Eötvös Loránd University Faculty of Education and Psychology
Doctoral School of Education
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Thesis summary of PhD dissertation

Monika Czinege

The application of cooperative learning methods in the instruction of Computer Science: An analytical approach

Theme consultant: Dr. Lajos Kis-Tóth, habil, college professor

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A brief summary of the research program

As an instructor of the Department of Methodology of the Budapest Business School Applied University of Sciences I have been participating in the work of the institution’s Informatics Group. The Informatics subject delivered by the Department facilitates the synthetisation of knowledge acquired in other economics-related subjects, the adaptation of acquired computing, statistical, and operation research methods along with introducing students to the basic aspects of data base management and operation. Consequently, I am convinced of the importance of the instruction of computer science and informatics in higher education. Such professional commitment determined the selection of my research theme to a great extent.

Since my career as a researcher has been contemporaneous with recent radical and accelerated changes in the fields of education and informatics such developments had a principal role in shaping my research interests. I firmly believe that informatics instruction has to keep pace with the changing economic and social circumstances and the habits of informatics use.

The emergence of a technologically proficient generation brought forth a need for courses focusing on the practical advantages and benefits of state of the art technologies. Furthermore, students came to realize that their own ICT devices previously used only for personal or entertainment purposes and maintaining interpersonal connections can be a significant economic or business resource as well. I share the view that the changing student demands can spark a renewal of methodological culture and this recognition inspired me to search for a teaching methodology feasible in a university environment facilitating the acquisition of knowledge promoting competitiveness at the labour market.

As György Csepeli and Gergó Prazsák pointed out in 2010: “At the turn of the 20th and 21st century the technological development resulted in fundamental social and cultural changes significantly impacting everyday life, habits, and lifestyles. The Internet not only facilitates communication, but promotes the creation, storing, and forwarding of information. Accordingly, the role of learning and memory has been modified as well leading to a rearrangement of everyday activities including the maintenance of personal contact, securing information, and purchasing” (Csepeli and Prazsák, 2010).

A survey performed jointly with my colleague played a major role in the selection of my field of research. The questionnaire focused on the relatively low academic achievement of recently enrolled students in Informatics and other aspects of computer science who otherwise developed a strong subject-related foundation in secondary education and achieved high scores during the admission process. The relatively poor results were even more puzzling as the students learn Informatics in high school and it is part of their everyday life. Having considered
this issue thoroughly our team decided to assess the informatics knowledge of students admitted to our institution. The actual results led to changes in the methodology and organisational forms of informatics instruction. The positive and practically applicable results of the survey included the following:

- Students achieving lower scores at the informatics survey can participate in remedial courses,
- in order to keep pace with the dynamic growth and development of computer science we continuously update the respective informatics course materials,
- in order to improve student motivation we introduce novel educational methods in addition to the frontal or teacher centred approach.

The data series gained as a result of a diagnostic test reveal that informatics teaching in secondary schools should be augmented or complemented and the respective improvement efforts should be continued on the higher education level as well. The respective data series was a starting point of my research project.

Naturally, as instructors confirm inadequate knowledge does not solely apply to informatics and the respective causes can be found in more profound social problems, which is beyond the focus of the present thesis. I share the view that the introduction of new instruction methods would provide a potential partial remedy for all further problems, while increasing the methodological arsenal aimed at improving the efficiency of the instruction process. Consequently, I consider it important that we attempt to introduce new teaching methods.

“The mass oriented approach in traditional higher education compels structural and functional modifications along with radically changing the world of students and instructors as well.” (Kozma, 2006).

The respective new methods should strengthen the learning communities of students while focusing on shared preparation efforts promoting learning motivation too. All the more so as the introduction of credit-based training programs led to the elimination of study communities or teams supporting the learning process resulting in the eventual dissolution of the learning communities.

I have always preferred methods based on group work as the respective cooperative approach can provide several benefits in addition to the obvious attendant advantages. Consequently, cooperative learning is a versatile method providing a variety of advantages including general, non-subject specific applicability along with improving communicational and social competences as well.
Students of the Faculty of Commerce, Hospitality and Tourism are clearly expected to use ICT devices experiencing a radical change in the past few years. This dramatic transformation can be felt in the field of tourism, especially the online booking systems or air ticket and hotel reservation schemes resulting in the declining role of travel agencies. Furthermore, on-line shopping and merchandising revolutionized the world of commerce while social media, Twitter and Facebook have become vital or indispensable marketing tools. Thus graduates planning to have a career in the abovementioned fields should be equipped with appropriate skills competences, and knowledge, develop a familiarity with the respective applications, and be able to use them while keeping up with the latest developments.

The research program also demanded thorough familiarity with the qualification requirements in Hungary as all accredited training programs have to meet such criteria. Consequently, I explored the qualification requirements related to undergraduate programs in tourism-catering, and commerce-marketing and studied the structure and content of informatics programs or subjects connected to the abovementioned schemes of several higher education institutions in Hungary. Furthermore, since tourism, catering, commerce and marketing have an inherently international perspective and realizing the need for keeping pace with the respective international trends I examined such programs and the relevant instruction strategies followed by higher education institutions abroad. At the same vein I explored the applicability of cooperative methodology both in Hungary and in foreign countries.

My thesis will also discuss the latest research results available in international professional literature. (Accordingly, international professional research results confirm that countries prioritising development and innovation in education enjoy a significant competitive edge compared to those neglecting or not paying enough attention to such areas. In Hungary the strategic recommendations of the Educational Research Institute pertaining to this higher education problem are integrated into the National Educational Innovation System (Halász, Balázs, Fischer & Kovács, 2011).) Furthermore, in Hungary cooperative learning is more prevalent in public, that is elementary and secondary education, but increasing amount of information is available regarding its application in higher education as well.

The empirical segment of the research program included the application of the respective cooperative methodology according to the established protocol with some of my student groups, and encouraged by increased experience the respective methods and the relevant texts were continuously modified as well. My courses tended to prioritise network-based learning in addition to applying cooperative learning methods. While aiming to meet institutional requirements a greater emphasis was placed on the use of the LMS system supporting network-
based learning, and after reading Barabási Albert-László’s ground breaking work titled, *Linked*, and meeting with the author in person I decided to try such methods in my teaching as well. During the course development stage I faced such problems as the formation of the respective student groups learning via cooperative methods or the impact of student absence on the efficiency of the knowledge acquisition process. It can be concluded that the latest results of network research can be helpful in solving the related problems.

In order to assess or evaluate the impact of cooperative learning on student development I performed questionnaire based surveys and conducted interviews along with tracing or monitoring academic achievement. The results of my research were analysed and are introduced and described in the present doctoral thesis. The objective of the application of cooperative methodology and the analysis of the respective results is not only the improvement of the efficiency of the instruction of the given subject, but the elaboration of general conclusions promoting its application during the teaching of other subjects, and their increasing use in the higher education arena.

Moreover, I would like to point out that my commitment to cooperative learning methods is a result of a thorough study of the expectations of the labour market. Consequently, young graduates face continuously changing requirements at the beginning of their career and in addition to subject knowledge general competences are in demand as well. Therefore, a carefully considered educational method can help graduating students in their professional life to meet the respective challenges. A survey of employers confirmed the demand for the following skills, attributes, and competences an entry level professional should possess: (Figyelő, 2010):

- flexibility
- adaptability
- self-motivation
- enthusiasm
- propensity to group work
- initiative and communication skills
- creativity

Research programs focusing on the labour market confirm that the skills and competences of the graduates of higher education and post-secondary programs fall short of respective requirements. (Halász 2011, Halász 2012, Kiss 2010). “Higher education training programs still
prioritise subject knowledge over skills and competences while assigning lower priority to the evaluation and development of outcomes” (Bazsa 2009).

The OECD countries jointly developed a competence list indispensable for competitiveness on the labour market. Accordingly, competences can be defined as “fundamental features of a given person which are in a causal relationship with the effective and outstanding achievement corresponding to the respective criterion level.” (Boyatzis, 1982). The 23 competences are divided into 3 main groups.

Key competences: communication, numerical, quantification skills, propensity to group work, problem solving skills, improving learning and academic achievement.

Work competences: flexibility, creativity, initially independent decision making, agency, or the ability to act, foreign language proficiency, self-confidence, critical perspective, exploration of options, awareness of responsibility.

Since the selection process assigns a high priority to foreign language and computer skills along with up-to-date knowledge of business and society-related developments and issues, such factors should be taken into consideration by instructors as well.

Tamás Kozma (Kozma, 2006) asserts that the structural and content-based transformation of the European university in the 21st century results in a lesser emphasis on expert-oriented training as “undergraduate programs will prioritise sclolarization at the expense of scholarly or scientific objectives” (Kozma, 2006, p. 112).

The dynamic transformation and growth of technology especially in the info-communication sphere leads to radical economic and social changes manifested in the emergence of the knowledge-based society whose main criteria according to EU specifications include:

- widespread or general availability of info-communication devices and technologies, instruction and research and development programs.
- the formation of competitive economies
- the maintenance of sustainable economic development
- the elaboration of a European model of social integration

According to a definition proposed by the OECD the knowledge-based economy is an economic arrangement whose growth and development is dependent on the creation, distribution, and utilization of knowledge and information.

"Computers and related technologies resulted in a radical transformation of the tools of education and research. Instructors must develop a familiarity with modern presentation technologies, online instruction, research, and professional data bases, along with being well-
informed with internet portals related to their professional or research interests. Consequently, the development of ICT has a significant impact on the learning and teaching process, as obtaining up-to-date information implies a challenge for instructors as well.” (Molnár, 2011).

If we accept that cooperative abilities are principal shaping factors of competences appreciated by the labour market the legitimacy of cooperative learning in higher education becomes evident. An internet search for such concepts as "team work" and "group effort" provides 275 and 105 million hits respectively. This high number is far from a mere coincidence as team orientedness or working in teams is a special competence prioritised by start-ups based on employee initiative along with major employers or corporations themselves. Human resource professionals strive to increase internal or team cohesion resulting in a family atmosphere or emotional bonding implying improved and strengthened employee loyalty. Thus cooperative learning can help young graduates to adjust to the prospective organisational or enterprise cultures.

**Research hypotheses and the respective results**

**Hypothesis One (H1):** We divided our sample in two segments, the test group and the control group. The test group included students acquiring knowledge via cooperative learning methods, while the control group was taught in a traditional manner. Consequently, it is supposed that the social skills and learning attitudes of test group members will show a positive change compared to that of the control group.

The research process spanned over several years, Accordingly, we prepared and distributed a questionnaire in order to assess the efficiency of cooperative learning in the 2014-2015 academic year. Members of the test group were given the following assignment: “Briefly describe your views whether cooperative learning or group work was effective or ineffective”. 72.2% of the respondents confirmed the effectiveness of cooperative work methods. Among the potential advantages students mentioned the improvement of the problem solving abilities due to shared efforts and the capacity to help each other while learning from peers within a group work format. Furthermore, working together led to more productive ideas, helped them to see the given problems from a variety of angles, and facilitated easier recovery of the learned material. Additionally, students felt that sharing the given work provides more hands-on, or practical experience, enables them to work in differing time and space while taking advantage of computer-based communication options. It can be concluded that their responses reveal a positive change regarding social skills and learning attitudes as well.
In a survey questionnaire administered in 2015-2016 the same question was asked. The respective answers highlighted the ability of learning from each other, or reciprocal learning, better task performance via joint effort, weaker peers being helped by stronger ones, effective task distribution along with an overall helpful attitude of group members. Consequently, the responses reveal a positive change in social skills and learning attitudes in this period as well.

The survey questionnaire administered in 2014-2015 included this item as well: “Describe whether you noticed any professional or personal improvement as a result of the group work.” 76.9% noticed a certain degree of development or improvement during the cooperative effort. The most frequently highlighted factors included presentation and communication skills, a diversified problem solving perspective, getting to know peers better, and improved cooperation. The scope of improved social skills includes communication, peer familiarity, and cooperation with group members.

The responses to the same question posed by the questionnaire administered in the 2015-2016 academic year highlighted such indicators of positive changes in social skills and learning attitudes as improved cooperation and willingness to compromise, better work performance in teams, and better interpersonal relations. Consequently, based upon the respective answers Hypothesis One (H1) can be considered as substantiated.

**Hypothesis Two (H2):** Participants of the experiment acquiring knowledge via cooperative learning displayed a positive change of attitude regarding the respective subject matter as compared to the control group.

Both the 2014-2015 and 2015-2016 questionnaire contained the following question: “Did group work significantly improve your attitude regarding the respective subject?” 44.4% and 65% of the respondents gave a positive answer marking at least 4 on a scale in 2014-2015 and 2015-2016 respectively. Furthermore, 31.5% and 27.5% evaluated their respective attitude at mark 3, or being neutral. The main objective of the research involved the adjustment or harmonization of cooperative learning methods with the given courses, along with improving the efficiency of the education process. Moreover, course modifications warranted by responses given to the 2014-2015 survey triggered significant improvement is the respective student attitudes.

Accordingly, in 2015-2016 at least 65% of students assessed their own course-specific attitude at level 4 indicating a 21% increase as compared to answers given in the previous year. While the scores or test results obtained in 2014-2015 are somewhat ambiguous, data obtained in 2015-2016 clearly and undoubtedly indicate a positive impact on student attitudes to the given subject matter. Consequently, Hypothesis Two can be considered substantiated.
**Hypothesis 3 (H3):** Students of the test group will display a positive attitude toward information and communication technology.

Both the 2014-2015 and 2015-2016 questionnaire contained the following question: “Did group work help you to develop a positive attitude toward computer-based communication?”

Accordingly, 41.8% of students marked level 4 at this question in 2014-2015 as compared to 55.9% indicating that cooperative learning helped to nurture a positive attitude to ICT assisted communication in the 2015-2016 period.

The questionnaire survey of 2014-2015 contained another relevant question, namely whether group work in class promoted the use of electronic devices. Since 54.5% marked 4 at this question, Hypothesis 3 can be regarded as substantiated.

**Hypothesis Four (H4):** Members of the test group will become proficient users of ICT devices.

The questionnaire survey administered in the 2016-2017 academic year included the following question:” Do you prefer to use the achievements of modern technology including computers, smart phones, and social media during problem solving?“

As 90.7% of respondents marked mostly true or fully true we can consider Hypothesis 4 substantiated.

**Hypothesis Five (H5):** Members of the test group have achieved higher scores in written tests than participants of the control group

<table>
<thead>
<tr>
<th>academic year</th>
<th>cooperative learning groups (test groups)</th>
<th>control groups</th>
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<tbody>
<tr>
<td>2014-15</td>
<td>3.41</td>
<td>2.78</td>
</tr>
<tr>
<td>2015-16</td>
<td>3.33</td>
<td>4.38</td>
</tr>
<tr>
<td>2016-17</td>
<td>4.1</td>
<td>3.83</td>
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</tbody>
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Grade averages of the sample groups
Subject-specific mark or grade averages of groups participating in the research process

Average marks in 2014-15, Average marks in 2015-16, Average marks in 2016-17 cooperative group, control group

In the 2014-2015 academic year two of those groups whose members learned with the help of cooperative methods had a higher mark average than the control group, but one group scored lower than the control group. In the 2015-2016 academic year the score average of two groups learning with cooperative methods was higher than three control groups, and one test group or intervention group earned lower marks than all control groups. In the 2016-2017 academic year all groups learning with cooperative methods had a higher score than the control groups.

Having compared the respective averages, I performed further computations in order to verify the positive impact of cooperative learning on academic achievement. By F probe testing for standard deviation I investigated whether a significant difference can be discerned among the groups learning with various methods. Accordingly, I combined the results of the cooperative learning and the control groups into separate groups according to type.
<table>
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<th></th>
<th>Academic average</th>
<th>Standard deviation or dispersion of scores</th>
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<tbody>
<tr>
<td></td>
<td>cooperative</td>
<td>control group</td>
</tr>
<tr>
<td></td>
<td>learning group</td>
<td></td>
</tr>
<tr>
<td>2014-15</td>
<td>3,1</td>
<td>2,9</td>
</tr>
<tr>
<td>2015-16</td>
<td>4,2</td>
<td>4,1</td>
</tr>
<tr>
<td>2016-17</td>
<td>4,0</td>
<td>3,8</td>
</tr>
<tr>
<td>Combined</td>
<td>3,8</td>
<td>3,8</td>
</tr>
</tbody>
</table>

While in the 2014-2015 academic year the results achieved by the cooperative learning group show a greater dispersion than those of the control group, at the 5% significance level no statistically discernible difference is applicable. At the same time the respective grade averages showed no statistically verifiable difference either with the cooperative average at 3,1% and the control group average at 2,9%.

In the 2015-2016 academic year the distribution or dispersion of the results of cooperative groups was greater than that of the control group results with 0,82; 0,74 respectively. In case of the cooperative groups the average of the respective results is higher than the average of the control groups (4,2; 4,1) while no significant discrepancy can be discovered between the deviations and averages.

In the 2016-2017 academic year the distribution of the results of the cooperative learning groups is greater than that of the control groups (0,88; 0,81) and the average of the results of the test groups is higher than that of the control group (4,0; 3,8), while no significant difference can be noticed at the 5% significance level.

I continued the computation by forming two groups combining the results of all academic years and allocated them into a test and control group again. The averages of the combined groups showed no difference at 3,8; 3,8 respectively. The dispersion of the combined cooperative learning group is higher than that of the combined control group (0,98; 0,84) while a substantial discrepancy can be discerned at the 5% significance level.

Since the respective results did not confirm that students learning via cooperative approaches will have higher scores and better grade averages merely by the application of said method, Hypothesis 5 cannot be considered substantiated.
Additional impact analyses for assessing the efficiency of cooperative learning methods

During the in-house defence procedure a suggestion was made for the impact analysis of cooperative methods especially related to the potentially negative influence of anxiety on the acquisition of natural science subjects. Consequently, a questionnaire was prepared to assess further the efficiency and legitimacy of cooperative learning in the teaching of Informatics.

The questionnaire aimed at the assessment of anxiety during the application of Informatics-related knowledge. The questionnaire was structured in a way that Informatics anxiety was evaluated not only in learning situations, but other contexts, especially in the workplace as well. If this hypothesis, namely that “cooperative learning can decrease or alleviate subject-related informatics anxiety“ was substantiated, new research themes could be identified.

Respondents included students learning informatics in a cooperative format and the members of the previous control groups as well. Accordingly, 20 students belonging to the cooperative learning group and 23 students of the control group completed the survey. While all submitted questionnaires could be evaluated and these small groups could form a representative sample, the samples were not obtained in a random manner therefore the respective results can only be considered for their information value. The assessment of Informatics-related anxiety was performed by the help of a 5 degree Likert scale ranging from 1 indicating no anxiety to 5 marking extreme anxiety levels.

The results of the informatics anxiety test

Responses to the questionnaire confirm that members of the control group show a greater anxiety in learning or work situations compared to that of the test or cooperative learning group. Regarding the thirteen questions members of the cooperative learning group indicated anxiety in case of only one item, namely: “Do you feel anxiety when the instructor asks a question at Informatics class?“

In order to interpret the results of the Informatics anxiety questionnaire we developed three domains. In case of the cooperative learning group the same results were provided by both scales, as 30% of students marked below average, 50% indicated average, and 20% showed above average level anxiety.

The dispersion based scale in case of the control group showed that 17,4 % and in the other scale 26,1 percent belonged to the below average category. In both cases this is lower than the cooperative learning group as average level anxiety was marked by two control group categories with 60,8 % or 52,2% respectively as compared to that of 50% with the cooperative learning group. Regarding both scaling methods 21,7% of the respondents in the control group and 20% of the cooperative learning group scored above average.
The abovementioned results substantiate that cooperative learning decreased subject related anxiety and reiterated that cooperative learning is an effective educational method to be used in Informatics instruction.

**Summarizing the research results**

During my research I relied on professional research results to prepare a comprehensive analysis on educational experiments in various parts of the world regarding cooperative learning. My findings are summarized in Chapter 2. In chapter 3 I explored the connection between learning and networks by the help of the latest results of network research. Moreover, premised on the fact that both the medium and the subject of the knowledge acquisition process is identical I provided an overview of options presented by informatics and the Internet as well. In Chapter Four of my dissertation I introduced the results of the entry level knowledge assessment tests administered at the Faculty of Commerce, Hospitality, and Tourism of the Budapest Business School University of Applied Sciences. Such tests help the continuous improvement of Informatics instruction while providing a foundation for the present thesis as well. The research also focuses on the qualification requirements pertaining to the programs of the Faculty along with examining the role of Informatics instruction in the economics programs of higher education institutions both in Hungary and abroad. The respective information can be found in the supplement section. Chapter Five describes the actual research program and the respective research results. In itself the research program commemorates an experiment performed in a higher education environment focusing on the advantages and disadvantages of the application of cooperative learning methods at the Faculty of Commerce, Hospitality, and Tourism at the Budapest Business School.

During my research I tested several cooperative learning methods and I elaborated assignments to be solved by cooperative learning during the Informatics class. In order to guarantee the methodological triangulation of the research process the empirical inquiry utilized several approaches including questionnaire, interview, and data analysis.

As a result of the aforementioned empirical approach I could substantiate or justify 4 out of the 5 presented hypotheses. I could draw the following conclusions:

- The social skills and learning attitudes of students learning via cooperative learning methods show a positive change as compared to the control group
- The attitude toward a given subject also shows a positive change as compared to the control group
- ICT-related attitudes also show improvement
• Students gain proficiency in the use of ICT devices.

It must be pointed out however, that Hypothesis Five, implying that members of the test group can achieve higher scores on written tests than participants of the control group, could not be substantiated.

In order to justify the legitimacy of cooperative learning as a method of Informatics instruction we prepared a questionnaire assessing whether cooperative learning can decrease the Informatics anxiety or stress levels of students. Responses confirmed that cooperative learning can alleviate Informatics related stress underlying its legitimacy as a potential method of instruction.

My overall research results help me to conclude that while cooperative learning can be a promising approach in higher education, it cannot be applied universally or across the board. Although the positive impact of cooperative learning on academic achievement was not proven, the application of this method can provide several advantages. Cooperative learning can increase the propensity for teamwork, tolerance, and helpfulness. These skills and competences are not only important components of one’s personal development, but are indispensable for success in the labour market.

Mapping out future research trends

As of the 2017-2018 academic year a new instruction structure was introduced at the University. As a result of the respective changes the instruction and content of Informatics was modified and the given subject’s place at the learning schedule was changed as well. Since the continuation of my research requires adaptation to the new academic structure, assignments to be solved by cooperative learning have to be elaborated along with the expanded application of cooperative learning methods to new subjects and to part time and distance learning student groups as well. Furthermore, larger student networks can be developed by the elaboration of appropriate materials and assignments either in full time, part time, or distance learning format. Consequently, the forthcoming research could focus on the spreading of networking in the learning process along with the exploration of teaching and learning connections among students. The application of the tenets of network research in pedagogy can help in the development of individual learning paths based upon familiarity with the respective individual characteristics. Individual learning paths have an increased significance in case of blended and on-line learning courses. The integration and utilization of the results of cooperative learning and network research could lead to the maximalization of the shared learning experience along
with the development of a mentor system based upon the analysis of learning networks and the exploration of learning hubs.

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Curriculum vitae of Monika Czinege

Monika Czinege was born in Vác in 1967 and after completing her elementary and secondary school studies she was admitted in the Budapest University of Technology where she graduated
with a degree in Electrical Engineering in 1991. She continued her studies at the same institution between 1993 and 1995 eventually graduating with a certified engineer-education degree. She worked as a teacher of informatics and electronics related subjects in Vác at the Boronkay György Secondary School of Technology between 1991 and 1994 along with being a panel member at high school graduation panels. Between 1994 and 2001 she served as a teacher of Informatics subjects, Mathematics, and Physics at the Selye János Humanities High School of Vác, besides serving as a head of the class, functioning as an examiner in adult education along with maintaining her position as member of a maturation panel.

She has been working as a lecturer since 2001 at the Institute of Methodology at the Faculty of Commerce, Hospitality and Tourism of the Budapest Business School University of Applied Sciences. She is an instructor of Informatics subjects for full-time, part-time, and distance learning students.

She has functioned as a chair of high school graduation panels both at medium and upper levels since 2010 and as of 2014 she has served as chair of final examinations of nationally registered professional training programs.

Between 2011 and 2014 she studied at the Learning and Education Doctoral Program of the Doctoral School of Education at Eötvös Loránd University. Her principal field of research is the applicability of cooperative learning methods in the instruction of computer science. Since 2003 she has contributed to educational material development programs, and she prepared a textbook for students of higher education institutions in the field of data base management. In 2005 she compiled auxiliary materials for distance learning programs, and in 2009 she was a co-author of a higher education textbook and in 2012 she participated in the elaboration of multimedia-based educational materials.

She participated in 14 professional and scientific events and conferences between 2009-2015. As of 2013 she has been a presenter at pedagogical conferences focusing on cooperative learning while publishing the results of her research both in Hungarian and foreign languages. All her publications relevant to the abovementioned research theme are listed in the Repository of Hungarian Scholarly Works.

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