15]	Software Testing Help [16]	Interaction Design Foundation [17]	Product Manager [18]	Creative Bloq [19]	Gartner [20]	Qualaroo Blog [21]	Webflow [22]	Pixso [23]	Growth-natives [24]	Medium [25]	Renaissance Rachel [26]	SoftwareSuggest [27]	Cleveroad Inc.[28]	ThemeSelection [29]	StartupTalky [30]	Infragistics Community [31]	Aalpha [32]	Startup House [33]	Software Development Hub [34]	Uxcel [35]	TrustRadius [36]	The CX Lead [37]
Flinto			7						18								8			8					
Webflow				6					13	4		3		9		5	14			12			4		
Mockplus RP				11		3		15	4							10				13			5	15	
Origami Studio				14	10				17	6		7	8			3	7	9		9					
Infragistics App Builder						6		14																	
Usabilla						7																			
Miro								3																1	
Lucidchart								9																	9
HotGloo								12							3										
Indigo.Design								13							14				1						
Moqups								16							6		15							12	
Claritee									5								12								
MockFlow									9						13										
Pixso											2														
FlowMapp													10		4										
Wondershare Mockitt														7											
Icons8 Lunacy															7									14	
Avonni Creator															12										
Protopie																	6								
Vectornator																	16								

Source: created by the authors

Table 2. Dataset of cross-multiple-iteration ranking of individual ranking of expert organizations on the potential of prototyping and UI/UX design solutions

Prototyping Software	Frequency of Mention	Relative Ranking by Mention Frequency	Number of Times of Occupying the First Leading Position	Number of Times Occupying the Second Leading Position	Number of Times Occupying the Third Leading Position	Number of Times Occupying the Fourth Leading Position	Number of Times Occupying the Fifth Leading Position	Relative Ranking by Priority	Xi- square
Figma	24	0.090	12	4	4	2	0	1.420	4.26
Adobe XD	24	0.090	4	7	6	2	4	0.967	4.25
Sketch	20	0.075	1	2	4	8	0	0.393	4.06
Framer	15	0.056	0	0	0	1	3	0.047	0.04
ProtoPie	6	0.022	1	0	0	1	1	0.032	0.76
Proto.io	13	0.049	0	1	0	0	1	0.034	0.04
Fluid UI	7	0.026	0	0	0	0	1	0.005	0.01
Marvel	16	0.060	2	1	0	1	1	0.176	0.06
UXPin	15	0.056	1	0	1	0	1	0.086	0.05
InVision	18	0.067	2	8	2	2	1	0.495	3.08
JustinMind	12	0.045	0	0	0	3	0	0.032	0.04
Axure RP	17	0.064	0	0	1	0	6	0.097	0.05
Zeplin	3	0.011	0	0	0	0	1	0.002	0.00
Balsamiq	10	0.037	0	1	2	1	0	0.052	0.02
Principle	7	0.026	0	0	0	0	0	0.000	0.00
Flinto	4	0.015	0	0	0	0	0	0.000	0.00
Webflow	9	0.034	0	0	1	2	1	0.034	0.01
Mockplus RP	8	0.030	0	0	1	1	1	0.023	0.01
Origami Studio	10	0.037	0	0	1	0	0	0.012	0.01
Infragistics App Builder	2	0.007	0	0	0	0	0	0.000	0.00
Usabilla	1	0.004	0	0	0	0	0	0.000	0.00
Miro	2	0.007	1	0	1	0	0	0.010	0.00
Lucidchart	2	0.007	0	0	0	0	0	0.000	0.00
HotGloo	2	0.007	0	0	1	0	0	0.002	0.00
Indigo.Design	3	0.011	1	0	0	0	0	0.011	0.01
Moqups	4	0.015	0	0	0	0	0	0.000	0.00
Claritee	2	0.007	0	0	0	0	1	0.001	0.00
MockFlow	2	0.007	0	0	0	0	0	0.000	0.00
Pixso	1	0.004	0	1	0	0	0	0.002	0.00
FlowMapp	2	0.007	0	0	0	1	0	0.002	0.00
Wondershare Mockitt	1	0.004	0	0	0	0	0	0.000	0.00
Icons8 Lunacy	2	0.007	0	0	0	0	0	0.000	0.00
Avonni Creator	1	0.004	0	0	0	0	0	0.000	0.00
Protopie	1	0.004	0	0	0	0	0	0.000	0.00
Vectornator	1	0.004	0	0	0	0	0	0.000	0.00

Source: created by the authors