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Digital Competence and Information Technology in Pharmacy as Foundations of Professional Competence in Distance Learning for Master of Pharmacy

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Abstract

This article showcases the findings of a scientific study focused on how digital competence is cultivated among future Master of Pharmacy students at medical (pharmaceutical) higher education institutions. The article examines the definition of digital competence and clarifies its developmental goals within the academic framework of pharmaceutical education. A regional survey involving professionals in the pharmaceutical/pharmacy sectors across Ukraine was conducted to evaluate how well-prepared graduates of pharmaceutical faculties are for implementing information technology in their occupational roles. In addition, the study assessed the intrinsic motivation behind the integration of information technology into the daily professional routines of pharmacy specialists. Key findings include an analysis of motivational subscales such as activity satisfaction, personal effort, competence awareness, and individual self-realization. Statistical validation using Pearson's consistency criterion revealed meaningful disparities in average scores across the examined cohorts. While the mean values alone are insufficient to conclude the overall level of motivation, they do provide insight into statistically significant differences between groups. The individual scores across the subscales act as markers for internal motivational variance regarding the adoption of information technology in professional practice. Ultimately, this study establishes a clear link between the degree of intrinsic motivation and the readiness of pharmaceutical professionals to use information technology in their careers.

Keywords: Master of pharmacy, Digital competence, Distance learning, Information technology in pharmacy, Professional competence

Introduction

In today's digitalized world, enhancing the quality of higher professional education has become a pressing concern. The swift advancement of technologies, coupled with global challenges such as the COVID-19 pandemic, has intensified expectations placed on healthcare professionals and the educational systems that prepare them. These pressures demand significant reform in teaching strategies and instructional formats, prompting the exploration of alternative educational frameworks designed to cultivate competitive specialists and socially-aware, creative individuals within Ukrainian society [1, 2]. One prominent issue is the accelerating obsolescence of knowledge: educational curricula, once stable for extended periods, now undergo frequent and regular revisions. These evolving conditions in both education and healthcare underscore the need for digital transformation, which has become central to updating the approach to information training for Master of Pharmacy students. This transformation focuses on the development of comprehensive knowledge and hands-on

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proficiency in applying information technology in pharmacy-related professional practices.

Review of existing literature and studies

The professional and digital competence development of future IT-related specialists has been examined through various lenses. Spirin [3] explored socio-professional competencies, while Kucherenko [4] clarified the definitions and scope of information and communication competencies, highlighting their role within the broader framework of specialized professional skills. Practical and methodological strategies for training students at medical (pharmaceutical) institutions, particularly future Masters of Pharmacy, have been addressed by Mykytenko and Kucherenko [5], Mykytenko and Lapinsky [6], Kuchyn *et al.* [7], Dobrovolska [8], and Saenko and Morokhovets [9].

Further contributions in the field include Reva *et al.*'s work [10], which presents both theoretical insights and applied developments related to IT training for healthcare professionals. Her research proposes a pedagogical model for shaping IT competence among future doctors and pharmacists during their university education. Complementary to this, Reva *et al.* [11] developed a conceptual framework for fostering information and communication competence in medical students, capturing the instructional nuances unique to medical and pharmaceutical institutions. Meanwhile, Pushkarova *et al.* [12] explored methods to better prepare healthcare students for employing information technology in their future workplaces. Pelo *et al.* [13] investigated how students could be introduced to modern ICT tools and strategies for integrating these technologies into their upcoming professional roles.

The scholarly work [14–18] addresses various dimensions of the competency-based approach in pharmaceutical education. Their research covers future trends in pharmacy education, independent learning techniques, and the shifting landscape of training within the pharmaceutical sector.

This study seeks to evaluate the motivation levels and preparedness of graduates from pharmaceutical faculties of medical (pharmaceutical) higher education institutions regarding their integration of information technology into their professional endeavors.

Materials and Methods

To address the research objectives, a combination of theoretical and practical scientific approaches was applied. The bibliosemantic method facilitated the analysis of educational psychology sources, academic publications, and official regulations about the development of digital competence among future Masters of Pharmacy. In addition, empirical research methods were employed to assess both the motivation and readiness of pharmacy faculty graduates from medical (pharmaceutical) institutions of higher learning to utilize information technology in their professional roles. A total of 165 respondents participated in the survey, which was conducted with the contribution of V. Klimchuka and A. Musica. Finally, statistical analysis tools were used to structure both the conceptual and experimental findings, as well as to evaluate the presence of statistically meaningful differences between the respondent groups.

Results and Discussion

An examination of current patterns in applying information technology in pharmaceutical practice highlights the critical need to cultivate digital competence in upcoming pharmaceutical industry professionals. This necessity reflects a shift in training expectations—from basic usage to a professional-level command of information and computer technologies.

A report by the Joint Research Center (JRC), part of the European Commission's Science and Knowledge Service [19, 20], outlines five foundational dimensions of digital competence:

1. Information literacy, including navigating, retrieving, assessing, and managing digital content and data;
2. Digital communication and collaboration, involving interaction via digital means, active engagement in civic digital life, online cooperation, etiquette, and managing one's digital identity;
3. Content creation, which encompasses developing, integrating, and editing digital material, recognizing copyright boundaries and licensing, and basic programming;
4. Digital safety focused on securing devices, safeguarding personal data and privacy, maintaining physical and mental well-being, and environmental awareness;
5. Problem-solving, covering technical troubleshooting, identifying needs, creatively leveraging digital tools, and recognizing gaps in digital knowledge.

According to the European Parliament and Council Recommendations [21], digital competence entails the confident and discerning application of digital technologies in work, personal life, and communication. It is grounded in core ICT capabilities, such as operating computers to gather, analyze, store, create, share, and present information, and to engage in online collaboration and communication.

As the pharmaceutical sector continues to evolve—driven by rapid advancements in technology, shifts in consumer behavior, and changes in professional interactions—employers now demand higher qualifications from new entrants. To thrive in this innovative and technology-intensive field, professionals must be adept at managing data streams and applying information and communication technologies effectively. This underscores a vital responsibility of pharmaceutical education: to prepare a Master of Pharmacy with the competencies needed to provide high-quality services that integrate computer-oriented technologies into routine professional activities. However, such integration must be thoughtfully embedded into the educational framework—not imposed as an afterthought—to ensure it enriches both teaching and learning within medical (pharmaceutical) institutions of higher education [22].

The targeted direction for building digital competence among future Masters of Pharmacy involves a set of core objectives:

- Developing a solid foundation of theoretical knowledge related to information technology in pharmacy, including data collection, organization, transformation, and dissemination within medical and pharmaceutical systems. This also includes understanding various types and formats of pharmaceutical data, national standards, approaches for data modeling, and the use of software algorithms for supporting clinical and pharmaceutical decision-making [23];
- Enhancing operational skills in utilizing digital tools for professional use, such as employing web-based resources and services, processing textual and visual data using general and specialized software, applying medical-technological systems, and implementing statistical methods to extract insights from data;
- Gaining fluency in core digital concepts as defined by the educational curriculum of the Free Economic Zone. This includes competencies in text editing, spreadsheets, relational databases, and proficiency with medical information systems and online resources to support key responsibilities within the pharmaceutical profession.

Given the increasing integration of information technology in professional pharmaceutical practice, it is essential to prepare future Masters of Pharmacy as digitally literate professionals capable of leveraging such technologies effectively in their careers. This preparation requires cultivating a well-rounded, system-level understanding of information-analytical skills throughout their educational journey. Central to this process are core computer science disciplines such as “Information Technology in Pharmacy” and “Computer Modeling in Pharmacy”, which play a foundational role in shaping the technological mindset of students. The instructional strategies for these subjects in higher education must be closely aligned with the practical demands of the pharmaceutical sector.

Through engaging with these subjects, students should gain not only technical proficiency but also a clear comprehension of the diverse ways in which modern computer technologies can be applied to real-world pharmaceutical tasks. This approach serves to foster genuine interest and enhance motivation toward mastering computer-related competencies. As digital technologies rapidly evolve, it becomes increasingly important to continuously adapt educational infrastructure and enrich the pedagogical approach—both in terms of teaching formats and curricular content—to reflect emerging technological trends.

To identify methods for refining the educational paths of pharmacy students and boosting their preparedness for the digital requirements of their future roles, a survey was conducted targeting professionals within the pharmaceutical/pharmacy sector across various regions of Ukraine and spanning a range of age groups. The survey explored how the expertise acquired through computer science courses translates into everyday professional practice.

The study included 165 participants, of whom 46.1% were pharmacists, 6.1% were pharmacist-interns, 6.7% worked as pharmacists in other capacities, 6.7% were pharmacy managers, and 0.6% held department head roles, while the remaining 33.9% occupied miscellaneous positions. Age distribution was as follows: 72.7% were under 25 years old, 14.5% between 26–34 years, 7.9% from 35–44 years, 3.6% aged 45–54 years, and 1.2% over 55 years.

Work experience varied, with 23% of respondents having 1 year, 55.8% reporting 1 to 5 years, 11.5% between 5 and 10 years, 3% ranging 10 to 15 years, and 6.7% having over 15 years of experience.

A breakdown of technology use revealed that 68.5% frequently work with word processing tools (MS Word), while 62.4% engage with electronic forms in their roles. Nearly all respondents (98.2%) utilize the World Wide Web for professional purposes, with 87.3% turning to online resources for continuing education and skills enhancement. Information-reference and information-search systems are employed by 92.7%, and 67.3% support the online sale of pharmaceuticals via pharmacy websites. Additionally, 59.4% of respondents implement multimedia or interactive presentations in their work, and 74.5% reported designing queries, reports, or macros in databases during daily tasks.

The use of industry-specific software was also assessed, with participants identifying tools such as Skarb, IBC Pharmacy, ANR Pharmacy, Paracelsus, PC Pharmacy, and 1C. Pharmacy. Among these, 1C. Pharmacy emerged as the most widely adopted platform, used by 71.5% of respondents. The distribution and frequency of use for the remaining programs are detailed in **Figure 1**.

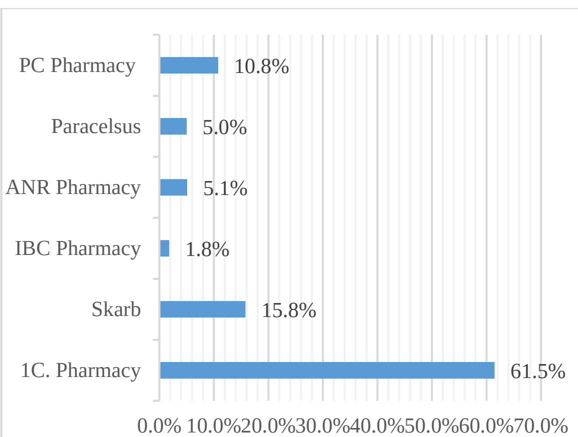

Figure 1. The use of software to sell and search for goods in pharmacies

In the realm of pharmaceutical practice, the integration of information technologies for functional approximation and statistical forecasting remains limited, with only 26.1% of respondents reporting active use of such tools. Slightly more prevalent is the application of computer-based statistical analysis specific to pharmaceutical data, utilized by 39.4% of participants in their professional tasks.

The study also explored the perception of distance learning among graduates of the Faculty of Pharmacy, a mode of education that expanded significantly during the COVID-19 pandemic. Opinions were divided: 43.6% endorsed remote education for future Masters of Pharmacy, 17.6% rejected its suitability, and 38.8% were undecided or found it difficult to respond definitively.

Another focal point of the survey involved assessing how knowledge from computer science disciplines is applied in daily pharmaceutical practice. A prevailing consensus emerged, indicating that digital competence is regarded by most respondents as an essential qualification for upcoming graduates of the Faculty of Pharmacy.

To gauge the perceived importance and relevance of digital competencies, respondents rated their views on a 10-point scale. The scores were distributed as follows: 22% awarded 10 points, 14% chose 9 points, 27% rated it 8, 11% assigned 7, followed by 5% for 6, 6% for 5, 5% for 4, 4% for 3, 3% for 2, and 2% marked it as 1 point. These detailed findings are presented in **Figure 2**.

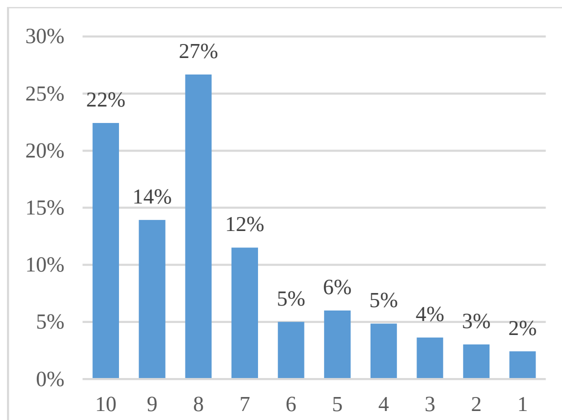

Figure 2. Distribution of respondents' answers on the importance of knowledge and skills acquired in the process of studying computer science disciplines for the professional activity of a pharmacist

Insights gathered from the questionnaire suggest that many professionals within the pharmaceutical industry actively incorporate the knowledge and practical skills gained from studying computer science disciplines into their work. Despite this, a portion of respondents still demonstrate minimal engagement with information technology in their day-to-day roles. Since the effectiveness of professional performance is heavily shaped by various motivational drivers, it becomes essential to identify and analyze the components that contribute to the motivational framework guiding IT use among pharmaceutical staff.

As outlined in the Ukrainian pedagogical dictionary, motivation can be defined as a complex of stimuli that prompt an individual toward specific behaviors or types of activity. Put differently, motivation encompasses the driving internal conditions that shape a specialist's actions and sustain behavioral activity over time.

To evaluate the depth of intrinsic motivation among pharmaceutical personnel regarding their use of digital tools, the study employed R. Ryan's Internal Motivation Questionnaire, adapted locally by V. Klymchuk and O. Musica. The instrument was designed to measure internal motivation—specifically, the personal interest and perceived value that drive individuals to engage in a particular activity, independent of external pressures or basic physiological demands.

The survey consisted of 14 questions, each measuring one of four motivational dimensions: job satisfaction, effort, awareness of existing competence, and personal self-realization. Each subscale allowed a scoring range from 1 to 5, except the "effort" scale which starts at 1, while the others range down to (-1).

Here are the statements respondents evaluated:

1. I found the work dull.
2. I took on the task by personal choice.
3. I felt confident in my qualifications while completing the task.
4. I exerted considerable energy.
5. I would describe the work as engaging.
6. I was pleased with the results.
7. I worked with genuine enthusiasm.
8. I struggled to comprehend and execute the task.
9. No one forced me to participate in the activity.
10. I believe I completed the task effectively.
11. I derived pleasure from performing the work.
12. I felt I had autonomy in choosing to complete the task.
13. I invested significant effort into the work.
14. Had I declined to work, it would have had negative consequences.

As highlighted in the methodological explanation, this tool serves research-oriented rather than diagnostic purposes. Thus, when applied to individual assessments, it does not provide valid standalone conclusions. Instead, its value lies in comparative analyses across two or more groups.

In our study, participants were classified into two segments based on their rating of the value of knowledge obtained in computer science disciplines:

- Group №1 included respondents who rated this importance from 6 to 10 points,
- Group №2 comprised those assigning scores from 1 to 5 points.

The breakdown of their responses across the motivational subscales is detailed in **Table 1**.

Table 1. Generalized distribution of respondents by subscales

Subscale \ Scale	Number of respondents (%) who got into each subscale							
	Group №1				Group №2			
	from 1 to 2	from 2 to 3	from 3 to 4	from 4 to 5	from 1 to 2	from 2 to 3	from 3 to 4	from 4 to 5
Pleasure from activity	13	29	35	24	34	26	21	18
Efforts made	9	31	40	20	42	21	18	18
Awareness of the formed competence	8	26	46	20	39	16	21	24
Personal self-realization	14	23	31	32	50	13	24	13

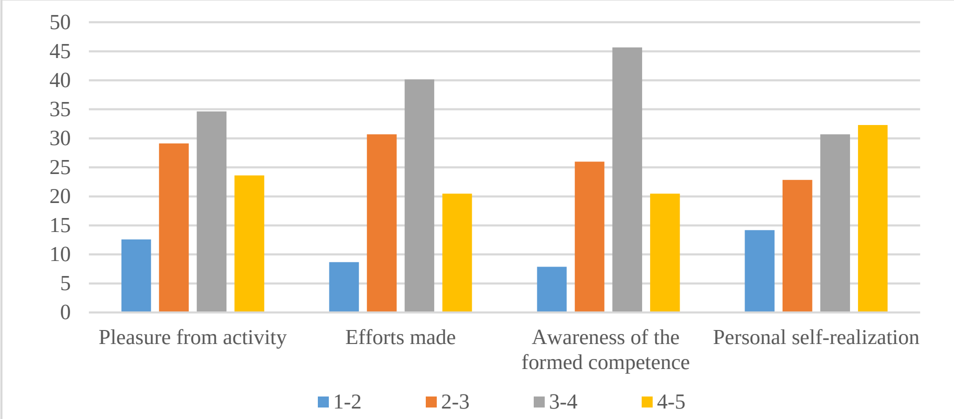

Figure 3. The results of the distribution of the first group of respondents

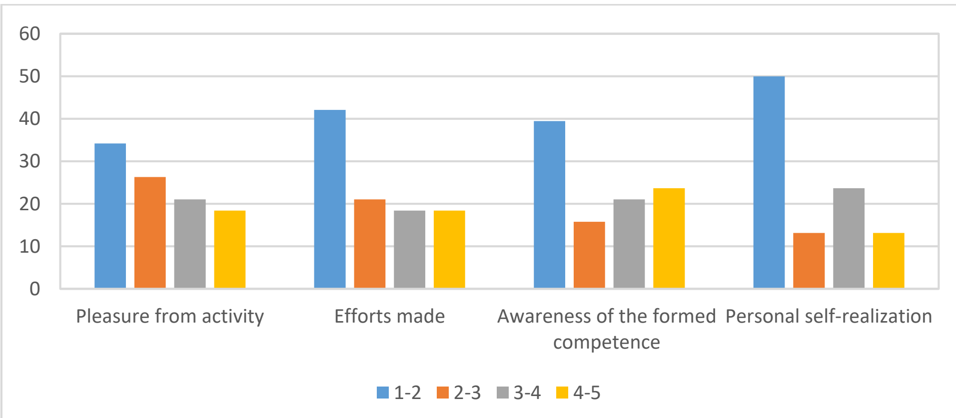

Figure 4. The results of the distribution of the second group of respondents

Given that the questionnaire lacks formally established benchmarks, the total scores recorded on each subscale were treated as indicative of variations in respondents' internal motivation to apply information technology within their professional scope. Accordingly, aggregated data were categorized and presented visually in **Figures 3 and 4**. Although direct comparisons between subscales are not methodologically appropriate—since individual participants may receive varying scores across different dimensions—this technique is suitable for drawing distinctions between the two predefined respondent groups, which differ in how they rated the relevance of computer science knowledge to the pharmaceutical profession.

The comparative evaluation of responses from group 1 and group 2 reveals noticeable differences in their average scores. For instance, in group 1, responses predominantly clustered in the 3–4 point range, representing 38% of the total. Conversely, group 2 was largely represented by scores in the 1–2 point range, accounting for 41%. That said, an in-depth look at individual subscales—such as "awareness of competence"—shows that group 2 occasionally exceeds group 1 in specific areas.

It is important to note that these groups are not uniform in composition. Since participants were selected randomly, the two samples are considered independent. The response scale consists of four categorical levels, making the data nominal. To assess whether the differences in average scores between the groups were statistically meaningful, the study employed Pearson's nonparametric criterion, with a significance threshold set at $\alpha = 0.05$.

$$\chi^2 = \sum \frac{(f - f_t)^2}{f_t}. \tag{1}$$

Where f is the empirical frequency, f_t is the theoretical frequency.

$$f_t = \frac{\sum f_i \sum f_j}{n}. \quad (2)$$

Where $\sum f_i$ is the sum of frequencies on the corresponding row, $\sum f_j$ – is the sum of frequencies on the corresponding column, n – the total number of observations.

Based on the χ^2-distribution table for degrees of freedom calculated as $\nu = (k - 1)(C - 1) = (2 - 1)(4 - 1) = 3$, and using a significance level of $\alpha = 0.05$, the critical χ^2 value (χ^2cr) is determined to be 7.8. Following the analysis, the empirical χ^2 value (χ^2emp) was calculated as 19.23. Since this empirical result exceeds the critical threshold, it provides sufficient statistical grounds to assert that the differences observed between the group distributions are indeed significant.

While averaging the subscale scores does not offer a comprehensive reflection of the overall motivation level, it does support the conclusion that measurable differences exist between the two groups. Interpreting the point totals as relative indicators, a higher cumulative score on the subscales is taken to imply a stronger degree of internal motivation regarding the integration of information technology in pharmaceutical professional settings.

Conclusion

The contemporary landscape of the pharmaceutical field demands competent professionals who are not only proficient in core pharmaceutical disciplines but also capable of confidently integrating information and communication technologies into their routine professional tasks. These specialists must also demonstrate the ability to handle extensive datasets, engage in continuous learning, pursue scientific inquiry, and commit to personal and professional development.

Findings from the research indicate a correlation between the degree of intrinsic motivation and the willingness to apply information technology within the scope of pharmaceutical work. Participants who rated the value of informatics knowledge in pharmacy lower exhibited reduced motivation levels across all four measured subscales.

It is essential to recognize that the use of R. Ryan’s internal motivation questionnaire focuses exclusively on intrinsic motivational dimensions, omitting various external motivators—such as financial incentives, social status, or external criticism—which may influence behavior, at times fostering passivity or diminishing proactive engagement.

Future investigations should focus on strategies to enhance the digital proficiency of upcoming Masters of Pharmacy, as well as trace and evaluate the evolving professional trajectories of graduates from medical (pharmaceutical) institutions of higher education (M(F)IHE).

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