

Didactic Potential of Humanities in Developing Transformative Competencies among Computer Engineering and Information Technology Undergraduates

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Abstract. In the recent decades harnessing the advanced information technologies and their tremendous potential to improve the quality of life for people all over the world is becoming an urgent need than a luxury. Knowing full well that as an innovative student-centred learning paradigm Education 4.0 creates favourable prerequisites for developing valuable professional skills, abilities and knowledge among Computer Engineering and Information Technology undergraduates, the researchers assumed that it also might be effective in preparing them for challenges of the contemporary world through developing their transformative competencies while studying the humanities. The paper aims to reveal the didactic potential of humanities for developing Computer Engineering and Information Technology undergraduates' transformative competencies. The researchers carried out an exploratory study in five Ukrainian universities using an online survey conceived and developed by a team of researchers. A total of 275 respondents selected by means of a purposeful sampling method took part in the survey. The study found that humanities (1) are more likely to apply various learning activities which can be done both individually and in groups than technical disciplines and (2) have much broader potential for developing all key constructs of transformative competencies among Computer Engineering and Information Technology undergraduates than technical disciplines. The results enabled the researchers to formulate recommendations for university teachers of humanities on how to develop transformative competences among Computer Engineering and Information Technology undergraduates. The combination of challenge-based learning (CBL) and activity-based learning (ABL) is being

considered as a major methodological approach of Education 4.0 for developing transformative competences among Computer Engineering and Information Technology undergraduates. Scientific novelty of research consists in revealing and describing the didactic potential of humanities for developing Computer Engineering and Information Technology undergraduates' transformative competencies.

Keywords: *activity-based learning, challenge-based learning, Computer Engineering and Information Technology undergraduates, Education 4.0, transformative competencies.*

I. INTRODUCTION

In the recent decades harnessing the advanced information technologies and their tremendous potential to improve the quality of life for people all over the world is becoming an urgent need than a luxury. Knowing full well that as an innovative student-centred learning paradigm Education 4.0 creates favourable prerequisites for developing valuable professional skills, abilities and knowledge among students [1] – [2], the authors of this paper assumed that it also might be effective in preparing Computer Engineering and Information Technology undergraduates for challenges of the contemporary world through developing their transformative competencies while studying the humanities.

More and more often researchers who are actively engaged in the problem of improving the training of Computer Engineering and Information Technology

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undergraduates emphasize that although the majority of present-day degree programmes for Bachelor of Science in Engineering in general and Bachelor of Science in Computer Engineering and Information Technology in particular are aimed at developing technical or so-called hard skills, higher educational institutions should also give due consideration to developing soft skills or competencies which will enable students studying at such programmes to make sound decisions and take responsible actions for the betterment of themselves and globalised knowledge-based society [3] – [8]. One possible explanation for it could be the fact that in the information era special requirements and high expectations are laid on students who specialise in Computer Engineering and Information Technology, since after graduating it is they who will be able to offer innovative technical solutions to upgrade aging information technologies, let alone to create breakthroughs in the field of computer science for further informatisation and computerisation of the world society. Taking the ideas set forth in the document entitled “OECD Future of Education and Skills 2030 Concept Note: Transformative Competencies for 2030” [9] as axiomatic, it should be noted that in order to achieve this objective, Computer Engineering and Information Technology undergraduates have to be equipped with three transformative competencies which can help them “shape the future for better lives” [9, p. 4].

Implying more than just the acquisition of knowledge and skills, the concept of “competency” includes the combination of such knowledge, skills, attitudes and values that enables their bearers to meet complex demands [10]. In this regard transformative competencies are those that “enable students to develop and reflect on their own perspective, and because they are necessary for learning how to shape and contribute to a changing world” [11, p. 8].

It should be noted that several concept notes developed by OECD identify three transformative competencies that “together address the growing need for young people to be innovative, responsible and aware” [10, p. 5]. These three transformative competencies are creating new value, reconciling conflicts and dilemmas and taking responsibility [9] – [11]. Each of the abovementioned transformative competencies consists of definite key constructs. Thus, for instance, sense of purpose, curiosity, open mindset, critical thinking, creativity, collaboration, agility, an ability to manage risks and adaptability are considered as key constructs of creating new value [9] – [11]. Key constructs which characterise reconciling conflicts and dilemmas as a transformative competency are cognitive flexibility, perspective-taking skills, empathy, respect towards others, creativity, problem-solving skills, conflict resolution skills, resilience, tolerance for complexity and ambiguity, sense of responsibility towards others [9] – [11]. Taking responsibility as a transformative competency is distinguished by locus of control, a sense of integrity, compassion, respect for others, critical thinking, self-awareness, self-regulation, reflective thinking, ability to build trust [9] – [11].

A search of the literature shows that being uniquely human transformative competencies can be effectively taught and learned during interactions with other people and, therefore, educational institutions on different levels can become an excellent place for their forming and developing. Moreover, one of the indisputable advantages of transformative competencies is that once learnt they can be used throughout the lifespan [9] – [11].

The present research is aimed at revealing the didactic potential of humanities for developing Computer Engineering and Information Technology Undergraduates’ transformative competencies.

II. MATERIALS AND METHODS

The researchers carried out an exploratory study in five Ukrainian universities using an online survey conceived and developed by a team of researchers. These universities were Kyiv National University of Technologies and Design (Kyiv, Ukraine), Interregional Academy of Personnel Management (Kyiv, Ukraine), National Aviation University (Kyiv, Ukraine), Kyiv National Economic University named after Vadym Hetman (Kyiv, Ukraine) and Kryvyi Rih National University (Kryvyi Rih, Ukraine).

To gather the information the researchers needed, they developed a web-based questionnaire in Google Forms. The essence of the concept of “transformative competencies”, the approach to classifying transformative competencies and their key constructs provided by “OECD Future of Education and Skills 2030 Concept Note: Transformative Competencies” [9] formed the basis for developing a web-based questionnaire which consisted of three separate parts.

Considering the idea raised at the World Economic Forum in 2017 that by 2030 the role of women graduating with a degree in STEM field would be of vital importance to leveraging the Fourth Industrial revolution to benefit our global society [12], the first part of the questionnaire included one question concerning participants’ gender and one question concerning the participants’ place of study.

The second part of the web-based questionnaire was aimed at finding out how knowledgeable present-day Ukrainian Computer Engineering and Information Technology undergraduates were about transformative competencies and their key constructs, on the one hand, and assessing the importance of transformative competencies and their key constructs for participants’ further professional development and succeeding in the future workplace, on the other hand. In this part of the web-based questionnaire respondents were asked to indicate if they were knowledgeable about the concept of “transformative competencies” and if they knew that creating new value, reconciling conflicts and dilemmas and taking responsibility constitute three transformative competencies. Then the respondents were asked to assess the importance of three transformative competencies (namely, creating new value, reconciling conflicts and dilemmas, taking responsibility) for achieving success and further professional development according to a 4-Likert

scale (where 1 – extremely unimportant, 2 – unimportant, 3 – important, 4 – extremely important). After that the respondents had to choose 5 most important key constructs from the proposed list of key constructs associated with three transformative competencies.

The third part of the web-based questionnaire which included two open-ended questions was developed to ascertain present-day Ukrainian Computer Engineering and Information Technology undergraduates' views on what learning activities and academic disciplines were the most effective in developing transformative competencies during their training at university. Participants' responses to the open-ended questions included in the third part of the web-based questionnaire were generalized by means of content analysis method.

Since the paper aimed to reveal the didactic potential of humanities for developing Computer Engineering and Information Technology undergraduates' transformative competencies, the team of researchers used a purposeful sampling method to select respondents. After the web-based questionnaire was created, a link to it was purposefully distributed among undergraduates who specialise in Computer Engineering and Information Technology. As a results, the researchers received 275 completed questionnaires. The data collection lasted for two months from 3 October to 30 November 2022.

III. RESULTS AND DISCUSSION

A. Gender Data

Table 1 demonstrates the gender data on online survey participants. The data in Table 1 below clearly shows that out of 275 Computer Engineering and Information Technology undergraduates who took part in the online survey, 84.3% were male and 15.7% were female. These data prove the fact that female Computer Engineering and Information Technology students continue to be under-represented in traditionally male occupations in Ukraine and such specialisations as Computer Engineering and Information Technologies are still the most popular among male students. These data also show that although the need for women in tech is growing every year, the number of female students graduating with a degree in computer science is not actually high in Ukraine.

TABLE 1 GENDER DATA ON ONLINE SURVEY PARTICIPANTS

| Higher Education Institution | Number of Participants | | | |
|--|------------------------|---------|--------|---------|
| | Male | | Female | |
| | Number | Percent | Number | Percent |
| Kyiv National University of Technologies and Design | 57 | 20.7 | 12 | 4.4 |
| Interregional Academy of Personnel Management | 39 | 14.2 | 9 | 3.3 |
| National Aviation University | 49 | 17.8 | 7 | 2.6 |
| Kyiv National Economic University named after Vadym Hetman | 52 | 18.9 | 8 | 2.9 |
| Kyryvy Rih National University | 35 | 12.7 | 7 | 2.5 |

Source: own study (N=275)

Figure 1 illustrates the data on gender difference between online survey participants.

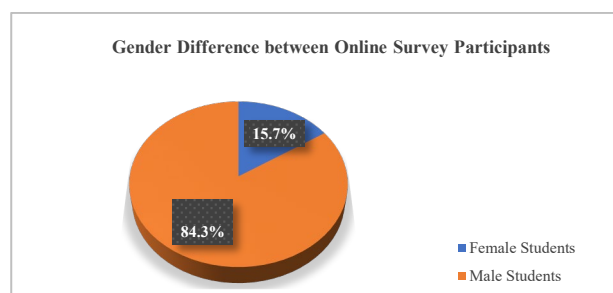


Fig. 1. Gender Difference between Online Survey Participants.

B. Awareness of Transformative Competencies

The results obtained demonstrate that 220 respondents (80.0%) were not knowledgeable about neither the concept of “transformative competencies” nor about three transformative competencies essential for changing the world for the better. 20 respondents (7.3%) stated that although they heard about this concept, they did not know exactly what it meant and they did not know that creating new value, reconciling conflicts and dilemmas, taking responsibility were considered to be three transformative competencies. 35 respondents (12.7%) found it difficult to answer this question.

Table 2 shows the data concerning respondents' views on importance of three transformative competencies for their future professional development and success.

TABLE 2 RESPONDENTS' VIEWS ON IMPORTANCE OF THREE TRANSFORMATIVE COMPETENCIES

| Transformative Competencies | Extremely Important (%) | Important (%) | Unimportant (%) | Extremely Unimportant (%) |
|-----------------------------------|-------------------------|---------------|-----------------|---------------------------|
| Creating New Value | 34.9 | 54.9 | 10.2 | 0.0 |
| Reconciling Tensions and Dilemmas | 45.8 | 37.5 | 16.7 | 0.0 |
| Taking Responsibility | 50.2 | 44.7 | 5.1 | 0.0 |

Source: own study (N=275)

The results obtained show that although present-day Ukrainian Computer Engineering and Information Technology undergraduates were not familiar with the official definition of the concept of “transformative competencies” and the approach to classifying them on such competencies as creating new value, reconciling tensions and dilemmas and taking responsibility, they believed that they were of paramount importance for their further professional development and succeeding in the future. This can be proved by the fact that none of the respondents (0.0%) considered that creating new value, reconciling tensions and dilemmas and taking responsibility as three transformative competencies were extremely unimportant. 96 respondents (34.9%) pointed out that creating new value as a transformative competency was extremely important, 151 respondents

(54.9%) stated that it was important and only 28 respondents (10.2%) indicated that this transformative competency was unimportant. Reconciling tensions and dilemmas was considered extremely important by 126 respondents (45.8%) and important by 103 respondents (37.5%). 46 respondents (16.7%) believed that this competency was unimportant. What arouses sincere interest is the respondents' views on taking responsibility as a transformative competency. Thus, 138 respondents (50.2%) indicated that they found it as extremely important and 123 respondents (44.7%) considered it important. This transformative competency is regarded as unimportant by 14 respondents (5.1%).

The data concerning respondents' views on the importance of key constructs of transformative competency of "Creating New Value" for their future professional development and success are given in Table 3.

TABLE 3 RESPONDENTS' VIEWS ON IMPORTANCE OF KEY CONSTRUCTS OF "CREATING NEW VALUE"

| Key Constructs of Creating New Value | Importance | |
|--------------------------------------|------------|---------|
| | Number | Percent |
| Sense of Purpose | 213 | 77.5 |
| Curiosity | 78 | 28.4 |
| Open Mindset | 98 | 35.6 |
| Critical Thinking | 192 | 69.8 |
| Creativity | 226 | 82.2 |
| Collaboration | 198 | 72.0 |
| Agility | 88 | 32.0 |
| Ability to Manage Risks | 49 | 17.8 |
| Adaptability | 233 | 84.7 |

Source: own study (N=275)

From the results in Table 3, it is seen that respondents view adaptability (84.7%), creativity (82.2%), sense of purpose (77.5%), collaboration (72.0%) and critical thinking (69.8%) as 5 most important key constructs of creating new value as a transformative competency. Figure 2 illustrates the results concerning respondents' views on the importance of key constructs of the transformative competency of "Creating New Value".

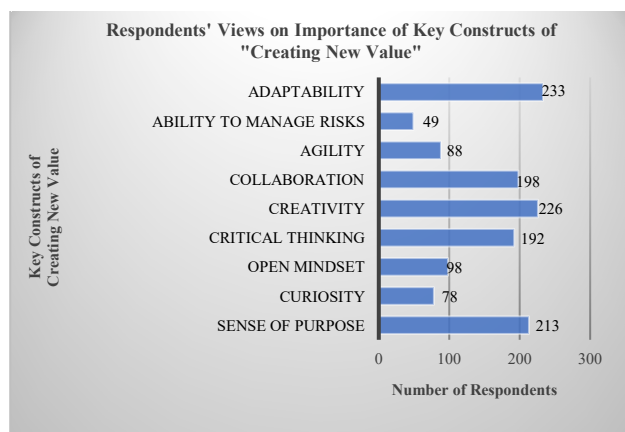


Fig. 2. Importance of Key Constructs of "Creating New Value" in Respondents' Opinion.

The data concerning respondents' views on the importance of key constructs of the transformative competency of "Reconciling Tensions and Dilemmas" for their future professional development and success are given in Table 4.

TABLE 4 RESPONDENTS' VIEWS ON IMPORTANCE OF KEY CONSTRUCTS OF "RECONCILING TENSIONS AND DILEMMAS"

| Key Constructs of Reconciling Tensions and Dilemmas | Importance | |
|---|------------|---------|
| | Number | Percent |
| Cognitive Flexibility | 81 | 29.5 |
| Perspective-Taking Skills | 211 | 76.7 |
| Empathy | 94 | 34.2 |
| Respect for Others | 170 | 61.8 |
| Creativity | 109 | 39.6 |
| Problem-Solving Skills | 149 | 54.2 |
| Conflict Resolution Skills | 191 | 69.5 |
| Resilience | 121 | 44.0 |
| Tolerance for Complexity and Ambiguity | 128 | 46.5 |
| Sense of Responsibility | 121 | 44.0 |

Source: own study (N=275)

The results, shown in Table 4, indicate that perspective-taking skills (76.7%), conflict resolutions skills (69.5%), respect for others (61.8%), problem-solving skills (54.2%) and tolerance for complexity and ambiguity (46.5%) are among 5 most important key constructs of reconciling tensions and dilemmas as a transformative competency. The researchers are inclined to consider that these key constructs were ranked high priority because they were hearing and respondents associated them with a person's ability to "to reconcile multiple and often conflicting ideas or positions, and recognise that there may be more than one solution or method to finding a solution" [9, p. 5].

The data on the research participants' views on the importance of key constructs of "Reconciling Tensions and Dilemmas" are summarised in Figure 3.

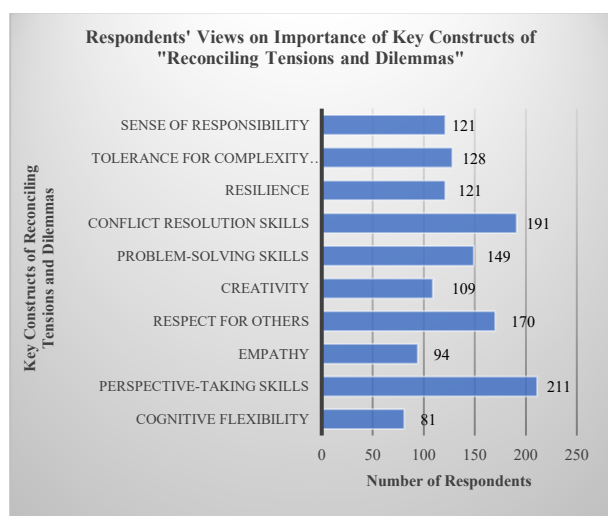


Fig. 3. Importance of Key Constructs of "Reconciling Tensions and Dilemmas" in Respondents' Opinion.

The data concerning respondents' views on the importance of key constructs of the transformative competency of "Taking Responsibility" for their future professional development and success are given in Table 5.

TABLE 5 RESPONDENTS' VIEWS ON IMPORTANCE OF KEY CONSTRUCTS OF "TAKING RESPONSIBILITY"

| Key Constructs of Taking Responsibility | Importance | |
|---|------------|---------|
| | Number | Percent |
| Locus of Control | 97 | 35.2 |
| Sense of Integrity | 156 | 56.7 |
| Compassion | 109 | 39.6 |
| Respect for Others | 136 | 49.5 |
| Critical Thinking | 188 | 68.4 |
| Self-Awareness | 193 | 70.2 |
| Self-Regulation | 169 | 61.5 |
| Reflective Thinking | 175 | 63.6 |
| Ability to Build Trust | 152 | 55.3 |

Source: own study (N=275)

Figure 4 illustrates the data on respondents' views on the importance of key constructs of "Taking Responsibility" for them.

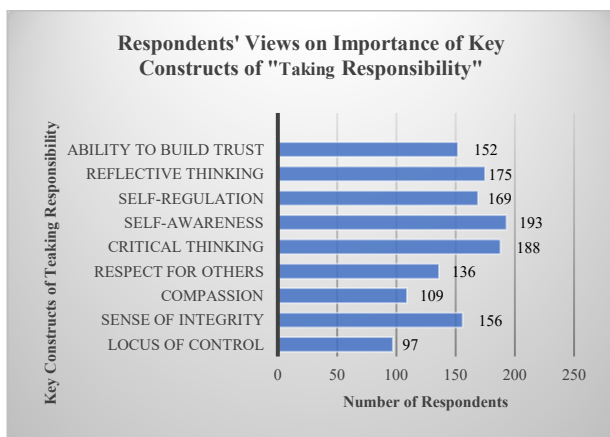


Fig. 4. Importance of Key Constructs of "Taking Responsibility" in Respondents' Opinion.

Thus, it can be seen that self-awareness (70.2%), critical thinking (68.4%), reflective thinking (63.6%), self-regulation (61.5%) and sense of integrity (56.7%) are ranked high and are among 5 most important key constructs of taking responsibility as a transformative competency.

C. Learning Activities and Academic Disciplines in Developing Transformative Competencies

It should be pointed out that the vast majority of respondents (84.7%) were of the opinion that transformative competencies could be developed by means of individual or group learning activities conducted in and outside the classroom

The results concerning learning activities which respondents considered the most effective in developing transformative competencies are given in Tables 6-7.

TABLE 6 RESPONDENTS' VIEWS ON INDIVIDUAL LEARNING ACTIVITIES EFFECTIVE IN DEVELOPING TRANSFORMATIVE COMPETENCIES

| Categories | Responses | |
|---|-----------|---------|
| | Number | Percent |
| Project Preparations | 173 | 74.2 |
| Work on Presentations | 202 | 86.7 |
| Search for Information on the Topic | 156 | 66.9 |
| Free Writing Activities | 89 | 38.2 |
| Preparation of Abstracts or Conference Reports for Student Scientific Conferences | 133 | 57.1 |
| Writing Reflective Essays | 64 | 27.5 |
| Reflective Journals | 37 | 15.9 |

Source: own study (N=233)

TABLE 7 RESPONDENTS' VIEWS ON GROUP LEARNING ACTIVITIES EFFECTIVE IN DEVELOPING TRANSFORMATIVE COMPETENCIES

| Categories | Responses | |
|---|-----------|---------|
| | Number | Percent |
| Project Preparations | 173 | 74.2 |
| Case Studies | 105 | 45.1 |
| Brainstorming Sessions | 157 | 64.7 |
| Games | 73 | 31.3 |
| Role Playing | 57 | 24.5 |
| Debates | 92 | 39.5 |
| Round Table Discussions | 68 | 29.2 |
| Participation in Olympiads (competitions) | 89 | 38.2 |
| Extracurricular club activities | 44 | 18.9 |

Source: own study (N=233)

The following excerpts from respondents' replies provide more information and thorough explanation on individual and group learning activities effective for developing key constructs associated with transformative competencies:

S27: *While completing this questionnaire, I learnt a lot of new information concerning transformative competencies and their key constructs. I think that there are many learning activities which can be useful in developing key constructs indicated in the questionnaire, to some extent. What I do believe is that our university teachers should combine learning activities which can be done individually or in groups (or in pairs) to develop transformative competencies and their key constructs. For instance, work on projects or presentations as well as search for information on definite topics involve studying various sources. It means that you should think critically to choose the most accurate and true information. What is more, doing these learning activities we learn to grasp new ideas or information. While preparing a presentation or a project like no other, we learn to think outside the box...*

S194: *I personally think that there is no single learning activity that works for everyone. I mean that some key constructs can be developed by means of individual learning activities and some of them can be developed by means of group learning activities. For instance, we won't be able to be collaborative and responsible, to show empathy and compassion if we do not work on joint projects. Participation in brainstorming sessions which involves teamwork can teach us to think outside the box*

and to take into consideration our groupmates' opinions. At the same time, writing reflective essays which requires individual work can help us to reflect on ourselves and our needs, to think about something that we did not think before. Reflective essays teach us to explore both our emotions and knowledge which we obtain while studying at university...

S263: *I haven't heard about transformative competencies before and now I know some information about them. I think our university teachers introduce some learning activities which are aimed at developing some key constructs of transformative competencies, for instance, a sense of responsibility, creativity, critical thinking, collaborative skills etc. But these learning activities are not aimed at simultaneous development of all key constructs of transformative competencies. I think, it is impossible to develop all of them during studying one discipline, the whole training course should be aimed at their forming and developing...*

The results obtained demonstrate that respondents understand quite clearly what learning activities can be used for developing investigated transformative competencies. Learning activities given in Tables 6-7 and pointed out by respondents enable us to state that the major methodological approach of Education 4.0 for developing transformative competencies among Computer Engineering and Information Technology undergraduates combines challenge-based learning (CBL) and activity-based learning (ABL).

It should also be noted that 42 respondents (15.3%) found it difficult to give a detailed reply to this question. Answering it they pointed out that the university lecturers should know it better what learning activities to apply in the classroom to develop investigated transformative competencies.

The findings concerning academic disciplines demonstrate that the majority of respondents (76.0%) considered humanities the most effective in developing transformative competencies. Among such academic disciplines respondents listed English and Ukrainian for Specific Purposes, Philosophy, Ukrainian studies etc. 14.2% of respondents expressed the view that technical disciplines were the most effective in developing transformative competencies while 9.8% of respondents found it difficult to answer this question. The results concerning humanities enable us to assume that these disciplines (1) are more likely to apply various learning activities which can be done both individually and in groups than technical disciplines and (2) have much broader potential for developing all key constructs of transformative competencies among Computer Engineering and Information Technology undergraduates than technical disciplines. But nevertheless, university lecturers who teach different academic disciplines to undergraduates who specialise in Computer Engineering and Information Technology should consider the possibility of creating favourable conditions for the full development of transformative competencies.

IV. RECOMMENDATIONS AND CONCLUSIONS

The main idea for our research is that unpredictable events which are taking place in our rapidly evolving globalised world clearly demonstrate that the abilities to set clear and purposeful goals, effectively collaborate with others, find unexpected opportunities for successful self-realisation and, moreover, to identify multiple solutions to big problems are becoming a living reality. The results obtained reveal the didactic potential of humanities for developing Computer Engineering and Information Technology Undergraduates' transformative competencies and enable the researchers to formulate recommendations for university teachers of humanities on how to develop transformative competencies among Computer Engineering and Information Technology undergraduates:

1. We are inclined to consider that taking into account the transformative processes which take place in the present-day globalised society and the need to meet the perspectives and, what is more, frequently changing requirements on the labour market, university lecturers should raise students' awareness concerning transformative competencies and students should receive transformative competencies awareness education for shaping and contributing to a changing world through the content of academic discipline (disciplines) they study.

2. Equal importance should be paid to developing key constructs associated with investigated transformative competencies. Such an approach should be explained by the fact that each key construct within each transformative competency equally contributes to forming and developing professionals of the 21st century able to invent something new, to think outside the box, to make complex and difficult decisions and to take responsibility for their actions or total inaction. What is more, the obtained results concerning the respondents' views on the importance of key constructs associated with investigated transformative competencies point to the need to pay more attention to those key constructs which were ranked low.

3. To develop transformative competencies among students, university lecturers should use the entire spectrum of individual and group learning activities in and outside the classroom since each particular learning activity promotes the development of particular key constructs. The combination of challenge-based learning (CBL) and activity-based learning (ABL) is considered to be a major methodological approach of Education 4.0 for developing transformative competencies among Computer Engineering and Information Technology undergraduates.

REFERENCES

- [1] A. A. Hussin, "Education 4.0 Made Simple: Ideas For Teaching," *International Journal of Education & Literacy Studies*, 2018, vol. 6, no. 3, pp. 92-98. Available: <http://journals.aiac.org.au/index.php/IJELS/article/view/4616/3541>. [Accessed: Dec. 14, 2022].
- [2] E. B. Moraes, L. M. Kipper, A. C. Hackenhaar Kellermann, L. Austria, P. Leivas, J. A. R. Moraes and M. Witczak, "Integration of Industry 4.0 technologies with Education 4.0: advantages for improvements in learning", *Interactive Technology and Smart*

- education, vol. ahead-of-print no. ahead-of-print, 2022. Available : https://www.researchgate.net/publication/360526523_Integration_of_Industry_40_technologies_with_Education_40_advantages_for_improvements_in_learning [Accessed: Feb. 18, 2023], <http://doi.org/10.1108/ITSE-11-2021-0201>.
- [3] M. Caeiro-Rodríguez et al., “Teaching Soft Skills in Engineering Education: An European Perspective,” in *IEEE Access*, 2021, vol. 9, pp. 29222-29242, 10.1109/ACCESS.2021.3059516.
- [4] L. Alves, P. Ribeiro, R. Machado, “Project-based learning: An environment to prepare IT students for an industry career,” in *Computer Systems and Software Engineering: Concepts Methodologies Tools and Applications*, Hershey, PA, USA: IGI Global, pp. 1931-1951, 2018. [Online]. Available: <https://bibliotecadigital.ipb.pt/bitstream/10198/9861/3/PBLStudIn dCareer.pdf>. [Accessed: Jan., 20, 2023].
- [5] O. Malykhin and N. Aristova, “Improving Computer Engineering and Information Technologies Undergraduate Students’ Training through Combination of Formal, Non-Formal and Informal Learning”, in Proc. ETR International Scientific and Practical Conference, 2019, vol. 2, pp. 208-213, <https://doi.org/10.17770/etr2019vol2.4113>.
- [6] O. Malykhin, N. Aristova, N. Dichek and N. Dyka, “Formation of Top Job Skills of Tomorrow among Computer Engineering and Information Technologies Undergraduate Students in the Process of Learning English”, in Proc. ETR International Scientific and Practical Conference, 2021, vol. 2, pp. 249-254, <https://doi.org/10.17770/etr2021vol2.6642>.
- [7] O. Malykhin, N. Aristova and S. Melikova, “Soft Skills Development Strategies for Computer Engineering and Information Technologies Undergraduate Students Devised in the Process of Learning English”, ETR International Scientific and Practical Conference, 2021, vol. 2, pp. 255-260. <https://doi.org/10.17770/etr2021vol2.6602>.
- [8] J. Tell and M. Hoveskog, “Applied engineering education for soft skills in the context of sustainability and mobility”, *International Journal of Sustainability in Higher Education*, 2022, vol. 23, no. 8, pp. 324-336, <https://doi.org/10.1108/IJSHE-07-2022-0202>.
- [9] The Organization for Economic Cooperation and Development, “OECD Future of Education and Skills 2030 Concept Note : Transformative Competencies for 2030”, OECD, 2019. [Online]. Available: https://www.oecd.org/education/2030-project/teaching-and-learning/learning/transformative-competencies/Transformative_Competencies_for_2030_concept_note.pdf. [Accessed: Nov. 10, 2022].
- [10] The Organization for Economic Cooperation and Development, “The Future of Education and Skills: Education 2030. Position Paper”, OECD, 2018. [Online]. Available: [https://www.oecd.org/education/2030/E2030%20Position%20Paper%20\(05.04.2018\).pdf](https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf). [Accessed: Oct., 24, 2022].
- [11] The Organization for Economic Cooperation and Development, “OECD Future of Education and Skills 2030: OECD Learning Compass 2030”, OECD, 2019. [Online]. Available: https://www.oecd.org/education/2030-project/teaching-and-learning/learning/learning-compass-2030/OECD_Learning_Compas_2030_Concept_Note_Series.pdf. [Accessed: Nov. 10, 2022].
- [12] “Why we need more women in tech by 2030 – and how to do it,” Nov. 3, 2017. [Online]. Available: <https://www.weforum.org/agenda/2017/11/women-in-tech-engineering-ellen-stofan/>. [Accessed: Dec. 20, 2022].