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MICRO-LEARNING EDUCATIONAL APPROACH: THE MAIN CHARACTERISTICS OF MICRO-LEARNING, ABILITY OF IMPLEMENTATION IN LUT, BARRIERS AND FUTURE PERSPECTIVES

Master’s Thesis

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Examiner(s): Professor Leonid Chechurin
ABSTRACT
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The method of micro-learning is a new educational technology in the field of education. In view of the fact that this technology has been little studied, this paper proposes the study of this method by creating an experiment and analyzing its results.

The Master’s Thesis explores impact of micro-learning implementation as a pilot project during the Summer School 2019 in LUT University in the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” The research is based on the literature review of various educational approaches, but deeply about micro-learning method. The depth of understanding about micro-learning were analysed by online survey among student and LUT University professors.

The results reveal the level of understanding about micro-learning approach among students and professors and gives the picture about implementation micro-content as part of the course.

Keywords: micro-learning, micro-content, video-lectures, micro-module, micro-content implementation.
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Lappeenranta, December 2019
Tatiana Panina
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ML - Microlearning
MOOCs - Massive Open Online Courses
OLS - Ordinary Least Square
1 INTRODUCTION

Throughout all times, the education system has been repeatedly changing and adjusting according to the influence of the emergence of new ways and methods of teaching, as well as scientific and technological progress. Technological development, experience, the growing digital literacy of teachers and students, as well as the increasing needs of students in relation to the quality and structure (form) of the subject, challenge the creation and development of new or innovative teaching methods that are supported by new information technologies.

It is obvious that a rapidly changing environment dictates new conditions in the ways of gaining knowledge that will allow you to take various courses and get acquainted with learning materials at any time and anywhere. These features will be critical to future and current learning concepts. Based on the fact that the learning process in most higher education institutions around the world seems to be traditional methods, it can be said that many courses do not have these properties and, therefore, cease to be attractive and the most efficient to students. Thus, there is a need to develop new solutions that could meet contemporary requirements of both students and teachers.

Nowadays, there is a significant trend, when students themselves request educational content based on their needs to obtain specific knowledge and skills for future professional activities. It can be noted that the education system today strives for individualization. Learning functions are delegated to students, cognitive management functions and opportunities for designing their own educational paths are provided. Thus, students have the freedom to choose educational activities.

In the modern world, a micro-learning system has been developed that allows people to create courses in a small format that contain specific information that learners need. One of the advantages of this system lies in the fact that micro-courses are placed on educational platforms. It is possible to study not only within the walls of universities, but in a place convenient for students at any time. Such micro-courses can be viewed an unlimited number of times, which is very opportune due to the fact that according to research findings, that approximately 80% of the information studied is forgotten after a month. Moreover, small educational units are easier to understand and perceive, which may indicate applicability to learners with different backgrounds.
During the last decade the number of micro-learning related topic in Google Trends show the increasing from 4 references in January 2010 to 100 in December 2019 (historical maximum value) (Google Trends, 2019). The data obtained allow concluding that the trend regarding micro-learning is significantly growing. These findings prove the high topicality of considering subject in question.

**1.1 The objective and research questions**

The education system undergoes various changes over time. Today, there are many training formats; however, the most common is traditional training. The problem is that the transience of the modern pace of life dictates the conditions in which students often prefer to choose alternative educational formats. This is micro-learning, which can reduce the time to acquire knowledge.

The objective of the thesis is to consider the relevance of micro-learning through the historical prism of the consistent evolution of educational approaches; to assess micro-learning experience of LUT University based on the course “Artificial Inventiveness” (former “Systematic Creativity and TRIZ basics”) at Lappeenranta-Lahti University of Technology LUT, Finland and create recommendations for future development of micro-learning implementation.

According to above the next research questions were created:

1. Are there any possibilities and shortcomings, which micro-learning brings to the educational process?
2. Are there evidence of improving learning process due to micro-learning implementation at LUT using experimental approach?
3. What is the depth of knowledge in the field of micro-lecture among students and professors of LUT University?
4. What are the recommendations for applying micro-learning approach?
1.2 Theoretical framework

In the Figure 1 it can be seen the theoretical framework which can assess the research questions.

![Theoretical framework diagram]

Figure 1 – Theoretical framework

1.3 Structure of the thesis

Table 1 illustrates the structure of the thesis.

Table 1. Structure of the thesis

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The first contribution of this study is to provide the comprehensive literature review for managerial purposes in the field of higher education. The second novelty of the research relates to the fact that this study shows the first research results of micro-learning at LUT University using experimental and survey methods. The third new output is to build systematic view through presenting recommendations on how to develop micro-learning approach at LUT University.
2 LITERATURE REVIEW

The development of various technologies in the field of education leads to the emergence of new teaching methods and approaches. Thus, various innovations do not bypass higher education institutions. Today, universities are striving to introduce new effective teaching methods to captivate work efficiency, as well as to attract more students. Therefore, in the part of the literature review, the transition from the traditional form of learning to e-learning and in particular to micro-learning is considered. The main focus of this chapter is to study a new educational approach – micro-learning, its main characteristics, rules and possibilities of application at universities.

2.1 Traditional education

For centuries, many universities around the world have used the traditional teaching method to transmit knowledge to students. This method is the most understandable and possibly simple for both professors and students. However, due to the constantly changing environmental conditions and the constant development of technology, the education system is undergoing significant changes.

Traditional education is characterized by a quiet atmosphere in the classroom, where the professor is the center of attention, and students receive information and make the necessary notes (Bogost, 2013). Traditional learning has its advantages. Students can ask questions directly during lectures, communicate face to face with professors, and ask them to explain in more detail incomprehensible moments in the lecture. However, all these things can be done online. Nowadays, it can be special chat with classmates and professors, where they can ask questions and moreover, to share new information on a topic that may also be useful for both students and the professors.

In traditional teaching, the professor is a central figure. Students often cannot influence the content they offer. Even though universities are building curriculums in accordance with the necessary set of subjects for different specialties, often in several countries there is no alternative choice of subjects. Despite the fact, that traditional education nowadays the most widely held approach it has a lot of gaps and disadvantages (OnlineUniversities, 2011). Many studies show that students lose their attention after about 10-15 minutes of a lecture. This indicator is averaged, so this time depends on various factors, for example, the intonation of the professor, the ability to present information, and attract the attention of
students (Bunce, 2010). However, it is quite difficult to keep the audience interested for several hours. Moreover, the question arises, how much information are students remember after listening to many hours long lectures in a classroom.

Students do not remember all the information provided by the professor, when listening to a lengthy lecture and periodic loss of attention. Various studies show that students in the absence of any activities, except for listening to a lecture, which lasts from 40 minutes and longer, remember only 20 percent of the information. In contrast with lecture, which lasts around 15 minutes, when student remember around 40 percent of given information. (Bradbury, 2016). Despite the fact that students try to make notes during the lecture, it is often difficult to restore complete information provided by professor.

As can be seen from the above, traditional study approach is not able to fully meet the modern needs due to high level of dynamics of the modern world, changes in people’s lifestyle, development of IT technologies in education and changes in the ability to remember information. Moreover, nowadays, students become a key figure in the educational segment, requiring the provision of the information they need.

### 2.2 E-learning

The advent of various technologies and the widespread use of the Internet has led to the beginning of a new educational format. At first, it was distance learning, which allowed teachers and students to communicate using mail and later email. in distance learning, all communication between the teacher and the student takes place via the Internet. Before the advent of the World Wide Web, professors sent lectures and assignments recorded on the floppy disk, by mail, and then students sent them their answers. Radio and television were also used. However, nowadays, with the development of technology, communication goes via the Internet. There is both open access to courses, and closed, access to which is carried out after payment by students (Pandza, 2013). However, with more intensive use and development of Internet technologies, as well as educational trends, e-learning has appeared. The emergence and implementation of e-learning has allowed education to become more flexible, to overcome geographical distances, as well as various circumstances in which a student cannot attend lectures at the university (Chin, 2016).
The European Commission (2001) defines e-Learning as the use of new multimedia technologies and the Internet to increase learning quality by easing access to facilities and services as well as distant exchanges and collaboration. Different studies determine the different rules and characteristics of e-learning, on which courses should be built (Paechter & Maier, 2010). For a better understanding of educational content, the educational program, all its components, as well as the courses themselves, should be well designed and clearly formulated. It should be clearly defined what students will receive from the course; what skills and opportunities for their further application will acquire. And also an important part is communication between teachers and students. Learners should receive timely feedback on emerging issues, as well as be supported by teachers throughout the course (Paechter & Maier, 2010). However, an important aspect in e-learning is the creation of the necessary convenient and comfortable conditions for both professors and students, which will provide high-level education without losing its quality (Rodrigues et. al., 2019). In this case, a number of parameters and aspects should be taken into account: the electronic course system should be well thought out, a convenient platform for both professors and students should be built and one more issue that is important is the well-defined methodology for assessing knowledge and evaluating students’ success.

E-learning provides an opportunity for active communication between students, which increases its attractiveness. Moreover, the use of various interactive tools and the involvement of students in active learning finds positive reviews both among students and among teachers (Brahmasrene & Lee, 2012). One of the important aspects of combining e-learning with micro-learning is the use of video content in courses, thereby engaging more students. However, in e-learning, the video segment is not a fundamental educational tool, it acts as an effective supplement that can be used to improve results, as it can be reviewed a large number of times if necessary (Abidin et.al., 2017).

E-learning is predominantly because its appearance entailed the creation of Massive Online Open Courses (MOOCs). MOOCs are an educational technology that involves both students seeking certain knowledge and teachers willing to share their research and developed courses. This is a free form of interconnection that does not require special conditions, except the situations when the certificates can be paid (Liyanagunawardena et al., 2013). The forerunner of the MOOC was OpenCourseWare (OCW), which was created in 2001 by the Massachusetts Institute of Technology (MIT). The idea of creation arose because of the
desire of teachers to publish their courses openly. It was also provided for licensing of all courses, which allows making various changes to them, as well as be distributed. Subsequently, many universities around the world joined this trend and began to publish their courses, for example, Open University of UK through the OpenLearn project and the Open Learning Initiative by Carnegie Mellon University (Liyanagunawardena et al., 2013).

MOOCs are built through different study platforms, such as Coursera, EdX, Udemy, Udacity and others. These platforms are providing special architecture to public various courses and allow people to study on them. MOOCs open for professors and students an incredible space for communication: to share and to get knowledge. The idea of such open educational platforms has found positive feedback among both teachers and students. Therefore, for example, more than 2.8 million students are registered on the Coursera platform, and the number of registrations for courses per month reaches about 1.4 million people (Hew & Cheung, 2014). Increasingly, MOOCs are used by universities to attract students not only from their own country, but also foreign students. This affects both the development of skills and the construction of electronic courses among teachers, and the prestige of the university in the world arena. Today, there is some competition among higher education institutions that want to educate the best students. The development of e-learning and the placement of e-courses allows universities to become popular and subsequently selected by students for study.

The emergence of the possibility of learning via the Internet, namely through the MOOCs, influenced further innovations in the field of education. Gradually, new educational models are created such as blended learning, flipped classroom, and micro-learning.

2.3 Blended learning

Blended learning is a separate form of knowledge transfer and acquisition. This study approach is an effective combination of face-to-face meetings of teachers with students and Internet technologies as it takes only efficient methods from traditional education and e-learning. Using this approach allows students to be more active, thereby increasing the interest among them. In the context of the restructuring of the educational system from teacher-centered to learner-centered, these characteristics inherent in blended learning become especially important.
In this context, there is a certain combination of synchronous and asynchronous learning (Garrison & Kanuka, 2004). Since blended learning involves face-to-face communication, part of it is synchronous. That is, both students and teachers are in the same place at the same time. For example, lectures can be held synchronously. However, students can do various tasks and passing tests asynchronously (Parslow, 2012). This trend allows students to communicate with the teachers and among themselves face to face, discuss various issues and come to some conclusions together. In addition, thanks to the combination of different styles in blended learning, students can perform tasks regardless of location, at a time convenient for them and in a comfortable environment, which can contribute to the achievement of more positive results of their work.

Blended learning affects the motivation of students and teachers. The use of various Internet technologies increases the interest in courses among students. The ability not to be always attached to the university allows them to find various examples for their work in the environment. Teachers, in turn, get the opportunity to make their courses diverse, interactive and more attractive to students. Thus, blended learning helps participants in the educational process to think out of the box and use their creativity (Allen & Seaman, 2003). Nevertheless, in spite of the fact that blended learning affects students' self-organization and pays more attention to the student-oriented approach to teaching, some students encounter various difficulties in this type of learning (So & Brush, 2008). Not every person has a good sense of time and the ability to manage it, which can negatively affect the implementation of various tasks. Despite the fact that students perform tasks without reference to the required lecture hours, they can easily skip the deadline or contact the teacher too late with a difficult question. In this case, taking all the advantages of blended learning, you also need to consider all the possible disadvantages of this method. Despite the transition to the approach to orienting the student as the center of the educational system, teachers still have to play a significant role as the correct motivation of the student and help them throughout the course. Moreover, the course should be designed in such a way that the mixing of traditional methods and Internet technologies is understandable and does not mislead students (Bonk et al., 2002). Otherwise, the effectiveness of such courses will simply be low and perhaps in this context, students will prefer to choose the traditional method rather than something new.

Overall, blended learning carries a positive trend in the educational environment. This approach allows reducing costs (teaching hours are less, that part of the courses are held
online/ students do not need to go to universities often), making various timely corrections in building the course, increasing students' motivation to study and self-education, focusing on the individualization of education, and also opening up new competencies (Bonk et al., 2002). Moreover, nowadays, not only universities using blended learning approach. Many different companies are successfully implementing this method (Mitchell & Honore, 2007). As working people, do not have a lot of time to study, employers started to use new educational methods to make study process of their employees more convenient.

2.4 Flipped classroom

The active spread of the method of blended learning has prompted society to a new idea of the educational form, in which the lecture will not take place according to the traditional method, and various homework and other individual tasks will be performed online, but vice versa. This new approach is called “Flipped classroom”. This method is based on recording video lectures by professors that students can watch them asynchronously. However, the implementation of various tasks and discussion of the theory with examples takes place with the whole group in the classroom. The concept of building the flipped classroom approach is shown in Figure 2. Thus, this teaching method combines the previously considered incompatible methods of traditional teaching, but within the framework of the discussion of various tasks and e-learning, for recording and viewing lecture material (Bishop & Verleger, 2013).

![Figure 2. The concept of flipped classroom (Bishop & Verleger, 2013)](image)

Since the speed of perception of information is different for people, this approach can be considered as convenient. In the traditional method, when a professor gives a lecture, some students may not keep up with the pace of the narration, or vice versa with too slow speech,
students may lose interest and stop listening to the material carefully. Thus, flipped classroom approach allows students to watch a video lecture at a convenient time and place. There is also the opportunity to always return to that moment, which is difficult to understand and to revise it or look for information for a better understanding (O’Flaherty & Phillips, 2015). Obviously, in the traditional method of studying, students can ask a teacher to repeat material that was difficult in understanding, however, learners may be timid to be afraid to ask or not want to interrupt the lecture and interfere with other students. The idea of building courses based on a flipped classroom approach provides the opportunity to watch video lectures in free mode, but also provides the opportunity to discuss obscure points in the classroom in face-to-face meetings.

With the development and active spread of the inverted class, various studies began to be conducted on the subject of its effectiveness. One study showed that interest in video lectures among students is getting higher. Moreover, with the addition of interactivity, the percentage of interest among students increases (Zhang et al., 2006). It is also important to note that the percentage of students’ involvement in class work, when it is not lecturing, but is interactive and provides different activities, is increasing (Bland, 2006). Students like not to sit at a long lecture, but to be an active participant in the educational process, that is, discuss various cases, work on projects in groups, and jointly analyze various issues.

In the context of constantly developing technologies in the field of education, many universities strive to consider various innovations as soon as possible in order to introduce them in a quality manner. For example, the flipped classroom approach can reduce costs in the face of reduced government funding, or simply as part of the redirection of funds for the development of scientific projects (O’Flaherty & Phillips, 2015). Moreover, the attractiveness of higher education institutions depends on the speed of application of new educational methods, which leads to an increase in the flow of students.

In some works on inverted learning, it is believed that this method is far from new. Teachers have long been giving assignments to prepare for the next lecture so that students had better understanding in what would be discussed (Abeysekera & Dawson, 2014). However, in the flipped classroom approach it is very important to take into account precisely the technological component of the method. In today's understanding of this method, it is believed that students receive not, for example, just an article for reading before class, but
they look at the lecture itself, which was previously developed and filmed by the professor. In addition, the flipped classroom method uses various quizzes and cases, which may require the use of computers, the Internet, or various study applications or platforms (McLaughlin et al., 2014). Thus, it can be concluded that the idea of trying to change the material delivery organization and direct education to a student-oriented system has been around for a long time; however, inverted classes should not be confused with these previous attempts.

2.5 Micro-learning approach

2.5.1 The emergency of micro-learning

Currently, there is an active development of Internet technologies, several social networks, as well as web sites and platforms containing various courses and trainings. Now the methods of obtaining information, as well as the exchange of it, are greatly simplified and become available to any person anytime and anywhere. At the request of an Internet user, an answer can be given in just a few minutes. Nowadays, people can comment on the information provided, create chats and discuss a wide variety of topics at the international level. Many experts note the increased dynamics of life. A person in modern society is more active and energetic to perform various kinds of activities, thanks to the development of information technology. All this leads to an acceleration of the rhythm of life, and leads to a tendency to obtain information avalanche, i.e. a large stream of all kinds of channels for its receipt.

Modern people receive a huge amount of information throughout the day, but does not keep it in his memory and remembers it in fragments. This tendency has led to the emergence of such a term as “permanent partial attention”, when due to the large flow of information, a person cannot devote a large amount of time to one object and switches to another, etc. It can be said that all kinds of information envelops society every day, however, in this vein, our task is to correctly understand it, use it and be able to select only the most necessary. Moreover, a person is forced to analyze information at a faster speed, be able to adapt, and also make decisions immediately. This tendency, thus, forms a new type of thinking - “clip”. “Clip” thinking in the 90s of the XX century was interpreted as the ability of an individual to perceive the world through vivid and memorable short images. For example, a music
video clip consists of bright, often changing fragments, which may be completely connected to each other. However, a person remembers such a format for a long time.

American sociologist Alvin Toffler was the first to introduce the phenomenon of “clip” culture as an integral part of the general information culture. In the modern information society, “clip” thinking can be called a common phenomenon. People on the way to work do not buy newspapers; they read news on web sites using mobile phones, or watch news clips. If people need to prepare a new dish, it is more likely they will find a short instructional video on YouTube than to buy a cookbook. Thus, society seeks to compress information, that is, to provide it in a small format, but that carries only the most valuable information.

Journalist K.G. Frumkin identifies five key factors that led to the emergence of a new type of thinking:

- accelerating the pace of life and increasing the volume of information flow, forcing to resort to the selection of information and its reduction;
- increasing requirements for the relevance of information and the speed of receipt, which reduces the time it takes to process it and establish causal relationships; the increasing variety of incoming information;
- an increase in the number of simultaneous actions or actions, which implies the need for perception of various information flows;
- the growth of democracy and dialogue at different levels of the social system.

There is some concern about the prevailing "clip" thinking in society. It is believed that it has a large number of disadvantages. For people with “clip” thinking, attention becomes scattered, it is difficult for them to concentrate on one object for a long time, it becomes almost impossible. They also distinguish a rapid onset of fatigue, a decrease in the ability to analytic activity and an inability to solve complex problems. There is an opinion that representatives of “clip” thinking lose ability to empathize, as they do not plunge deeply into the information, they receive.

Nevertheless, there are positive aspects in the “clip” thinking. Our environment is changing very dynamically; there is a constant development and emergence of new technologies and innovations. All this is very difficult to perceive for a person with linear thinking, who is used to the moderate pace of building a sequence of his thoughts and actions. While “clip”
thinking helps in a short time to adapt to the receipt of a large amount of information, and helps to quickly determine how to use the knowledge gained. Moreover, “clip” thinking contributes to a person’s work in the form of multitasking and helps to produce results in a short time. In addition, this phenomenon can act as a defensive reaction of a person to information overload and represents the development of some cognitive skills at the expense of others. Consequently, at present, the tendency toward fragmented presentation of information is clearly traced.

For learners, whether they are pupils or students, or employees of a company undergoing training, it is increasingly difficult to listen to many hours of lectures or to watch long video lessons. At some point in time, the concentration of attention decreases, then interest disappears and the student is distracted. In connection with these conditions, changes began to occur in the forms and methods of providing educational services. Many higher educational institutions and organizations have begun attempts to create such a teaching method that would correspond to the features of “clip” thinking. Such a format should include the adoption of a “clip” culture as an environment for educational activities; an attempt to introduce “clip” forms of learning into the traditional, by creating “inverted classes” (flipped classroom); development of various tasks suitable for “clip” thinking, as well as knowledge control systems.

All of the above elements is a micro-learning system, which is aimed at “clip” thinking. However, this form of training not just information in the form of fragments, but as sequential information in the form of a short video.

2.6.2 The meaning of micro-learning

The term micro-learning was first defined in 2004 by Gerhard Gassler. Micro-education describes a learning method in which concepts and ideas are presented in very small fragments, at very short time intervals, if necessary, or under conditions of maximum susceptibility.

Theo Hag, who described the basic structure that defines this learning format, uncovered the fundamentals of micro-learning. The main properties include a rather short period necessary for the “consumption” of content, which is also associated with the small size and relatively independent units of content. Research in the field of micro-learning focuses on the principle
of life-long-learning, on-demand learning, and mainly among members of the society such as “mental workers”, a group into which students of higher education institutions can be classified.

When focusing on the real impact, emotional involvement and individualization of the needs of modern society, it can be said that micro-learning is considered an appropriate choice. Structuring learning materials into smaller sections will affect the improvement of individual specific results. Emotional engagement is provided by multimedia (although this is not something new in terms of e-learning, in relation to micro-learning, it is defined as one of the key properties of the content being studied). However, according to many experts, design or the structure of the course should not correspond to technology, but use it to adapt to an educational concept.

The trend towards individualization of learning makes micro-learning one of the most important components of the personal environment for acquiring knowledge. Almost every person today has a laptop computer and a smartphone, which create the opportunity for studying by micro-courses. Nowadays, various forms of micro-learning are used to create a learning environment that has the following characteristics:

- Consistency - training materials are recorded regularly, updates occur as new information appears regarding the subject in question (field of knowledge);
- Accessibility - providing access to the course materials at the request of students (if, as part of the course at universities, access is opened by the teacher);
- Directness - the ability to receive information of any kind as soon as possible, as well as quickly solve problems. Students can also formulate questions of interest to them at the time of their appearance, and start looking for an answer later;
- Interactivity - direct interaction with teachers, course curators, as well as experts in the field of knowledge (often on open, independent, educational platforms), as well as chats with fellow students to discuss materials and discussions;
- Adaptability - providing the right information in the right place and in the requested format.

Increasingly, experts argue that modern society thinks, "clip". Therefore, a person for a certain period is able to process a much larger amount of information. In the recent past,
curriculum developers, when compiling educational content, relied on the fact that human memory is capable of storing 1–2 objects at a time. Today the situation has changed, the memory of a generation of people with “clip” thinking can process many objects at a time, but not so deeply, since there is a scattering of attention, and a person lingers on one object for no more than a few minutes. Thus, the educational environment is faced with the problem of rapid loss of people's attention to the subject being studied, which indicates the need to build courses consisting of small semantic blocks. For example, one component of a micro-course should take no more than 5-15 minutes and reveal one specific topic. Thus, the advantages of micro-learning can be attributed:

- easier perception of information by students;
- a clear study of the content of the micro-course, containing small blocks (only the necessary information);
- the ability to learn anytime, anywhere;
- constant updating and addition of micro-course materials;
- cost reduction for employee training (for the business industry).

Today it is very important to pay more attention to the integrated learning approaches, which contributes to the acquisition of new experiences by students. Given this trend, the education system cannot remain in the familiar traditional form; it should include new teaching formats. In order to understand the differences between traditional learning and micro-learning, Figure 2 is compiled regarding educational content and its implementation.
<table>
<thead>
<tr>
<th></th>
<th><strong>Macrolearning</strong></th>
<th><strong>Microlearning</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Learning context</strong></td>
<td>formal learning</td>
</tr>
<tr>
<td>2</td>
<td><strong>Time spent</strong></td>
<td>several hours</td>
</tr>
<tr>
<td>3</td>
<td><strong>Content type</strong></td>
<td>learning modules, comprising and structuring a broader range of ideas or topics</td>
</tr>
<tr>
<td></td>
<td>and combining learning objects</td>
<td>microcontent as small chunks of information, focusing on a single definable idea</td>
</tr>
<tr>
<td>4</td>
<td><strong>Content creation</strong></td>
<td>content created by subject matter experts, usually with authoring tools</td>
</tr>
<tr>
<td></td>
<td></td>
<td>content co-created by learners with Web 2.0 and rapid e-learning tools</td>
</tr>
<tr>
<td>5</td>
<td><strong>Content aggregation and fragmentation</strong></td>
<td>learning objects usually need to be combined with other learning objects to enable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>full understanding, content can be easily split for re-use and restructuring</td>
</tr>
<tr>
<td>6</td>
<td><strong>Content retrieval</strong></td>
<td>courses or topics retrievable through a unique URL, however single learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>objects are not addressable</td>
</tr>
<tr>
<td>7</td>
<td><strong>Structure of the learning cycle</strong></td>
<td>hierarchic, sequential, pre-planned structures consisting of a number of units</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or lessons, each combining a number of learning objects, such as texts, images,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>audio, video</td>
</tr>
<tr>
<td>8</td>
<td><strong>Target group</strong></td>
<td>learners aiming at gaining an insight into topics defined by domain experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>learners aiming at exploring concepts or solving practical problems</td>
</tr>
<tr>
<td>9</td>
<td><strong>Learner’s role</strong></td>
<td>learners as consumers of content, attempting to build mental structures similar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>to those of experts</td>
</tr>
<tr>
<td>10</td>
<td><strong>Learner participation</strong></td>
<td>focuses on learner-content interactions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>focuses on social interactions between learners</td>
</tr>
</tbody>
</table>

**Figure 3 – Macro-learning compare to Micro-learning**

Groups of learners consists of people with different abilities and speed to study. In traditional teaching, situations may arise when the student does not have time to process the information, or a teacher can explain a clear topic to a majority of the audience for a long time. Consequently, one part of the group has to adapt to the pace of the other part of the group, which can cause discontent among students. When using the micro-learning format, each student are acquainted with the material and performs tasks at their own pace, since micro-learning is aimed at an individual approach. Moreover, the material studied can be revised if necessary, while it is not possible to ask a teacher to explain topics one more time.

The ways and methods of acquiring new knowledge over the past few years have changed significantly. The development of various information video platforms, for example, such as
YouTube, opens up the possibility of choosing the right training video for a specific person for specific purposes. As statistics show, mainly users of this portal choose to view videos lasting from three to five minutes. This is due to a global lack of attention and focus on obtaining small, but specific and accurate modules of information.

Humanity globally moves from a culture of deep attention, when people are concentrated on one particular object, to a culture of hyperactive attention - concentration on many objects at the same time. Nowadays, in order to maintain attention on a specific object, people need additional incentives and factors that will not allow them to divert attention to other objects. Conducting various sociological surveys showed that most people, receiving a long e-mail, do not read it completely, but only skim through it, peering into meaningful phrases. On average, the people who most often communicate by email spend only 20 seconds viewing one digital document. However, they read only 25% of the entire text. Some draw conclusions about the content, getting to know only the subject of the letter.

Studies show that the traditional methods in which students actively begin to memorize information during preparation for exams, soon forget a lot of information. However, with gradual training with the possibility of quick access to already studied materials and the possibility of returning to them, they are able to hold information for a longer time and accumulate it. This phenomena was studied by psychologist Herman Ebbinghaus in late 1800 and shown on Figure

Figure 4. The Ebbinghaus Forgetting Curve
The advantage of micro-learning in the fight against forgetting information is that any micro-course can be viewed at any time if necessary. The micro-training system aims to combat loss of attention by compiling short video lectures that can be viewed an unlimited number of times; using tests and tasks in the form of cases, and also have knowledge control. All this allows to overcome the Ebbinghaus Forgetting Curve and seen in Figure 5.

Thus, with an integrated approach consisting of repeating, reminding and verifying the information studied, it is possible to overcome a high percentage of forgetting among students. This trend is possible and effective thanks to micro-learning approach, since video lessons have a short duration, and the test and case systems are aimed at captivating students with the subject.

At the moment, there are no uniform rules and exact standards for the duration of micro-contents, but they should be short. If talking about full-time study, then it is worth recalling the rule 90/20/8: 90 - the maximum comfortable duration of the full-time study module for the public; 20 - every 20 minutes the type of activity should change; 8 - every 8 minutes it is necessary to engage the audience (survey, voting, questions / answers). It is believed that in micro-learning the modules should be about 5-15 minutes long, and at the same time, the pace of the narrative may change every 20 seconds, however, there is no established regulation for the duration of micro-modules and their elements. Nevertheless, speaking...
about the duration of the micro-content, it is necessary and very important to take into account both the type of content and the type of information supply.

As part of the creation of micro-courses, content should be reduced. However, in order to do this correctly, it is necessary to understand the purpose of demonstrating each unit of content. It should not be just grabbing and cropping most of the course. Each unit of content should be disassembled, processed and, if necessary, included in the micro-content. When creating micro-content, the level of complexity is reduced, the main course is simplified, but at the same time the content should be enough for a correct and full-fledged application. Content units should be self-sufficient, autonomous, but also can be part of something more - a full course, a training unit or a part of blended learning system or flipped classroom.

Reducing content in micro-learning approach should be supported by expanding and deepening the context. For this, it is necessary to use stories, associations that hold the listener's attention and are remembered much better than a dry theory. However, the stories themselves should not be long either: a separate picture, a short animation or just a few words is enough for stable association and assimilation of content.

One of the effective methods of perceiving and remembering information is return (recurrent) learning, that is, repetitive, template, non-linear, which allows you to focus first on the most complex elements, and then on the least important content elements and individual preferences, providing an understanding “from the beginning to end”. Students should be able to return to materials already completed at any time if necessary or interested in repeating the material. Most of the skills that people possess deeply and comprehensively, in fact, consist of a set of elementary skills. The use and application of information and skills that people gain through different trainings or traditional learning may not be used immediately or may not be applied. In fact, people need a very limited set of skills every day. In view of this, it can be said that the passage of many hours of lectures and trainings may subsequently not have the desired effect, unlike micro-learning. The study of information in the framework of micro-learning allows people to receive and use the content that is needed and applicable at the present moment of a person’s need for specific knowledge.

One of the main goals of micro-learning is to provide an opportunity to look at the topic being studied from all sides. Including for this, micro-learning should be multi-format (the
ability to achieve the learning goal in different ways from different devices). The holistic approach combines different types of content: concepts, best practices / principles, procedures / tutorials, demonstrations, etc. A good course should be balanced in terms of channels of perception and action.

The general logic of micro-learning is to shift roles - from instructor-driven, when the teacher knows better what needs to be taught, to learner-driven, when the student chooses topics and modules himself. Thus, a student makes the “order” for teachers to create a course on a particular topic in accordance with their interests. However, this approach may seem difficult for teachers who are used to giving the same lectures for a long time without any changes. Therefore, it may seem difficult for teachers to switch to such a training format. Nevertheless, at present, people have a unique opportunity to access repositories of content, for example, YouTube or Coursmos. These repositories are publicly available and contain an almost unlimited amount of content. Moreover, today a large number of design platforms are being developed for creating micro-courses. For example, now about 37,000 micro-courses are published on the Coursmos website. Anyone can place his or her micro-course on the platform. This is both a plus and a minus - not always users can control the quality of the content they receive.

In addition, today it is possible to create micro-courses using software (LCMS, LMS), so as not to publish the course on the network and distribute it within the university or organization. Nowadays, micro-learning can be used as a complete training program. However, it becomes most effective when combined with traditional training programs in a blended learning format. The applications of micro-training in traditional mass courses. This is preparatory work before the full-time courses, and consolidation of the results, and repetition after a while.

2.5.3 The future of the micro-learning approach

The education sector in the modern world is in constant development. Today there are a large number of different methods of education and new ones appear. This trend is significant, since the speed of life and the perception of information by people are changing. In this regard, it is interesting to consider the popularity of micro-learning today and try to predict the future of this concept.
According to Google Trends the number of micro-learning related topic, show the increasing from 4 references in January 2010 to 100 in December 2019 it can be seen in Figure

![Figure](image)

As it can be seen from Figure, the significant interest in this topic starts from 2017. This confirms that this micro-learning approach is new and is only gaining popularity and continues to develop.

It was also interesting to trace the comparison of micro-learning approach with other methods that use technology in learning and described in a literature review, such as blended learning and flipped classroom. The comparison can be seen in Figure

![Figure](image)

This figure shows that, relative to other methods, micro-learning is not yet so widespread and well-studied. However, given the fact that flipped classroom are not so widespread in educational institutions, but continue to gain momentum in development, it can be assumed that after some time, micro-learning will be more understandable and known in society.

The amount of sources about micro-learning was analyzed among source databases such as “LUT Finna” and “Scopus” and shown on figures
As it can be seen from figures above, the amount of articles about micro-learning increases from 2016. However, there is decrease in 2019. This may indicate that the data studied at the moment are checked and tested to identify opportunities for further development of the concept.

Overall, the concept of micro-learning is new in modern society and at the moment, researchers are trying to understand the possibilities of its application, to highlight its positive aspects together with possible negative consequences.
3 DATA AND METHODOLOGY

Based on previous studies considered in the literary review, it can be noticed that micro-learning approach is new educational method and not yet widespread. Many studies describe the first tests to determine the effectiveness of the method, both among students and among professors. Regarding to this, an experiment was conducted among students during the LUT University Summer School 2019. In order to determine the depth of knowledge of students and professors in LUT University on the subject of the understanding of the micro-learning approach the empirical study is carried out.

3.1 Methodology of conducting the experiment

To answer on the research question: “Are there evidence of improving learning process due to micro-learning implementation at LUT University in the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” using experimental approach?” by professor Leonid Chechurin and me the micro-module was created. The message of the course that there is an approach and number of tools in order to support creativity, to assist the way of thinking to generate new ideas. This course were created by professor Leonid Chechurin and Creativity Lab of LUT University to meet people who wants to think creatively in a systematic way with number of different tools. The course describing the outstanding tool in the market of the tools to support creativity, which is called Theory of Inventive Problem Solving (TRIZ in the Russian abbreviation).

The theory of inventive problem solving was invented in the former Soviet Union by soviet engineer and inventor Genrich Altshuller, who analyzed 40 thousand patents in an attempt to find patterns in solving problems and new ideas. In his work, Altshuller investigated a large number of patents in order to identify patterns in the process of solving problems and the emergence of new ideas (Malmqvist et al., 1996). The analysis revealed that in most patents, the possibilities and methods of resolving conflicts arising in the system are considered. Based on the studies, Genrich Altshuller revealed that the invention process is associated with finding both technical and physical contradictions in systems, as well as finding ways to overcome them. As a result, Altshuller proposed a theory of solving inventive problems, which includes 40 different techniques showing the direction and areas in which the desired solution can be found (Malmqvist et al., 1996).
Using the rules for constructing micro-content studied in the literature, an educational video about Design for Manufacturing and Assembly (DFMA) was created. DFMA is a design tool that tells how to reduce manufacturing and assembling efforts. It advises on how to decrease the amount of parts and how to reduce time and complexity of manufacturing operations.

The sequence of actions required to build micro-content for the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” in LUT University Summer School 2019 is shown in the Figure 8.

The created micro-module, which was implemented as a part of the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” in LUT University Summer School 2019 and its analysis allows gathering statistics about students’ engagement in watching the video and evaluating the understanding of the video-content by analyzing the percentage of correct answers to the quiz after the video.

During the Summer school in LUT University the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” was launched. The duration of the course was four weeks from 12th of August until 8th of September. There were 59 people registered.
the course, but only 14 of them actively taking part in the course and did tasks. In this experiment, 17 video lectures that are contained in the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” are considered: Function definition Part 1, Part 2, Part 3; Function Oriented Search Intro (FOS Intro); Ideal Final Result (IFR); Trimming; Contradiction Part1, Part 2, Part 3; Cause-Effect Chain Analysis (CESA); Trends of Engineering System Evolution (TESE); Axiomatic Design; Design for Manufacturing and Assembly (DFMA).

In this study, simple linear regression model is used to regress students’ engagement on video duration. The regression estimator is ordinary least square (OLS). Students’ engagement is a relative variable in percentage and indicates a ratio between the duration of the part of the video, which was actually watched by a student, and the whole video duration. High engagement rate shows that a viewer did not tune out during watching the video and thus remained receiving information from the course. It means that a student found the video interesting and was able to get knowledge out of it. In terms of the “Thinkific” platform, students’ engagement seems to be the most consistent metric to assess video performance from the educational process point of view. The range of data that can be gathered from “Thinkific” platform is shown in Figure 9.

Figure 9. “Thinkific” platform analysis
According to previous finding which are mentioned in the literature review part there are evidences that video performance is affected by many factors, one of which is a video duration. In regression analysis, video duration is presented by total length of a video in seconds. However, it is obvious that other factors as well influence on video performance, for example, video structure or content.

The regression model is supposed to test following hypothesis: “The video duration negatively affected students’ engagement in course “Artificial Inventiveness” (former “Systematic Creativity and TRIZ basics”) taught during LUT University Summer School 2019”. The model is estimated using following equation:

\[ y = \alpha + \beta * x + \epsilon, \]

where \( y \) is the dependent variable, which shows students’ engagement in percentage, \( x \) is the independent variable which presents video duration in seconds, \( \alpha \) is the intercept, \( \beta \) is the coefficient, which describe linear relation between engagement and video duration, and \( \epsilon \) is the error term.

The model is built in order to estimate students’ engagement dependency on video duration and its direction. It does not aim to have either high explanatory power or predictive ability.

### 3.2 The methodology of conducting the survey.

To answer on the research question: “What is the depth of knowledge in the field of micro-lecture among students and professors of LUT University?” the online surveys were conducted.

The online survey were chosen due to lack of time and because it is the most convenient way to ask people, as many of them want to stay anonymous. In the survey among students 77 learners took part, 18 of them from SPbPU and others from LUT University. In the survey among professors there were used the special digital system of sending the information to all LUT University professors. But only 25 people answered.
The survey were created according to achieve and answer on research questions. There were 17 questions for professors and 10 questions for professors. The questions was built in the logic to find out the depth of understanding about micro-learning concept.
4 RESULTS AND FINDINGS

4.1 Results from the experiment

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Min</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>17</td>
<td>45,00%</td>
<td>64,35%</td>
<td>60,00%</td>
<td>90,00%</td>
<td>12,84%</td>
</tr>
<tr>
<td>Duration</td>
<td>17</td>
<td>149,00</td>
<td>385,30</td>
<td>313,00</td>
<td>762,00</td>
<td>198,30</td>
</tr>
</tbody>
</table>

The total number of observations is 17. It is clear from Table ??? that the videos under consideration have different engagement rate with minimum value equal to 45% and maximum value – 90%. The mean value is slightly higher than the median, which means that the distribution is positively skewed. Considering the standard deviation and maximum value, it could be said that the video with maximum value had relatively high performance in terms of students’ engagement and it is worth to consider it individually. On the other hand, duration of the video as well distributed in wide range. The distribution is also positively skewed, and the sample includes the video with notably high length. The whole sample of videos is presented in Table ???.

Table 2. Duration and Engagement Rate for Videos

<table>
<thead>
<tr>
<th>Video Title</th>
<th>Duration, seconds</th>
<th>Engagement, percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function definition Part 1</td>
<td>261</td>
<td>60%</td>
</tr>
<tr>
<td>Function definition Part 2</td>
<td>288</td>
<td>71%</td>
</tr>
<tr>
<td>Function definition Part 3</td>
<td>224</td>
<td>76%</td>
</tr>
<tr>
<td>FOS Intro</td>
<td>319</td>
<td>63%</td>
</tr>
<tr>
<td>IFR</td>
<td>704</td>
<td>50%</td>
</tr>
<tr>
<td>Trimming</td>
<td>724</td>
<td>50%</td>
</tr>
<tr>
<td>Contradiction Part 1</td>
<td>246</td>
<td>67%</td>
</tr>
<tr>
<td>Contradiction Part 2</td>
<td>444</td>
<td>60%</td>
</tr>
<tr>
<td>Contradiction Part 3</td>
<td>353</td>
<td>60%</td>
</tr>
<tr>
<td>CESA</td>
<td>664</td>
<td>57%</td>
</tr>
<tr>
<td>TESE Part 1</td>
<td>313</td>
<td>58%</td>
</tr>
<tr>
<td>TESE Part 2</td>
<td>232</td>
<td>75%</td>
</tr>
<tr>
<td>TESE Part 3</td>
<td>263</td>
<td>51%</td>
</tr>
</tbody>
</table>
The simple linear regression model was built according to the methodology part and following results were obtained (Table ???).

Table 3.

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Estimate</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0,8174</td>
<td>0,0000</td>
</tr>
<tr>
<td>Duration</td>
<td>-0,00045</td>
<td>0,0019</td>
</tr>
</tbody>
</table>

R-square = 0,49

Estimated model shows that video duration had negative effect on students’ engagement rate in course “Artificial Inventiveness” (former “Systematic Creativity and TRIZ basics”) taught during LUT University Summer School 2019, which means that increase in video length reduced the duration of the part of the video which was actually watched by a student. Each additional minute of a video decreased students’ engagement rate by approximately 2,7%. Obtained coefficients are statistically significant at 1% confidence level which means that the results reject the null hypothesis. The R-square of the model is rather small and equal to 0,49. Thus the model does not fit the data well and it does not have high explanatory and predictive power. However, the aim behind the model is just to understand the engagement rate dependency on video duration which was practically achieved.
Looking at Fig. 11 it is clear that videos with high length had engagement rate below average value, whereas videos with relatively smaller duration are placed above and below the line of average engagement rate. It is worth to note that videos which were created by the author had the highest engagement rates and at the same time had microlearning-course-like length. All the videos with engagement rate higher than average value had duration not higher than approximately 300 seconds.

Figure 12
Fig. 12 shows that there is no clear dependency between engagement rate and % of correct answers on quizzes, however, micro courses provided by author had enough high % of correct answers.

Table 4

<table>
<thead>
<tr>
<th>Video title</th>
<th>% of correct answers</th>
<th>Engagement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function definition</td>
<td>42%</td>
<td>69%</td>
</tr>
<tr>
<td>IFR</td>
<td>13%</td>
<td>50%</td>
</tr>
<tr>
<td>Trimming</td>
<td>22%</td>
<td>50%</td>
</tr>
<tr>
<td>Contradiction</td>
<td>31%</td>
<td>62%</td>
</tr>
<tr>
<td>CESA</td>
<td>43%</td>
<td>57%</td>
</tr>
<tr>
<td>Axiomatic design</td>
<td>40%</td>
<td>45%</td>
</tr>
<tr>
<td>DFMA</td>
<td>33%</td>
<td>84%</td>
</tr>
</tbody>
</table>

4.2 The results from the survey

Deepen knowledge about micro-learning

The first answers from the LUT University professors were analyzed.

The age of respondance in this survey vary from 25 to 58.

Table 5. Students and teachers who had experience in studying by video lectures

<table>
<thead>
<tr>
<th>Answers</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>49</td>
<td>63,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>5,2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, in online course (for students)</td>
<td>24</td>
<td>31,2</td>
</tr>
</tbody>
</table>

In the Table 5 We can see the results of student and teachers answering the question about having the experience in studying by video lectures. The percentage of those of them who had this experience, is much higher than the percentage of those who had not, also there was and additional variant of answer for students whether they studied by video lectures during the online course.
Table 6. Convenience of the video lecture format for respondents.

<table>
<thead>
<tr>
<th>Answers</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>Yes</td>
<td>66</td>
<td>85,7</td>
</tr>
<tr>
<td>No</td>
<td>9</td>
<td>11,7</td>
</tr>
<tr>
<td>I do not know</td>
<td>2</td>
<td>2,6</td>
</tr>
</tbody>
</table>

Most respondents assume that video lecture format to be convenient, though students tend to like this format more than teachers do (85,7% of the students and 72% of teachers answered “yes”).

Table 7. Respondents, who think ten minutes are enough for a video lecture.

<table>
<thead>
<tr>
<th>Answers</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>Yes</td>
<td>48</td>
<td>62,3</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>I do not know</td>
<td>9</td>
<td>11,7</td>
</tr>
</tbody>
</table>

Talking about micro-learning, it is important to understand, that usually in this format of learning shorter video-lectures are used. In the Table 7 We can see, that more than half (62,4%) of the students have found the length of ten minutes to be enough for a video-lecture, but considering teachers’ answers to this question of the survey, we can see that almost half of them (48%) agree that ten minutes are enough for a video lecture, and a little bit less (44%, that is one respondent less) think that this length is not enough.

Table 8. Having information about what micro-learning and micro-courses are?

<table>
<thead>
<tr>
<th>Answers</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>Yes</td>
<td>27</td>
<td>35,1</td>
</tr>
<tr>
<td>No</td>
<td>50</td>
<td>64,9</td>
</tr>
</tbody>
</table>
In the table 8 There are results that show the percentage of students and teachers who know what micro-learning and micro-courses are, and they are quite similar to each other if to compare the results of teachers’ answers and students’ ones. Here students and teachers almost equally do not know, what micro-learning and micro-courses are, but further we will see that students use these technologies (like open educational services, as a part of their usual studies) and would like to have more of them during their university studies.

Figure 11 Study approaches applied by professors

The most popular approaches that professors usually apply during their lectures are traditional approach and flipped classroom (Figure 11). Also, online courses tend to become more popular, then blended learning and a mix of all the approaches mentioned above.
At the same time, from answers about the most effective approaches we can clearly see that three of them are the most effective in professors’ opinion: traditional approach, flipped classroom and a mix of methods, that depends on the subject (Figure 12).

Effectiveness not always correspond with the convenience, as we can see from the Figure 13. The traditional study approach still is the most popular one among professors.
From the Figure 14, we can see that 80% of the respondent professors apply technologies during their lectures.

Figure 15. The most convenient methods of providing information during the process of creating lectures
Talking about methods of providing information most of professors prefer to use PowerPoint presentations in the process of creating their lectures (Table ?).

![Pie chart showing the desire of professors to have their lectures recorded.](image)

**Figure 16** Desire of professors to have their lectures recorded

From the Figure ? We can see the opinion of respondent professors about recording their lectures, and more than half of them (52%) would like to have their lectures recorded, 36% do not want to record their lectures, and 12% do not know.

![Pie chart showing the desire to replace traditional lectures by video-lectures.](image)

**Figure 17.** The desire to replace traditional lectures by video-lectures
More than a half (64%) of respondent professors do not want to replace their traditional lectures by video-lectures, and only 24% of them would like to do this (Figure ?).

From the Figure 18 We can see how the opinions divide between “yes” and “no” answers to the questions about the length of ten minutes to be enough for a video lecture – 48% and 44% respectively, and 8% of the respondents answered “I do not know”.

Figure 19. Desire to make short videos based on lecturing materials
Most of respondent professors (64% according to the Figure 19) would like to make short videos based on their lecturing materials, 20% of them would not like this, and 12% do not know.

![Pie chart showing knowledge about micro-learning and micro-courses.](image)

Figure 20  Knowledge about micro-learning and micro-courses.

The results of questioning the professors whether they know what micro-learning and micro-courses are, show that a big percent of them (64%) do not know about this approaches (Figure 20).
The results of the question about the implementation of micro-courses (Figure 21) correspond with the results of question about having knowledge about this approach (Figure 22) - here we also can see that more than a half of them (56%) are not familiar with it. 32% of the respondent professors here chose to say “yes” about implementing of this approach, and 12% said “no” (Figure ?).
In the Figure 22 We can again see the results of professors being not familiar with the approach of micro-courses, but also many of them assume that there are no barriers for implementing this approach. Lack of technologies in the university is also an important factor.

![Figure 22. Effectiveness of the quizzes method for evaluation student’s knowledge.](image)

Most of the respondent professors keep neutral answering the question about the effectiveness of the quizzes method for evaluation student’s knowledge, but also many of them are of different opinions from “strongly agree” to “strongly disagree” (Figure ?).
As it is seen from the answers to the question about having experience in studying by video lectures, 63.3% of the respondent student had this experience, and 31.2% had it during some online-course (Figure ?).

To make it more detailed, a question about sources for online video lectures was made, and from the answers we can see that respondent students most actively use online course platforms or the video lectures were a part of a university course (Figure 25). Popular platform YouTube keeps 13% (Figure 25), possibly because of the different format of the source itself.
Most of the respondent students (85.7% according to the Figure 25) find the format of video lectures convenient for them, and only 11.7% find it inconvenient, also we can see here that 2.6% do not know, whether the format is convenient for them.

This chart (Figure 26) shows the percentage of students who consider the length of ten minutes to be enough for a video lecture (62.3%) and who consider it not be enough (36%), also we can see here 11.7% of those, who do not know.
Most of the respondent students (64,9% according to the Figure 27) know about micro-learning and micro-courses and 35,1% do not.

In Figure 28 We can see which of suggested methods for presenting information are the most effective for students: lectures at the university tend to be the most effective, then the video-
lectures format, presentation format using MS Power Point, then text format using books, magazines and articles, and in the end the less popular are the formats like projects, discussions, etc. Text format is twice less popular than video-lectures. And most students prefer the first four variants instead of having active learning, discussions, etc. This can be the result of tendency for self-studying, where the process is controlled by the learner (time, speed and tempo, opportunity to repeat the information for better remembering, etc.) and can be customized according to individual preferences. This can also be seen in the answers for the question about university lectures to be replaced by short video courses - more mobility, no strict timings, can be held in convenient time.

**Limitations:** The limitations of the study is small amount of respondents 25 professors from LUT University and 77 students, 18 from SPbPU and others from LUT. Next limitation is that there were only one pilot experiment on micro-learning approach among students during the Summer School in LUT University.
The objective of the master's thesis is achieved. Firstly, the evolutionary transition to microlearning and its need in the modern world are considered in the literary review. Secondly, an experiment was conducted in order to evaluate the effectiveness of micro-content in LUT University in the course “Artificial inventiveness (former Systematic Creativity and TRIZ basics online)” in Summer School 2019. Third, a survey conducted to determine the depth of understanding of the concept of micro-learning among students and professors from LUT University was conducted, and the main results were described.

The results of the analysis of the literature review and the experiment showed that there is a dependence of the involvement of students' interest in watching the video on its length. Thus, it can be assumed that short video lectures that increase interest in the future can effectively affect students' understanding of the content and positively influence the passage of various tasks for evaluation based on pre-delivered video lectures. However, not only the length of the video is a significant factor that affects student engagement, as well as the effectiveness of student outcomes. It is also necessary to carefully study the content, structure the course, and draw up the correct tasks for a comfortable passage of students by the course. Thus, it is very important to follow the rules for building micro-courses, which can help make the course more effective and have positive feedback later.

Based on the results of the survey among teachers and students, it can be seen that a greater number of students are familiar with the format of video lectures and this format is convenient for them to perceive and understand information. Moreover, many teachers themselves use this format as their training. However, micro-learning is not just video recording, but a whole environment for building modern courses. Survey data showed that teachers are mostly not familiar with this new method of providing knowledge. Therefore, several recommendations can be given to familiarize LUT University professors with the micro-learning approach and its advantages.

To familiarize teachers with micro-learning, you can create various workshops and invite specialists in this field to conduct them. Moreover, the brochures on micro-learning approach can be created to familiarize professors with the new method and distribute it to the university.
Furthermore, the system of motivation and bonuses for teachers can be used, for the successful application of micro-education at the university. For example, the creation of such courses will help attract more students both on a full-time basis and as part of an open university.

It is also proposed to conduct a pilot project in which it is possible to consider the reduction in the time for teachers to teach using traditional methods and how this reduction will affect the research activities of teachers. Perhaps the free time will affect the increase in the number of projects at the university, as well as various grants, which may favorably affect the financial side of the university.

For future research in this area, recommendations may include further experiments in the field of micro-learning and analysis of the results, as well as a study among companies on the use of the micro-learning method among workers.
6 CONCLUSIONS

This study is about the concept of micro-learning at LUT. The analysis and questioning of students makes it clear that there is a need and high interest among students to learn from video lessons. Thus, this work can be used as a pilot project for testing micro-content and for further study of this method. This work contributes to the consideration and development of teaching methods and allows to see the depth of understanding of the concept of micro-learning among teachers and students.

Despite the fact that the implementation of this method encounters some problems such as insufficient popularity among teachers, lack of necessary equipment at the university, time costs, micro-learning is a rethinking of the concept of education in general.

Perhaps future research in the field of micro-learning will be more complete and clear. But for this, time must pass and experiments must be carried out in large numbers. Thus, it will be possible to trace whether interest in this method of training is continuing or whether it has not met its expectations.
LIST OF REFERENCES


