Existing and to be developed teacher competences in engineer teacher training

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Abstract

Teacher competences are made up of abilities, skills and other knowledge and behaviours that teachers need to carry out well as a teacher. The effective establishment and development of these should therefore be a key objective of teacher training. In this paper, we present what engineering undergraduate students in teacher training consider to be the current and expected level of competencies they need to have in their teaching profession. The survey included students who already acquired professional methodology and knowledge during their training. The measurement instrument contained a list of competences, including key competences proposed by the European Council, as well as student competencies and knowledge that we consider essential for an engineering teacher. The results highlight the competences that need to be developed in teacher training so that students can meet professional expectations and challenges as a practicing teacher.

Keywords: Teaching competences, key competences, teacher training, engineering students.

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1. Introduction

The teaching profession is a profession requiring highly qualified professionals with a high level of education. All teachers need to have comprehensive professional knowledge, good pedagogical knowledge, skills and competencies to guide and support students, and to ensure this, we need to be aware of the competencies expected of teachers.

The basic organisational framework for describing teacher competencies is given by the possible roles of the teacher, in a different approach by the dimensions of the teacher activities. Henczi and Zollei (2007) also approached the definition of competence through activities, emphasising that these formations of personal resources resulting from learning (experience and practice) allow the individual to apply the acquired knowledge and personality components constructively and successfully.

The importance of acquiring comprehensive competencies necessary for effective learning is indisputable today. In spring 2002, the Council of Europe identified eight key competencies: communication in the mother tongue, communication in foreign languages, mathematical competence and basic competencies in science and technology, digital competence, learning to learn, social and civic competencies, sense of initiative and entrepreneurship and cultural awareness and expression (European Commission, 2018). This reference framework for key competencies can be used as a reference in the context of any lifelong learning education and training and is crucial for the development of training and output requirements.

In addition to the key competences proposed by the European Council, hundreds of teacher competencies have been described in the literature over the last few years (Huda et al., 2017; Smith, 2016; Tambunan, 2014; Vogt & Rogala, 2009). The situation is further complicated by the fact that these competencies are not static. In one way or another, they are losing their social significance, while others appear as new needs arise. Fortunately, meanwhile it has become very clear that the quality of teacher general education competence is determined, on the one hand, by the so-called professional knowledge and, on the other hand, by the system of diverse personality factors and their special organisation and alliance (Aydin, Bavli & Alci, 2013; Klassen & Tze, 2014; Xu & Ye, 2014).

For training and output requirements, teacher competencies (Falus, 2005) cover the essential aspects of pedagogical activity and include the basic knowledge, dispositions and activity components necessary for their effective implementation. If in teacher training we follow the competency system necessary for the successful continuation of the teaching profession, then this will increase the efficiency of the training (Pukanszky, 2010).

It is indisputable that teachers play an important role in the process of socialisation and education, they teach and evaluate students' work, and therefore their abilities, skills and competencies significantly influence the effectiveness of education (Zhu, Wang, Cai & Engels, 2013). Their behaviour, professional personality and the belief in their own abilities influence the performance of their students. Fresh graduate teachers who find themselves in deep waters when they start teaching are exposed to the challenges of the profession because the professional environment for newcomers is still new, but needs to meet professional expectations and even local characteristics (Hercz, 2015).

In teacher training, a strong emphasis is placed on the introduction of competence-based training, and the promotion of professional development of teacher candidates has become a priority. Graduates need to be 'competent', since only a teacher aware of and possessing his or her own teacher competencies is capable of competence-based development. This justifies the research on teacher competence perceptions among teacher training students.

2. Presentation of the survey

In Romania, higher education legislations place teacher training under the jurisdiction of universities and allow them to operate as an independent institution. In the institutes, the training

unfolds in parallel with a basic university education. This also limits the possibilities – as basic education determines the subjects that can be taught – and the teacher training diploma becomes valid with the basic education diploma. There are two levels of training; completing the first level of the pedagogical module enables the candidate to work as a teacher in the four grades of the secondary school (grades 5–8) and in the lower grades of the high school (grades 9–10). The completion of the second level of the pedagogical module gives the candidate a chance to teach at any level of public education in post-secondary education (a special form of Romanian education) or at university level. The prerequisite for the second level is the completion of the first level (certificate of successful final examination) and master's degree or the student's status of the master's degree.

The organisational structure of the Teacher Training Institute of the Sapientia Hungarian University of Transylvania is characterised by the fact that it provides training in three areas of basic education: technology, language and communication, and human and social sciences. This provides a framework that enables to train students from a broad range of disciplines. The curriculum of teacher training programmes for obtaining a teacher qualification has three main parts: core curriculum (curriculum nucleus), additional curriculum (curriculum extins) and optional curriculum (curriculum optional). The core curriculum consists of compulsory subjects and educational activities of the teacher training programmes. It includes the following subject packages: fundamentals of psycho-pedagogical training, methodological subjects of teacher training and professional practice.

The Teacher Training Institute considers it a fundamental task to provide quality education with properly trained teachers. The primary purpose of the organisation of its educational programmes is to provide the specific professional competencies necessary for the successful practice of the teaching profession. The most appropriate subject for this is 'Didactics'. Within the framework of this subject, students become familiar with the latest pedagogical trends and concepts, gaining professional methodological knowledge, which enables them to apply educational strategies, methods and tools which can help education.

Based on the students' professional methodological knowledge, the purpose of our research was to map whether the undergraduate teacher training students of Sapientia University possess competencies that are essential to their teaching profession. The measurement instrument of the survey was a questionnaire that examined student competencies in two ways: on the one hand, what students think of those professional skills and abilities they need in their teaching profession; and, on the other hand, what kind of professional skills and abilities they have. In addition to the background information of the students, the questionnaire asked about the assessment of the training, general and teacher competencies. It contained a 34-item list of competencies, of which eight items asked about key competencies were proposed by the European Council and 26 items asked about student competencies and knowledge were what we considered essential for an engineering teacher. The survey included students who already acquired professional methodology knowledge during their training. Accordingly, data were collected from Sapientia University's second and 3rd-year engineering students (n = 64). Since in the curriculum of the Sapientia University Teacher Training Institute the subject 'Didactics' is in the second semester, data collection took place after the end of the second semester, in the 2018–2019 academic year. The survey included undergraduate students in Computer Sciences, Automation and Applied Informatics, Mechatronics, Machine building technology, Horticultural Engineering, Agricultural Engineering and Agricultural Engineering.

3. Results

A total of 64 teacher training students participated in the study, out of which 33% were male and 67% were female. More than half of the students surveyed (57.2%) had some form of teaching experience, i.e., they had already completed their teaching practice during their high school studies or conducted some group work in student camps. 33.3% of the students said they had a practicing teacher in the family and almost everyone said (97.6%) they had met a teacher in high school who they considered to be an exceptionally good teacher (Table 1).

Table 1. Background information

Background questions	Variables	Percent
Sex	Male	33.3
	Female	66.7
Do you have any teaching experience (Kindergarten teacher training, camps, programme management, etc.)?	Yes	57.2
	No	42.8
Is there any teacher in your family?	Yes	33.3
	No	66.7
Did you have any teacher during high school who you considered to be an exceptionally good teacher?	Yes	97.6
	No	2.4
Do you plan to take up a teaching position if you get a teaching qualification?	Yes	35.7
	No	4.8
	I don't know	59.5
How much would you like to work as a teacher?	Very much	16.7
	I'd like	42.9
	Not really	38.1
	I don't want	2.4

A significant number of students are uncertain in their plans for a teaching career, as nearly 60% of them are uncertain whether they will apply for a teaching position and only 35% of the students is sure of this. It is interesting to observe that when they were asked if they want to pursue a teaching career, the ratio is exactly the opposite, as almost 60% of them said they want to be a teacher. This may be due to the fact that they are still in the process of teacher training and will make their decision after completing the teaching practice.

Completion of the professional methodological course is a prerequisite for independent individual practice. At this point, there is no real output assessment, but it is important to determine when we consider a teacher candidate to be ready for consistent school practice. The students must have all the theoretical knowledge, i.e., the basis of the eight teacher competencies, especially those that are closely related to the educational work. In addition, the student should have his/her own educational ideas based on the analysis and evaluation of different pedagogical views and individual pedagogical experiences.

The eight competencies proposed by the European Council were measured by a separate set of questions. The results in Table 2 show that the self-assessment values are lower than those of expectations related to teachers. This refers to the students' realistic self-evaluation and sincerity, as they are aware of the fact that they are still in the preparation stage and need further professional development and training.

Table 2. The assessment of each key competence ranked according to its importance (mean)

Competencies students have for the teaching profession		Competencies	Competencies that are needed in the teaching profession		*T*-test
Ranking	Mean		Mean	Ranking	
1	4.57	Communication in the mother tongue	4.80	1	*
2	4.07	Self-development and self-education	4.65	2	***
3	3.92	Active use of ICT	4.04	6	NS
4	3.92	Cultural awareness	4.11	5	NS
5	3.88	Entrepreneurship	4.14	3	***
6	3.76	Civic and social competencies	4.14	4	**
7	3.47	Knowledge of mathematics, science and technology	3.97	8	***
8	3.11	Communication in foreign languages	4.02	7	***

Verified by *t*-test: NS = not significant ($p > 0.05$).
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Students gave the highest value to the mother tongue competence and the ability of self-development in both self-evaluation and their expectations related to teachers. The development of the mother tongue competence is a prerequisite for effective education and the transfer of appropriate professional knowledge, while the abilities of self-development and of self-training are the guarantee of personal efficiency. Students who are preparing for a teaching career are aware of the need to develop their own personality and of the importance of self-education and they have realised that this profession requires a whole person who is able to constantly adapt to changes and is always open to new challenges.

The results/data show what additional tasks should be undertaken in teacher training: according to the students' assessment, the development of foreign language communication skills as well as mathematical and scientific competencies is mostly needed.

We have grouped students' knowledge and competencies containing 26 items according to training and output requirements (Kotschy, 2011), we have also developed eight factors.

1. *Developing the personality of pupils and validating individual treatment* – in this factor, we grouped items that examined whether the student possessed all the theoretical knowledge needed to help pupils develop their personality and that their views on education formed a coherent system. The following questions were included: getting to know the pupils' world and their lifestyles (and utilise this knowledge); to know the social, emotional and moral development of adolescents; and to approach pupils with a warm heart.
2. *Supporting and developing pupil groups and communities* – in this factor, we grouped items that examined whether the student is familiar with the pedagogical methods promoting the development of pupil groups, is he or she able to organise consciously pupil communities and help constructive resolution of conflicts. The following issues were listed: to create an atmosphere of cooperation and mutual trust; assist in conflict resolution; and to support the development of pupil groups and class communities
3. *Professional methodology and subject knowledge* – in this factor, we grouped items that examined whether the student is able to apply his/her theoretical and empirical knowledge independently and in an integrated way, to facilitate the personal development of pupils and whether he/she is prepared to integrate various learning organisation methods and learning strategies into his/her educational practice. The following issues were listed: to teach your subject through appropriate methods; to have up-to-date knowledge of the latest pedagogical, didactic and educational issues; and to develop, manage and evaluate attractive and effective learning activities.
4. *Planning the pedagogical process* – in this factor, we grouped items that examined whether the student is familiar with the documents, types of curriculum that determine the pedagogical activity, whether he/she understands their role in the content regulation of education and with his/her advanced subject knowledge is the student able to determine the content taught, its structure and logical construction and to choose the appropriate strategies for learning and teaching. The following issues were included: planning the pedagogical work comprehensively and in detail based on a nuanced analysis of the conditions; creating a good lesson plan by using the curriculum; and following the changes in the curriculum.
5. *Supporting, organising and managing learning* – in this factor, we grouped items that examined whether the student has knowledge of the learning and teaching process, whether he/she considers developing learning abilities important, whether he/she is aware that active student engagement, ongoing teacher feedback and reinforcement are needed to raise pupil interest and whether he/she is able to build on pupils' motivation and involve them in the management, planning and evaluation of their learning process. The following issues were included: creating a clear, organised, task-oriented learning environment and structure; organising and asking questions properly; and preparing tools and audiovisual materials for the lesson.

6. *Assessment of the pedagogical processes and students' personality development* – in this factor, we grouped items that examined whether the student is able to develop his/her assessment activities and whether he/she is aware of the basic evaluation rules and relationships. The following issues were included: analytical evaluation of pupils' developmental processes and educational achievements; use of different forms and tools of evaluation; and making records, reports and administration related to pupils.

7. *Communication and professional cooperation* – in this factor, we grouped items that examined whether the student is aware of the specifics of the classroom communication and seeks to apply them, whether he/she knows information sources, organisations and their contacts and management, related to his/her field and teaching profession and whether he/she understands with confidence the specialised text and communicates effectively and how active and initiator he/she is in his/her tasks. The following issues were included: being enthusiastic about your own subject and the pupils' progress in this subject; finding joy in your task and feel commitment to the profession; effective communication and networking; and applying new information and communication technologies.

8. *Commitment and responsibility for professional development* – in this factor, we grouped items that examined whether the student is familiar with the scientific theories about the role of the teacher, whether he/she is able to find, interpret, use and communicate professional sources of information, in knowing the research methods of educational science is he/she able to participate in, plan and manage school work research, to interpret and apply results of research in educational work. The following issues were included: establishing and developing your self-study abilities; correcting your work based on your professional experience and theories you have learned; and understanding the methods of pedagogical research and applying them in your field.

Table 3 shows the results of the eight established factors. According to the students in both self-evaluation and expectations related to the teacher, the competencies of communication and professional cooperation are the first among competencies of the teacher. Self-evaluation shows that students feel good about developing students' personality, personalised treatment (second place) and forming student groups and communities and they need further development in the planning of pedagogical processes, the enrichment of professional methodological and subject-specific knowledge. In the last place (eight place) is the commitment and responsibility for professional development (3.81), which is partly due to the fact that not all students are sure that they will apply for a teaching position or understand that the teaching work takes responsibility. This is evident from the fact that the value of this competence (4.20) is higher than that of the expectations related to teachers.

Table 3. The assessment of factors containing student knowledge and competences ranked according to their importance (mean)

Competencies students have for the teaching profession		Competencies	Competencies that are needed in the teaching profession		T-test
Ranking	Mean		Mean	Ranking	
1	4.54	Communication in the mother tongue	4.61	1	NS
2	4.15	Developing the personality of the pupils, validating individual treatment	4.35	4	*
3	4.11	Supporting and developing pupil groups and communities	4.56	2	***
4	4.10	Supporting, organising and managing learning	4.47	3	***
5	3.89	Assessment of the pedagogical processes and students' personality development	4.15	8	**
6	3.88	Planning the pedagogical process	4.19	7	**

7	3.82	Professional methodology and subject knowledge	4.34	5	***
8	3.81	Commitment and responsibility for professional development	4.20	6	***

Verified by *t*-test: NS = not significant ($p > 0.05$).
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

The evaluation of the expectations related to teachers involves pupil groups and communities, followed by learning support, organisation and management. This is reflected in the importance they attach to having a good teacher–pupil relationship and their expectation is that the teacher should not only be professionally good, but also support the learning process and pay attention to the development of students communities.

4. Conclusion

In our study we examined the existence/development of teacher competencies and key competences for teaching among engineering students in teacher training. We wish to **collaborate** our examination **with** those educational efforts in Romania that consider competence-based teaching important (Gu**t**u & Vicol, 2014).

The students' answers showed that they considered communicating in their mother tongue and for the self-development skills to not only be the most important key competencies, but also for the active use or ICT, cultural awareness, entrepreneurship and civic competencies to be important. Among the competencies of the teachers, the most important competencies proved to be the ability to form student communities and to support the learning process, which means cooperation and paying attention to pupils is very important. Self-evaluation data show that they feel the least competent in mathematics, science and foreign language communication. Among the competences of teachers, there is a need for improvement in the planning of the pedagogical process, in the area of professional methodological and professional knowledge, as well as in taking responsibility.

Based on the students' answers, the following tasks for teachers were formulated: during training methodological and professional knowledge should be further developed, the sense of responsibility in students should be strengthened through examples and the teachers should support students in the process of learning to become a teacher.

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