ENGINEERING STUDENTS' SELF-ASSESSMENT OF LEARNING OUTCOMES IN THE CONTEXT OF TRANSFORMATIVE LEARNING

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Abstract. Students' self-assessment of their learning is an essential and recognized part of the study process that helps improve motivated studies. The aim of the study was to outline the components of transformative learning, the role of educators, students and learning environment, and to analyse students' self-assessment of the learning outcomes at the Latvia University of Agriculture. The theoretical study was focused on the analysis of transformative learning and conception of learning outcomes. The method of questionnaire was used to investigate the students' self-assessment of their learning outcomes. The results of the study were obtained from the first-year and third-year students of agricultural engineering, machine building, forest engineering, construction and information technologies fields of the Latvia University of Agriculture (LLU). There were compared the data and their difference of significance got from the first and third year students data.Therefore, the questionnaire results serve as a means of the students' and educators' understanding of the quality of the process of teaching and learning, and thinking transformation. As the self-assessment of learning outcomes for a vital number of the first and third year engineering students is only on a middle or even low level it is necessary to include the themes on transformative learning in further education programmes for educators and to persuade them to use more learning from experience by means of critical reflection through rational discourse. So, the transformative learning allows the students to use the contexts of their formal learning experiences to construct and reconstruct personal meanings.

Keywords: self-assessment, learning outcomes, transformative/transformational learning, higher education.

Introduction

The 21st century is positioned as a way towards the knowledge society where creating innovations and working with global information is a serious challenge for young professionals because they need appropriate skills and readiness to be persons who are able to foster progress. Universities have a vital role in that process because students have to develop meta (reflection and methodological), self-, professional and social competences [1] in order to be able to create innovations in their professional field and promote the development of sustainable society at the same time.

The 21st century educators have to empower that process and move it forward in their practice. It can be done by implementing transformative learning and highlighting the 21st century skills, which are known as "Four Cs": critical thinking, communication, collaboration, and creativity [2]. The four skills are ascribed mainly to general education but they should be developed during university studies as well because they also describe humans' vital attributes important for a knowledge society.

Both transformational and transformative learning are used in the article. The usage depends on the choice of cited authors.

The Academy of Diversity and Inclusive Education recognises that transformative learning promotes adults' ability to think autonomously. It allows learners to develop their own sense of meaning in the world free from the accepted purposes, beliefs, judgments, values, and feelings that we received from our cultures, religions,family beliefs, personalities, and life experiences [3].

It means that autonomous thinkers assess processes and learning outcomes. Therefore, transformative learning is a means of revising successes and failures and fosters critical thinking about the learning process.

Autonomous thinking is vital for full participation in a democratic society as well as for moral decision making; thus, it is the goal of higher education to produce autonomous thinkers [4].

The European Federation of National Engineering Associations outlines continuing professional development and career strategy demands for engineers in modern working area. They are: competitive work place, accelerating pace of work, high expectations on professionals, expanded scope of work, need to develop new competencies, increased need to collaborate with others, demand for increased flexibility [5]. It means that progressive engineers should be able to transform their professional routine and views through consciously directed processes critically analysing and assessing their outcomes. University studies should facilitate that ability stressing the meaning of our

own needs, aims, experience, interpretations, views, judgements and emotions. So the becoming engineers develop their autonomous thinking and one of the means how to do it is purposefully directed transformative learning. Transformative learning allows adult learners to use the contexts of their formal learning experiences to construct and reconstruct personal meaning[6].For that reason the aim of the study was tooutline the components of transformative learning, the role of educators, students and learning environment, and to analyse students' self-assessment of the learning outcomes at the Latvia University of Agriculture.

The theoretical significance of the study is in assessment and summarization of the components of transformational learning and activities of the educatorand students.

The practical significance of the study comprisesthe results of students' assessments of their learning. The results reflect the students' ability to use knowledge, think analytically, creatively and autonomously, and co-operate. The results could be used in revision and improvement of the competence based approach towards the study process.

Materials and methods

According to UNESCO learning outcomes are understood as statements that describe three major domains: knowledge (learning to know), skills (learning to do) and competences (learning to be) [7].

Learning outcomes comprise overlapping professional, social, meta and self competence [1]. The empiricial study covers concretized items of social, meta and self- competence which reflect elements of transformative learning.

The theoretical basis of the study was the transformative learning theory developed J. Mezirow and his followers. According to the theory students have to be active and facilitated by teachers to use their experience and to reflect critically of it through rational discourse. J. Mezirow's theory substantiates how learners construe, validate, and reformulate the meaning of their experience. The process of transformation relates to three dimensions: psychological (changes in understanding of the self), convictional (revision of belief systems), and behavioral (changes in lifestyle). In the process of transformation learners change their beliefs, attitude and emotions and transformations happen due to psychological aspects as disorientating dilemma, alienation, reintegration, experimenting with new roles, building confidence in new ways, self-examination, planning a course of action, getting of knowledge how to implement plans, etc. J. Mezirow identified rational discourse as a catalyst for transformation, as it induced the various participants to explore the depth and meaning of their various world-views, and articulate those ideas to their teacher and group participants [8; 9].

E. O'Sullivan [10] developed J. Mezirow's theory stressing a dramatic shift of consciousness during transformative learning. That shift has an impact on humans' relations, attitude towards life, living and self, and it promotes re-evaluation of new opportunities.

As regards university studies transformative learning helps develop students' own sense of meaning and psychological, convictional and behavioral dimensions should be considered using rational critical reflection. That approach is holistic, of course, and demands appropriate readiness also from teachers because from one side it is rational, cognitive and analytical and from the other side it is quite emotional, intuitive and creative process. The teachers should be ready to respect and discuss alternative meanings proposed by students and recognise their originality in the process of transformation.

Critical reflection of the experience has an impact on the changes of understanding of the self, others, social and professional phenomena. By means of rational discourse the meaning schemes are transformed and the learners develop their thinking skills integrating new cognitions in their experience. Critical transformation of experience in the process of development of new professionals is a feature that they think about learning outcomes and attitude, change them and become autonomous learners. Students are involved in analytical process and they change their beliefs and find new ways how to think about social and professional problems.

A vital acquisition for students in a result of transformative learning is a skill of integration new meaning schemes and ideas into their experience. Knowledge is a basis of constructing meanings, but in transformational learning making of meaning is a wider process. J. Dirkx [11] also emphasizes the development of democratic relations and self-actualization of individuals. The students are aware of

transformations and in addition to social and professional beliefs it touches their attitude and emotions. Therefore, that skill has to be developed routinely through regular transformative learning work and both the students and teachers have to contribute.

Transformative learning is quite complicated way of personal changes and they happen also in transmissional and transactional education. Learning means changes but not all of them is transformation. J.P. Miller and W. Seller [12] explain that there is a difference between transmissional, transactional and transformational education. The relevance of transmissional education is that a teacher is in the centre and knowledge is transmitted from the teacher to a student and a stress is put on understanding and reproduction of information. It means that the teacher orientates to the contents and compilation of knowledge rather than critical and self-regulated learning.

According to J.P. Miller and W. Seller [12]in transactional learning students are promoted to use their experience, critical thinking and interaction with other learners.

According to S. D. Brookfield, transformative learning happens if it involves a serious critical reflection of thoughts and actions [13]. Therefore, a lot of time for serious analysis of beliefs and assumptions should be planned in the case of transformative learning.

In the case of transformative learning the role of educators is to foster critical reflection of experience while learners are aware of their changed assumptions and beliefs. The learners' interpretations of their and others experience and beliefs are crucial because they share meaning of experience and the educators have to reserve time for it. The educators have to choose interactive methods by which the learners can actively participate in assessing their beliefs, values and emotions. P. Cranton [14] reminds that the educator's personal example of critical reflection, changes and autonomous thinking in continuous development can have an impact on students in relation to their transformative changes.

According to J. Mezirow educators have to encourage practice in redefining problems from different perspectives [15].The educator should promote creating of equal and positive learning environment and relationships because open dialogues and discussions are highly important in the case of critical reflection of experience that develops autonomous thinking. J.Mezirow recommends such methods as metaphor analysis, concept mapping, consciousness raising, life histories, repertory grids, and participation in social action, learning contracts, group projects, role play, case studies, and simulations [15].He believed that these could stimulate critical reflection and rational discourse, integral parts of the transformative process in his model.

Empirical study was carried out in 2015 and 2016 by means ofthe method of questionnaire to investigate students' self-evaluation of their learning outcomes. There were included ranged answer choices. Students marked high (h), medium (m) and low (l) levels.There were involved 159 first year and 109 third year engineering students in the study.

The data were compared and their difference of significance got from the first and third year students data using Chi-square in determination of p value ($p \leq \alpha = 0.05$). The obtained results could be used in the revision of planned results of study courses and implementation of methods and content promoting better reaching of learning outcomes.

Results and discussion

In a result of theoretical studies of transformational learning it is possible to state that the main components of it are learners' experience, rational discourse, critical reflection and assessment of meanings. Regular usage of the components in the learning process promotes self-assessed development of autonomous social and professional beliefs and is a precondition of transformations in a worldview.

The educator as a facilitator of transformational learning implements the following activities:

- encourages students to reflect on and share their knowledge, feelings and ideas;
- keeps holistic approach towards students and self considering the unity of physical, intellectual and emotional functioning of the personality in the learning process;
- is ready to be transcendent of his own beliefs and respects others' beliefs;
- implements versatile ways of learning;

- keeps supportive and positive environment in which dialogue is one of the central methods;
- is able to a mentor reflecting on various themes;
- helps students question reality in ways that promote shifts in their worldview.

Students as participants of transformational learning implement the following activities:

- are free and aware of their own reality/meanings and open for discussions to substantiate or transform it;
- are active participants in critical reflection of their experience;
- develop the ability to transcend past contexts of learning and experience;
- are able to integrate critical reflection into their studies and personal life;
- are aware of their physical, intellectual and emotional functioning.

LLU students' self-assessment of indicators that serve as an evidence of social and professional transformations are depicted in Table 1. There were involved 159 first year and 109 third year engineering students. The students were asked five questions related to change of their thinking and beliefs.

Table 1

Students' self-assessment of learning transformations

Indicator	Respondents		Self-assessment			*p*-value	Chi-square
	Year	Totally	h	m	l		
1. I am able to use knowledge, skills and competence in new learning situations.	1	150	51	94	5	0.489	1.43
	3	109	31	72	6		
2. I develop an ability to think autonomously and critically and to express my opinion.	1	150	56	87	7	0.262	3.206
	3	109	52	51	6		
3. I develop an ability to analyse, synthesize and assess information.	1	150	65	79	6	0.438	1.652
	3	109	56	49	4		
4. I learn to judge autonomously about my behaviour and understand myself in the process of taking decisions.	1	150	91	55	4	0.786	0.482
	3	109	73	32	4		
5. I am able to co-operate with others.	1	150	105	36	9	0.442	1.631
	3	109	81	25	3		

There is not a disparity between the first and the third year students' data in numbers in all the five indicators using Preachertest [16]. There is only a tendency towards disparity between the first and third year students in the second indicator, where the results of the first year students are higher than the third year students.

Further coherences were stated between the first and second, first and third and fourth and fifth indicators for the first and third year students. The results are depicted in Table 2.

Statistically significant differences ($p < 0.05$) between the indicator one and two are in the third year and between the indicator one and three in the first and third year as well as between the indicators four and five in the first year.

Other compared differences are not statistically significant. The results of the first year students are higher than the third year students.

That phenomenon is in both tables. It could be concluded that the third year students' self-assessments are more critical. The third year students filled in the questionnaire longer time than the first year students and it proves their wish to think over each question more deeply. The third year students' experience in the learning process is determined more by critical reflection on each question. It means that there happen transformations in the students' thinking and attitude and proves indirectly that the study programme fosters transformational learning.

Table 2

Coherences of students' self-assessment in peer indicators of learning transformations

Indicator	Respondents		Self-assessment			*p*-value	Chi-square
	Year	Totally	h	m	l		
1. I am able to use knowledge, skills and competence in new learning situations.	1	150	51	94	5	0.658	0.838
2. I develop an ability to think autonomously and critically and to express my opinion.			56	87	7		
1. I am able to use knowledge, skills and competence in new learning situations.	3	109	31	72	6	0.02	8.104
2. I develop an ability to think autonomously and critically and to express my opinion.			52	51	6		
1. I am able to use knowledge, skills and competence in new learning situations.	1	150	51	94	5	0.21	3.081
3. I develop an ability to analyse, synthesize and assess information.			65	79	6		
1. I am able to use knowledge, skills and competence in new learning situations.	3	109	31	72	6	0.00	11.956
3. I develop an ability to analyse, synthesize and assess information.			56	49	4		
4. I learn to judge autonomously about my behaviour and understand myself in the process of taking decisions.	1	150	91	55	4	0.03	6.89
5. I am able to co-operate with others.			105	36	9		
4. I learn to judge autonomously about my behaviour and understand myself in the process of taking decisions.	3	109	73	32	4	0.49	1.418*
5. I am able to co-operate with others.			81	25	3		

*At least 20% of expected frequencies are less than 5.

Transformative learning has a powerful potential for enhancing the students' self-actualization process. According to L.M. Baumgartner educatorshave to consider ethicsduring transformational learning. He emphasizes the necessity of mutual trusting between students and the educator. It means that both sides create free, positive environment and respect personalities of each other. L.M. Baumgartner also recognises that the students who see the educator as an authority figure may have difficulty or reluctance to challenge conventional values, beliefs, and interpretations of facts. L.M. Baumgartner recommends a formal code of ethics be designed and implemented, and encourages adult educators to establish a learning forum in which they can create mutual support and exploration of the dynamics of transformational learning [17].

Transformative learning allows students and educators to develop genuine relationships in which the educator makes a difference in the students' lives and feels a difference in his or her own life as well [18]. Transformative learning allows adult learners to use the contexts of their formal learning experiences to construct and reconstruct personal meaning [5].

T. B. Roberts states that the major intellectual error of our times is the failure to recognize the fundamental primacy of mind-body states, and that any cognitive science which omits them is incomplete. He gives examples such as imagery, relaxation, meditation, prayer and spiritual disciplines, martial arts, psychoactive drugs, yoga and body disciplines, breathing techniques, acupuncture, out-of-body experiences, biofeedback, dreams, suggestion and hypnosis, near-death experiences, psychoneuroimmunology and others. All these types of learning experiences could be activities in a transformational learning experience. He suggests that medicine and psychotherapy are fields, which have applied mind-body approaches first, and predicts that they will become important in education as well [19].

As regards environments, which promote transformational learning, J. Mezirow [15] describes it as one in which participating have full information and they are free from coercion, have equal opportunity to assume various roles, can become critically reflective of assumptions, are empathetic and good listeners, and are willing to search for common ground or a synthesis of different points of view.

P.A. Cranton [20] substantiates that transformative learning is more spiral-like process and describes seven aspects of teaching strategies that can be used to set up a learning environment that promotes transformation. She offers clear examples how each strategy has the potential to be transformative.

Conclusions

1. Transformative learning during university studies is an acceptable way of developing skills and competences according to the 21st century progress demands and tendencies.
2. Transformative learning is a systemic way of developing autonomous thinking and widening of consciousness and it is a feature of learning quality when students use information to solve relevant problems, create products or overcome challenges allowing to develop the students' own sense of meaning and feel free from accepted beliefs and judgements.
3. Thinking transformations is a result of systemic work of educators and students, where a supportive environment is kept, and the usage of interactive and reflective methods are provided to stimulate active critical reflection on rational discourse.
4. As the self-assessment of learning outcomes for a vital number of the first and third year engineering students is only on a middle or even low level it is necessary to include the themes on transformative learning in further education programmes for educators and to persuade them to use more experience in learning by means of critical reflection through rational discourse. So the transformative learning allows the students to use the contexts of their formal learning experiences to construct and reconstruct personal meanings.

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