

THE EFFECTS OF DIGITAL TECHNOLOGY ON TRAINING INFORMATION TECHNOLOGY FOR AGRICULTURAL ENGINEERS AT THAI NGUYEN UNIVERSITY OF AGRICULTURE AND FORESTRY

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Received:	13/9/2023	Training information technology (IT) at universities is a key factor in forming and developing technological capacity for agricultural students. In today's 4.0 era, when digital technology has gradually taken over professional jobs, innovation is crucial for training information technology. To determine the effects of digital technology on training Informatics for students at Thai Nguyen University of Agriculture and Forestry, the article uses theoretical research methods, practical research, and data processing. The results of the article can not only show how graduates' training information technology ability can satisfy their actual job requirements, but also be the basis for proposing some specific measures for training information technology, under the influence of digital technology to improve learners' capacity to meet the new requirements of today's digital agriculture.
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ẢNH HƯỞNG CỦA CÔNG NGHỆ SỐ ĐẾN QUÁ TRÌNH ĐÀO TẠO TIN HỌC CHO KỸ SƯ NÔNG NGHIỆP TẠI TRƯỜNG ĐẠI HỌC NÔNG LÂM – ĐẠI HỌC THÁI NGUYÊN

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THÔNG TIN BÀI BÁO		TÓM TẮT
Ngày nhận bài:	13/9/2023	Đào tạo về Tin học trong trường đại học là yếu tố đóng vai trò chủ đạo để hình thành và phát triển năng lực về công nghệ cho sinh viên ngành nông nghiệp. Trong thời đại 4.0 hiện nay, khi công nghệ số đã và đang dần chiếm lĩnh các công việc chuyên môn, yêu cầu đổi mới trong giáo dục Tin học là tất yếu. Để xác định được những ảnh hưởng của công nghệ số đến quá trình đào tạo về Tin học cho sinh viên trường Đại học Nông lâm - Đại học Thái Nguyên, bài báo sử dụng các phương pháp nghiên cứu như: Phương pháp nghiên cứu lý luận, nghiên cứu thực tiễn và xử lý số liệu. Kết quả của bài báo bên cạnh việc cho thấy mức độ đáp ứng về trình độ Tin học của sinh viên sau khi ra trường so với yêu cầu thực tế công việc, còn là cơ sở để đề xuất một số biện pháp cụ thể cho công tác đào tạo về Tin học trước những ảnh hưởng của công nghệ số nhằm nâng cao năng lực người học, đáp ứng yêu cầu mới của nền nông nghiệp số hiện nay.
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1. Introduction

The impact of the 4.0 revolution has led to drastic changes in all areas of modern society. In particular, agriculture applying digital technology is a widespread and highly effective development trend in countries in the region and the world [1].

In Israel, agricultural technology attracts about 7% of global funding for new technologies. Devices such as automated robots or unmanned aerial vehicles have been initiated here and are being widely used in almost all stages, for example: Sow, put down fertilizer, spray, agricultural harvest, etc. [2]. The "Internet plus" strategy in China has created millions of job opportunities for workers, improved agricultural production efficiency, and created a sustainable agricultural ecosystem [3]. In Thailand, solutions for indoor farming with IoT, sensors, and automation equipment are provided by many companies to develop a variety of profitable agricultural products [4].

In Vietnam, digital technology has been applied more and more in enterprises in the agricultural sector. The results in the studies [5]-[8] show that information on animal health, humidity, temperature, pests, nutrition, and crop yield are done through sensor measuring devices. Devices such as automatic robots or unmanned aerial vehicles have been used in crop irrigation, crop yield monitoring, feed mixing, milking, product quality classification, spraying, and pest control on crops. In addition to farming and animal husbandry activities, production and business activities also changed significantly. Channels of product introduction, promotion, and consumption are strongly developed through forms of e-commerce to create favorable conditions for consumers, increase the ability to connect with customers and improve the operational efficiency of the value chain.

The change and development of technology have led to new needs for human resources, the structure of occupations, and the qualifications of workers in the agricultural sector. In the field of agribusiness, research by Erickson et al [9] has shown that the knowledge, skills, and capabilities that employers require are the abilities to install, calibrate, troubleshoot, and repair equipment; precise agricultural knowledge, and text processing skills. According to Aleshina et al [10], the training of students at universities should focus on the ability to program, database creation and management, and how to work with automation devices. The study of Kopishynska et al [11] provides an electronic energy framework to be achieved for agricultural students in Ukraine include: Innovation of technologies, document processing, information and knowledge management, and process improvement.

The requirements of the actual work have led to an inevitable change in higher education. Training programs have drawn a lot of interest from educational institutions. However, the actual quality of training has not really met the expectations of employers or training institutions. Research by Erickson et al [9] shows that Employers in the agribusiness sector find it difficult to find qualified candidates due to low qualifications or a lack of key skills in their profession. In the study of Bournaris [12], the technology skills of students studying at Agricultural Universities in the Euro-Mediterranean region are only at an average level (Portugal, Spain) and below average (Greece, Italy). Most students are aware of the importance of precision agriculture technologies. However, they think they have not received much training in these skills.

In Vietnam, N. N. A. Pham's research at the Mekong Delta region showed that although human resources in the agricultural sector had a high proportion of university and college degrees, the practical operational competencies such as: Foreign languages, training information technology (IT) or science and technology still did not meet the needs of the job [13]. Research by M. T. Pham [14] also showed that, the quality of training in Informatics, Foreign languages and Soft skills of students at the Vietnam National University of Forestry is still limited. In research by T. T. Hua & T. H. Trinh [15] on the current status of the job competencies of students at the university of Agriculture and Forestry, Thai Nguyen university, the average score of students' IT competence achieved after graduation (3.32) is much lower than the requirements of employers (3.61).

In order to improve the technological capabilities of employees, the quality of training in general and training in IT in particular at universities plays a key role. However, many studies find that this training has not yet responded to the general development trend. Therefore, the objective of this study is to understand the impacts of digital technology on the agricultural sector and the training of ITs for agricultural students. Based on the analysis of the current situation of training IT at the University of Agriculture and Forestry - Thai Nguyen University (TUAF), the study proposes some solutions in training IT to suit the reality at TUAF today.

2. Methodology

In this article, we use theoretical and practical research methods to talk about the impacts of digital technology in agriculture, the current situation of Informatics education, and the status of students' qualifications in the field of agriculture.

The data processing method is used to assess the status of students' qualifications and factors affecting IT training at TUAF. We conducted a survey for lecturers and students, during the period from September 2021 to June 2022. For lecturers, we took a survey of 16 lecturers teaching General Informatics and Applied Informatics. For students, the survey was conducted with 384 first-year students (who have not studied informatics courses at school) and 312 final-year students (about to graduate). The purpose of the student survey is to assess the difference in the level of students before and after learning IT, the initiative of students in learning, and at the same time determine the level of achievement of students after the training process. To conduct this survey, we use the IT application competency framework of agro-forestry engineers that we have built previously, including 07 competencies and 21 criteria [16]. The survey uses a 5-point Likert scale, in which the actual situation of students' ability in IT is assessed on a scale from 1 (very poor) to level 5 (very good), while the current status of teaching and learning is from level 1 (not used) to level 5 (very often).

The data collected after the survey was entered in Excel and used as input data on the IBM SPSS Statistics 20, statistics in proper case. The data is statistically classified according to the coded variables, and the mean scores and standard deviations of the responses in the collected survey sheets are calculated. The scale is tested using Cronbach's Alpha coefficient. This is a method to help eliminate inappropriate variables and evaluate the reliability of the scale. The scale is considered reliable if: The corrected Item - Total Correlation coefficient is ≥ 0.3 and Cronbach's Alpha coefficient is ≥ 0.7 .

3. Result and recommendations

3.1. The current situation of IT training for students at TUAF

3.1.1. Features of the Informatics training program for students at TUAF

At TUAF, the courses of IT include General Informatics and Applied Informatics. For General Informatics, the content of the course helps students to form and develop basic knowledge and skills such as general understandings of policies, trends, and laws in using IT; knowledge of computer networks, the Internet, and basic operations; how to use office software and applications to present documents, process spreadsheets, the ways to create presentations in practice; how to find and use information; how to use forms of electronic communication in communicating, introducing and promoting products, etc. [17].

For Applied Informatics courses, depending on the profession, there are differences between the courses, in order to provide general and in-depth knowledge for that profession as: Build industry databases, manage product quality and value chains; be able to use a number of media in propaganda, product promotion and market development; be able to use a number of smart agricultural equipment and software; have an understanding of the laws in using IT and apply them to communication, and behavior in the digital environment.

3.1.2. The current situation of the Informatics level of students at TUAF

After surveying the students' Informatics levels, we obtained the following results: The correlation coefficient of the total variables was greater than 0.4, with the coefficient of Cronbach's Alpha for first-year and final-year students being 0.804 and 0.852 respectively. This proved that the observed variables have high reliability, and the scale given in this study is reliable and suitable for analysis.

The survey results on the time of using IT devices in a day showed that students often use these devices for a relatively high amount of time. 63.3% of first-year students spend 4-6 hours a day on predominantly smartphone devices. For final year students, 57.9% of students spend 4 hours or more on a variety of devices, and nearly half of them use computers for more than 6 hours. The difference in the purposes of using IT devices between the two above student groups is shown in the following figure 1.

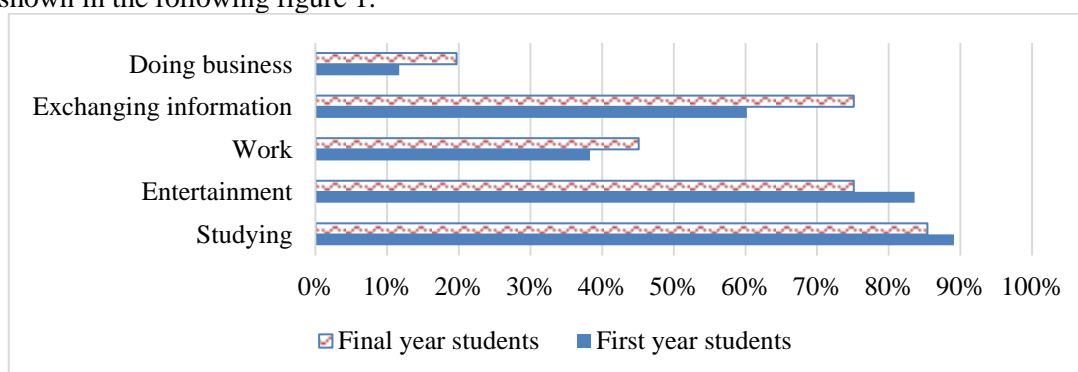


Figure 1. Purpose of using IT devices of first year and final year students

According to the above data, students are more interested in activities such as learning, entertainment, and information exchange. Besides the main task of studying, many students now work part-time. Many students participate in jobs using IT equipment, a few students carry out self-employment forms with the support of these devices.

For the survey results on each specific competency criterion, after running the software, we obtained the average score and the difference between the two groups of students. The above difference can be represented in more detail through the figure 2.

Through the statistical figure in the fig. 2, it can be seen:

Firstly, the level of Informatics of the first-year students at TUAF is quite low, below the average level with the obtained results ranging from 2.13 to 2.93. This is consistent with the characteristics of current first-year students at the university: Most students come from remote and isolated areas, areas with special difficulties, learning opportunities and exposure to technology devices are limited, and input quality is low. Besides, a number of criteria such as Competence 4.10, Competence 5.13, and Competence 5.14 are related to professional expertise that students have not been trained and Competence 6.19 is about how to apply in professional practice.

Secondly, the education of Informatics in the university is effective with all criteria being improved with a difference between 0.74 and 1.45. However, this result is only average with the average score of all criteria being 3.5. Scores of Competence 4.9 and Competence 4.10 reached the lowest level. This shows that students are not familiar with the technological equipment commonly used in agriculture. Students rated their own ability better in the criteria Competence 1.3, Competence 2.5, Competence 5.11, Competence 6.17, Competence 7.20, Competence 7.21. They are the abilities to self-study, and self-update about the regulations and new trends of technology; skills in searching and exchanging information; skills in using office utilities and software; communication skills, cooperation, and application of e-commerce forms.

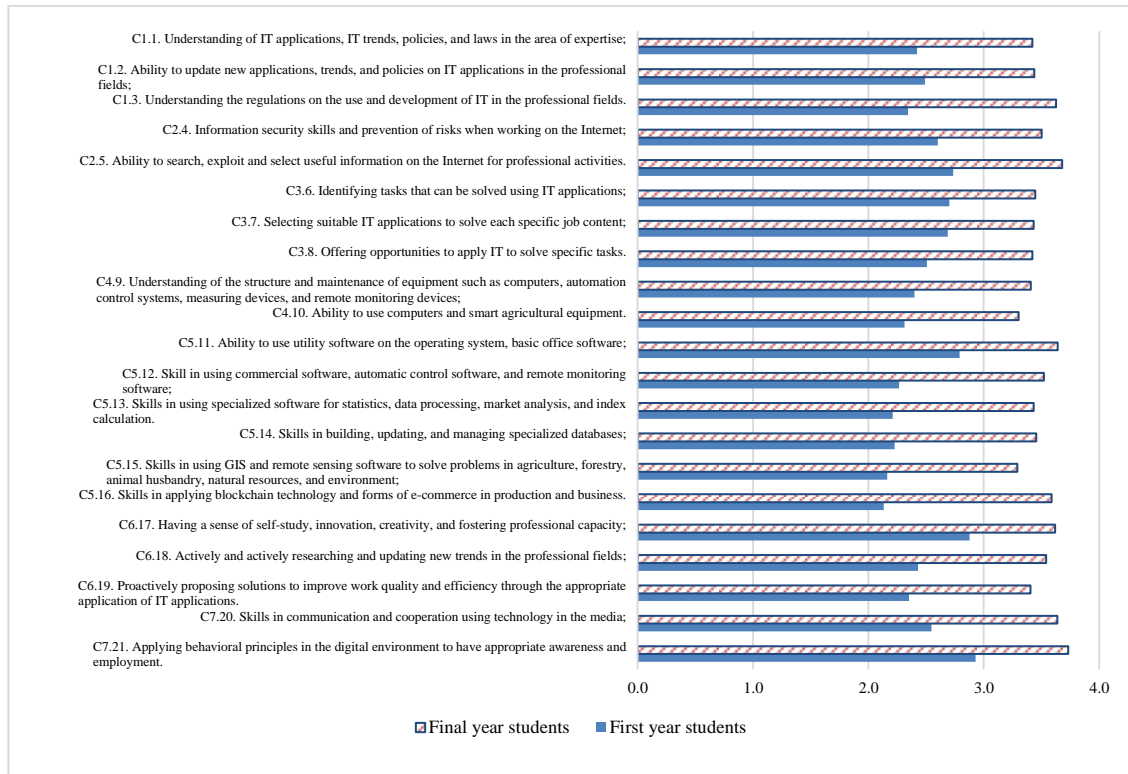


Figure 2. Comparison of the achievement of the competence criteria of first-year and final-year students

From the above analysis results, we find that:

The education of Informatics for students at TUAF has achieved certain effects. Students have a basic understanding of technology and basic software; they can see the importance of the subject and the role of technology; they also have the ability to self-study, consciously practice soft skills; have the ability to exploit information, and initially know how to apply technology in advertising and business. This is one of the competencies needed to support product development and startups today.

However, the weakness of students is reflected in the knowledge and skills for equipment and software of automatic control devices and smart agricultural equipment. Besides, students' ability to apply knowledge in practice is still limited. According to our research, the introduction of subjects on smart agriculture has only been shown in the training programs of the Crop industry and high-tech agriculture. Other industries still just stop at basic IT applications, there is no update according to new trends. Through the actual survey and collecting opinions of students, many students need to learn about these devices in practice. However, the investment in these devices in the university is still very limited. Most new students are only introduced to the subject and observed during practice or internship. Meanwhile, students participating in professional internship programs abroad have very good skills. Most of them, after graduation, start their own businesses through farms on agricultural products or work for high-tech companies in agriculture.

3.1.3. The current situation of teaching and learning Informatics subjects at TUAF

To assess the current situation of students' teaching and learning of Informatics subjects, we conducted a survey of the opinions of 16 lecturers teaching Informatics subjects and 312 final-year students at the school.

Survey results about teaching methods/techniques that teachers often apply show that: Teachers mainly use specific methods in teaching Informatics and traditional teaching methods, such as

presentation, conversation, practice, and problem-solving. Survey results on teachers' updating with modern teaching methods and teachers' support for students is shown through the figure 3.

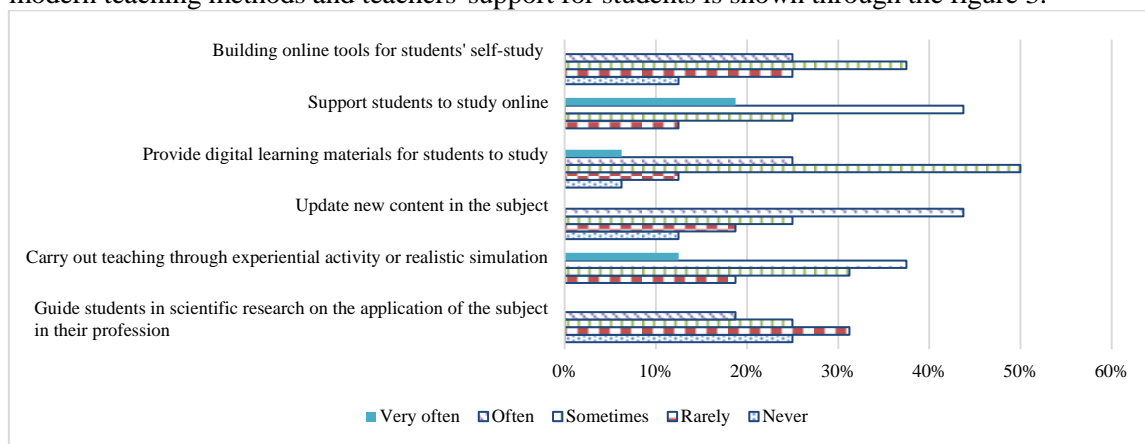


Figure 3. Survey results on technology updates in teaching and teacher's support for students

According to the data on the figure, 69% of teachers regularly update subject content, and more than 50% of teachers were interested in applying subject knowledge into practice through the application of different teaching methods and scientific research activities. Teachers also often support students in learning activities and self-study. However, the provision of digital resources for students has not been popularized. Much of the material is still in hard copy, not updated yet. E-learning methods are quite popular nowadays, however, only a few teachers have implemented them with a simple construction method, little content, and have not yet attracted the attention of students. The main tools used are course site, Edmodo, Schoology, and MS Teams.

The results of the survey on the frequency of students' learning activities show that the frequency of students participating in learning activities is only at an average level. Except for group work activities and practical activities in class at 60%, the remaining activities are only at low levels. This shows that students are still not active in carrying out learning activities. Through the survey results on teachers and students, it can be seen that besides traditional teaching methods, teachers have had access to active teaching methods. However, the level of use is still not much, especially in the methods that connect subject knowledge with practice. Most of the teaching methods are still used in the traditional way, not taking advantage of the advantages of ICT. A part of students is still passive in the learning process.

Thus, through the assessment of the current situation of Informatics training at TUAF, it can be affirmed that the Informatics training program for students has not caught up with the development trends of technology in agriculture; teaching and learning methods have not made the most of the advantages of technology and communication; level and access to technologies in smart agriculture are limited; the facilities for teaching and learning activities do not meet the requirements.

From the above analysis, we draw conclusions about some of the effects of digital technology on the training process of Informatics at TUAF as follows:

Firstly, digital technology changes some subjects in the curriculum. The application of technology in performing professional activities requires the addition of new subjects. Those are subjects related to controlling and exploiting technological devices, collecting, and analyzing data to make timely and accurate forecasts and decisions. In addition, the content of the subjects must also be regularly updated to suit the needs of students.

Second, digital technology creates favorable conditions to diversify teaching ways and methods. The traditional face-to-face teaching and learning in the classroom with the aid of the board and chalk is being replaced by online classes using technology devices. Teaching methods

are geared towards capacity development, motivation, self-study, and personalized learning. The use of digital applications in the design and simulation of teaching content will create practical experiences, create excitement, and enhance the ability to apply knowledge to practice.

Third, digital technology promotes the activeness and flexibility of learners. With a rich digital data warehouse, learners will easily access resources for self-study and research. Online courses, teaching software, or other forms of distance learning, e-training create a flexible educational environment that meets the needs of learning anytime, anywhere, creating favorable conditions for learning at a lower cost.

3.2. Recommendations

In order to promote the advantages of digital technology in teaching, and at the same time improve students' adaptive capacity to the strong impact of digital technology on employment in the agricultural sector, we propose some solutions for IT training at TUAF are as follows:

To the university, the university should:

Regularly update the training program, including references from many sources; compare the training program with training curricula in developed agricultural countries; focus on developing new technology-related subjects.

Update the output standards of Informatics to suit the requirements of the new program.

Implement digital transformation in all aspects of the university; increase investment in IT infrastructure and smart agricultural equipment; connect with enterprises in the training process to take advantage of facilities and improve students' ability to apply knowledge into practice.

Create favorable conditions for teachers to develop professionally; encourage research related to the application and development of technology in the major.

To the lecturers, the lecturers should:

Regularly update the content of the subject according to the change in technology and new requirements of the job.

Create a modern learning environment, including regular support and interaction between teachers and students; use active teaching methods in addition to subject-specific methods to improve students' ability to apply knowledge into practice; diversify forms of teaching organization, giving priority to those with the high practical connection.

Encourage students to participate in programs, projects, and scientific research topics on the application of the subject in practice to improve knowledge, skills, and access to specialized knowledge in the industry.

Promote and enhance the student's ability to self-study, research, and practice necessary soft skills, with emphasis on exploiting rich digital learning resources and combining the use of learning methods, such as e-learning, m-learning, u-learning, and smart-learning.

Participate in training courses and workshops to improve professional capacity, keeping up with the trends of modern society.

4. Conclusions

The main purpose of our study is to investigate the factors that need to change in the process of informatics training for students at TUAF under the impact of digital technology on the education and employment of agricultural engineers. The results of the article show that factors related to training programs, facilities, and teachers need to change in order to meet technological innovations and the advantages of technology in the process of teaching and learning. We have also proposed some solutions for Informatics training at TUAF in the coming time. In the solution section, we have not mentioned the learner factor, due to the unique characteristics of this object at TUAF, the conditions of facilities, and factors in teaching that affect the ability to self-study, explore and use technology. Learners are the most important factor, in determining the final outcome of the training process. Therefore, we will specifically address this solution in future studies.

REFERENCES

- [1] R. Birner, "Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges," *Agric. Appl. Econ. Assoc.*, vol. 43, pp. 1260-1285, 2021, doi: 10.1002/aep.13145.
- [2] A. Tal, "Israeli agricultural innovation: Assessing the potential to assist smallholders," in *Working paper, Syngenta Foundation's Policy Initiative and Department of Public Policy*. Tel Aviv University, Israel, 2019, pp. 299-358.
- [3] C. Zhao, J. Li, X. Feng, and M. Guo, "Application Status and Trend of 'Internet Plus' Modern Agriculture in China and Abroad," *Chinese J. Eng. Sci.*, vol. 20, no. 2, p. 50, 2018, doi: 10.15302/j-sscae-2018.02.008.
- [4] J. Muangprathub, N. Boonnam, S. Kajornkasirat, N. Lekbangpong, A. Wanichsombat, and P. Nillaor, "IoT and agriculture data analysis for smart farm," *Comput. Electron. Agric.*, vol. 156, no. November 2018, pp. 467-474, 2019, doi: 10.1016/j.compag.2018.12.011.
- [5] M. T. Ha *et al.*, "Current situation and solutions for promoting hi-tech agriculture application in production, preservation and processing in Thai Nguyen province," *TNU J. Sci. Technol.*, vol. 228, no. 08, pp. 457-465, 2023, doi: <https://doi.org/10.34238/tnu-jst.7998>.
- [6] M. H. Vuong and T. T. Nguyen, "Development of agricultural 4.0 in Vietnam: Successful models and barriers," *J. Sci. Technol. Hanoi Univ. Ind.*, no. 52, pp. 129-132, 2019.
- [7] H. H. Le, L. O. Nguyen, D. L. Do, and T. B. N. Nguyen, "Study to improve of automatic control system in tea black production ferment processing by applying of digital image processing technology," *TNU J. Sci. Technol.*, vol. 225, no. 06, pp. 388-395, 2020.
- [8] M. H. Tran and T. T. P. Nguyen, "The Application of High Technology by Agricultural Cooperatives in Long An Province," *VNU J. Sci. Econ. Bus.*, vol. 37, no. 1, pp. 78-89, 2021.
- [9] B. Erickson, S. Fausti, D. Clay, and S. Clay, "Knowledge, Skills, and Abilities in the Precision Agriculture Workforce: An Industry Survey," *Nat. Sci. Educ.*, vol. 47, no. 1, pp. 1-11, 2018, doi: 10.4195/nse2018.04.0010.
- [10] E. A. Aleshina, D. V. Serdobintsev, and I. S. Novikov, "Formation of the Personnel Potential of the Digital Transformation of the Agriculture in Russia," *Sci. Pap. Manag. Econ. Eng. Agric. Rural Dev.*, vol. 21, no. 2, pp. 27-38, 2021.
- [11] O. Kopishynska *et al.*, "Information systems and technologies in agronomy and business: Employers' requirements-oriented study in agricultural universities," *25th World Multi-Conference Syst. Cybern. Informatics, WMSCI 2021*, vol. 19, no. 8, pp. 113-118, 2021.
- [12] T. Bournaris *et al.*, "Current Skills of Students and Their Expected Future Training Needs on Precision Agriculture: Evidence from Euro-Mediterranean Higher Education Institutes," *Agronomy*, vol. 12, no. 2, pp. 1-13, 2022, doi: 10.3390/agronomy12020269.
- [13] N. N. A. Pham, "Human Resource Training for Agriculture and Rural Areas in the Process of Industrialization and Modernization in the Mekong Delta," *CTU J. Innov. Sustain. Dev.*, vol. 33, pp. 102-108, 2014.
- [14] M. T. Pham, "*Solutions to improve the quality of foreign language, information technology and soft skills training for students at the Vietnam National University of Forestry*," Vietnam National University of Forestry, 2019.
- [15] T. T. Hua and T. H. Trinh, "Current status of the job competencies of students at the university of Agriculture and Forestry, Thai Nguyen university," in *Proceedings of the 2nd international conference on innovation in learning instruction and teacher education – ilite2*, 2021, pp. 312-325.
- [16] T. T. Hua, "The status of it application competence of students of Thai Nguyen University of Agriculture and Forestry," *Int. J. Adv. Res. Innov. Ideas Educ.*, no. 6, pp. 1267-1275, 2022.
- [17] Thainguyen University Agriculture and forestry, "Detailed outline General Informatic course," 2022. [Online]. Available: <http://cfi.tuaf.edu.vn/>. [Accessed July 10, 2023].