

# Competences-driven and GenAI-supported hybrid personalized learning

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**Abstract.** The paper presents a conceptual model of the system for personalized learning of students, in which lessons and their topics are divided into mandatory and optional, and are searched according to the competencies they provide to the student. The area of competences is divided by the depth of the competences (the depth of knowledge and skills they provide) and by the breadth (the number of teaching topics of each teaching unit). During implementation, the area of competences can change both in depth and breadth, depending on the needs of students and employers. Each student has his own specific repository of links to learning objects, located in the university's repository, which is used for learning, as well as for verification and evaluation of what has been learned.

A hybrid procedure for the preparation of teaching materials is applied. The teacher prepares the application of the GenAI tool in accordance with the university's standards and checks the generated results. Two approaches to the application of generative artificial intelligence are used for the preparation of teaching materials: 1) application of prompt engineering for GenAI tools; 2) application of automated preparation of prompts for GenAI tools. All forms of verification of achieved competences (tests, assignments, exams, etc.) are personalized because each student can have different optional topics in his competence portfolio of each course.

The goal is to significantly increase the efficiency of preparing teaching materials and verifying what has been learned, which is necessary in the case of personalized learning because it requires a larger number of optional topics and different depths of their study, and more work for their implementation. Therefore, the application of GenAI tools is a necessity in the case of personalization of learning and verification of what has been learned.

**Keywords:** Personalized learning · AI in education · Hybrid preparation of teaching materials

## 1 Introduction

New technologies are developed faster and more often. Due to competition, companies have to offer new, innovative products or services. Their lifespan is getting

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shorter due to the growth of new technologies and new market demands. The challenge for higher education is how to offer curricula that offer a wide range of competencies to students to meet the needs of companies and the desires of students. Academic curricula quickly become outdated, offering outdated competencies and becoming unattractive to students and employers. Students and employers are increasingly interested in short and fast courses that address their new needs. One of the most relevant answers to this great challenge for higher education institutions, in our opinion, is the personalization of learning, because it can provide the necessary flexibility of curricula. But personalizing education requires:

- smaller teaching groups or even individual consultations and guidance of students,
- development of many different digital learning materials for students.

These two factors increase the cost of education. Higher education institutions are now under pressure to reduce their costs, but with the personalization of education, this task is now a major challenge for them. Using GenAI is the solution to this challenge. This can significantly reduce the cost of developing digital learning materials and the time required for this development, that is, increase the efficiency of this development. This paper presents a conceptual solution for the personalization of education supported by GenAI, which was prepared and accepted by the Belgrade Metropolitan University (BMU).

The paper builds on the researches listed at the end of the paper, but the paper does not aim to provide their analysis here. The paper presents a proposal for a new concept for the development and application of personalized learning for students, guided by their needs for acquiring new competencies, supported by the application of generative artificial intelligence for the preparation of all kinds of teaching materials, which students can also prepare, but with the active participation of their teachers.

## **2 Required prerequisites for successful personalized education at BMU**

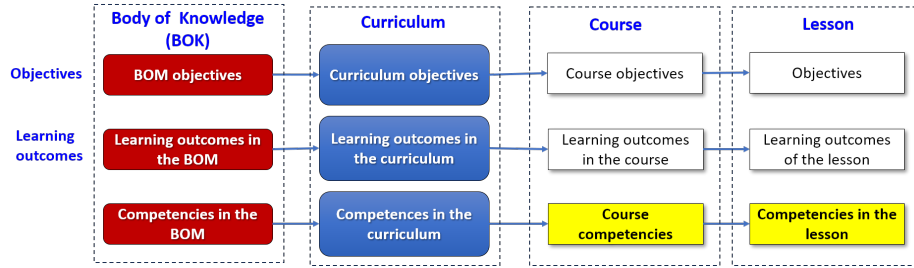
### **2.1 Development of the curriculum and the syllabus**

Before we determine the curriculum, we analyze global and local development trends in the economy, industries and technologies trying to predict what competencies employers will need in the next 5 to 10 years. These analyzes have a major impact on our curriculum design decisions. We want to prepare our students for the future needs of employers and avoid offering curricula and courses based on the interests of our teachers, who may have some special interests. As the dynamics of change are increasingly significant, it is important to anticipate the future needs of employers, and not use only current needs and requirements. Education must be carefully planned to be ready for the future.

Another important actor in the design of our curricula are the recommendations of various professional groups and their professional organizations. All

BMU study pro-grams must be based on the recommendations of internationally recognized professional organizations in a particular field of science (such as IEEE and ACM in computer science). They periodically publish their Body of Knowledge (BOK) recommendations. We select the most appropriate body of knowledge (BOK) for each of our study programs. Each BOM defines its own objectives, learning outcomes and competencies. We map them into the curriculum we want to design based on these recommendations. Taking into account the recommended BOK units of study, we list all the courses that should implement the selected BOK (Fig. 1).

These BOK-to-curriculum mappings make our curricula internationally recognizable. In cases where BOK is not specific enough in a field of science, we expand it to more specific fields and sub-fields, bearing in mind the specific requirements of our study programs. We also take into account similar curricula of the most recognized and prestigious universities in the world, when determining the compulsory and optional courses of the curriculum. After that, we map the already defined objectives, learning outcomes and competencies of each curriculum to the objectives, learning outcomes and competencies of each of its courses. All their extensions and implementations provide a deeper and wider insight into the foundations determined by the BOK and the curriculum as its specialization and extension.

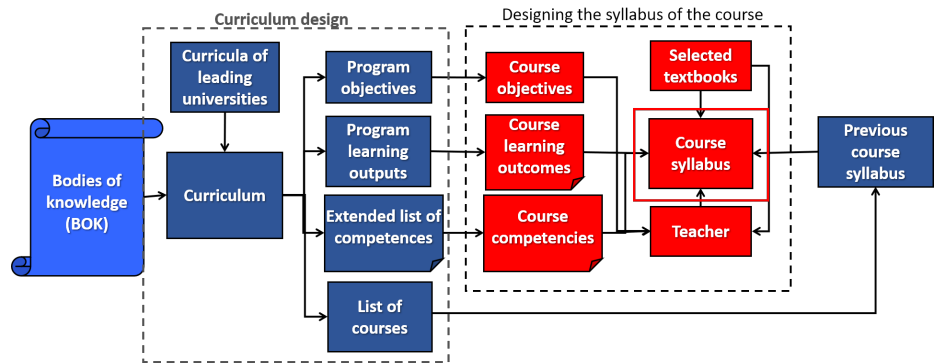


**Fig. 1.** Mapping the objectives, learning outcomes and competencies from the original BOK to our relevant curriculum, its subjects and their lessons.

This process of mapping objectives, learning outcomes and competencies ensures their top-down consistency and two-way linkage. No course or its lesson should be irrelevant or independent of the curriculum and its BOK. This ensures consistency of all courses and its lessons with the BOK and its curriculum. For example, if we add a competency to a lesson that is not supported by any course-level competencies, then a warning message can be sent to the course or curriculum creator, asking for their approval and verification of this expansion of the competency list. Therefore, our curricula, courses and their lessons are guided by the BOK competencies, but can be adapted and expanded according to the future needs of our target labor markets. This is an important feature that will be explained later.

For each course, we analyze the available and relevant international textbooks and for each course we select several of them, which are used by the most prominent universities and publishers. The curriculum designer collaborates with the course designers to determine appropriate lessons based on selected textbooks for each course. In this way, we map the goals, learning outcomes and competencies of each course into the goals, learning outcomes and competencies of each of its lessons (Fig. 2).

If the objectives, learning outcomes and competencies are well planned in the curriculum, this curriculum development process reduces the risk that the curriculum or some of its courses or lessons will become obsolete when the first generation of students graduates. But that is not enough. We must be ready for surprises and for new demands of the labor market that we did not expect and plan for. The solution to this challenge is fast, adopting new competencies into our curricula on the fly, and the "recipe" for this challenge is to personalize our curricula.

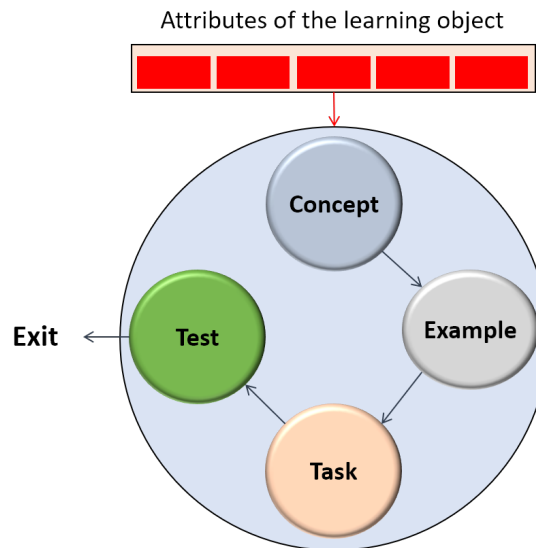


**Fig. 2.** Mapping the corpus competencies into the curriculum and into its subject programs.

### 3 Application of learning objects

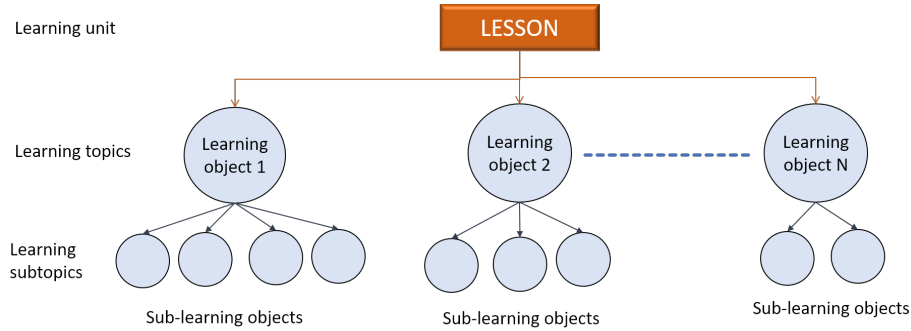
Before we explain the concept of personalization of education, we need to explain the role of the so-called learning objects that we use in all our subjects and curricula. Learning object (LO) is the smallest unit of knowledge that has 4 components (Fig 3):

1. A concept that reveals new knowledge
2. An example of how new knowledge can be used
3. A task that the student must solve by applying new knowledge
4. A test used to assess understanding of a concept



**Fig. 3.** Structure of the learning object.

The learning object has sections that contain a description of these LO components: Concept, Example, Task and Test. These sections are actually carriers of knowledge and skills of learning objects. Sections can have a textual, graphic and visual type of knowledge presentation. They may also have external references to different software services or products. Learning objects can have their own hierarchy if needed when modeling learning activities and learning materials. This allows a learning object to have one or more sub-objects. Only the lowest in this hierarchy is the smallest possible learning object that provides detailed learning, or the smallest piece of knowledge. A learning material (LM) consists of a set of learning objects that have different structures. In the context of higher education, a common lesson structure is shown in Figure 4.



**Fig. 4.** Learning objects and their sub-objects of a lesson.

Learning objects in Figure 4 can be topics of learning units, i.e. lessons. Sub-objects can be sub-topics.

Learning objectives, learning outcomes and learning competencies can be determined for each learning unit, i.e. lesson, but also for each learning topic, i.e. learning object. They can be specified as learning object attributes and can also be used to search for learning objects with a specific value of one of these three characteristics.

As a competence, it has two components: knowledge and skill of applying this knowledge (here we ignore its third component of competence – the attitudes of the person who has the competence, because it is not of interest for our analysis). For our further analysis, we will use competencies as the main classifier of learning objects representing learning units (lessons), learning topics or learning sub-topics.

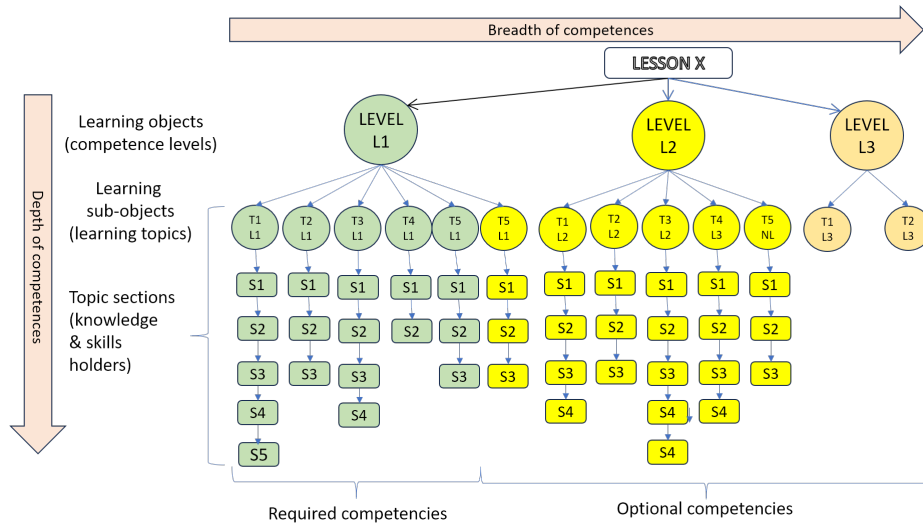
### 3.1 Use of three levels of competence of learning objects

For the learning object that represents the learning topic, we can determine three levels of competence:

1. Level 1 (L1): This compulsory competence that every student must acquire
2. Level 2 (L2): This is an optional competence (above level 1) that the learner can choose to acquire.
3. Level 3 (L3): Optional competence above level 2, which reflects the student's ability to think critically, i.e. for rational, analytical and creative thinking and the ability to synthesize new knowledge based on given facts.

Figure 5 shows the structure of learning objects of a lesson (learning unit). The number and content of learning object sections determine the depth of competence, and the number of topics (sub-learning objects) reflects the breadth of competence. The green color represents the mandatory (obligatory) competencies of the lesson, and the yellow color represents the optional competencies.

As shown in Figure 6, the lesson learning process for Level 1 may use a mostly fixed, sequential sequence of activities that perform the same actions on learning



**Fig. 5.** Lesson presented with three learning objects representing three levels of competence with their sub-objects representing lesson topics with their sections.

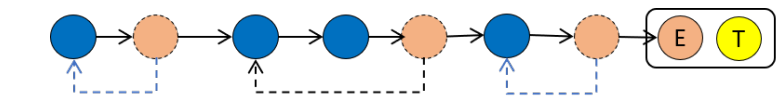
objects, i.e. on its mandatory topics. This is the most commonly used learning path for the acquisition of mandatory (or required) competences (level 1).

For optional competences (level 2) learning paths can be more complex, as they can also use branching learning processes. For level 3, there are several activities that the student performs in order to prepare an essay to present in a debate with other students. If the task is to develop a learning unit and its learning objects, he/she can apply problem-oriented learning at L1 and L2 competence levels, and in some cases at L3.

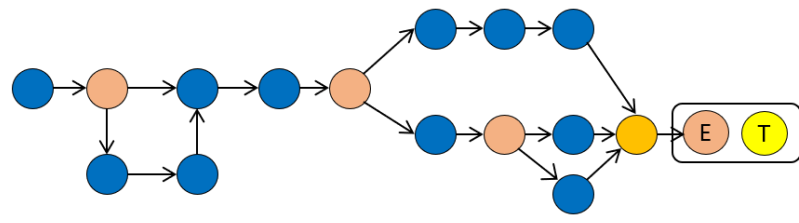
Figure 7 shows these learning processes as sub-processes applied at the L1, L2 and L3 competence levels.

According to the accreditation rules, in Serbia, the course must provide students with up to 100 points, of which 30 to 70 points can be earned by pre-exam obligations (assignments). BMU decided to apply the 70:30 model, i.e. that the pre-exam assignments provide up to 70 points, and the exam, up to 30 points. In this way, the concept of active learning is supported, which implies greater permanent and active learning of students during the semester, which enables constant contact with students and direct insight into their progress in learning during the semester.

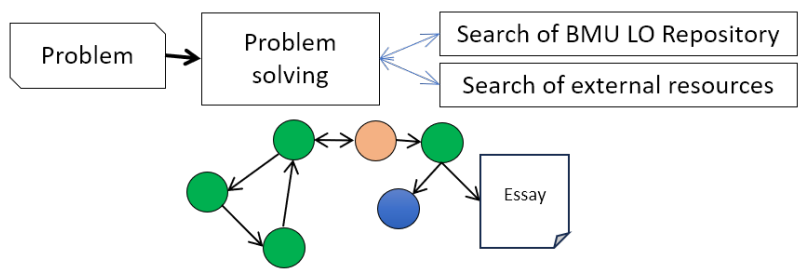
With this in mind, Figure 8 a shows a competency model for their courses. Students must have at least 35 points to be eligible for the exam. They must win 28 points from mandatory (key) competencies and at least 7 points for optional points. This gives students a better chance of getting at least 35 points, as the model offers more electives than core competencies. Teachers are obliged to provide teaching materials for basic competencies for each basic topic of at



a) Linear (sequential) learning process with optional evaluations (for level 1)



b) Alternative learning pathways (for level 2 )



c) Problem-oriented or self-learning of a student (levels 3)

● Learning object ● Learning verification ● Learning activity

**Fig. 6.** Learning process in the case of three levels of competence.

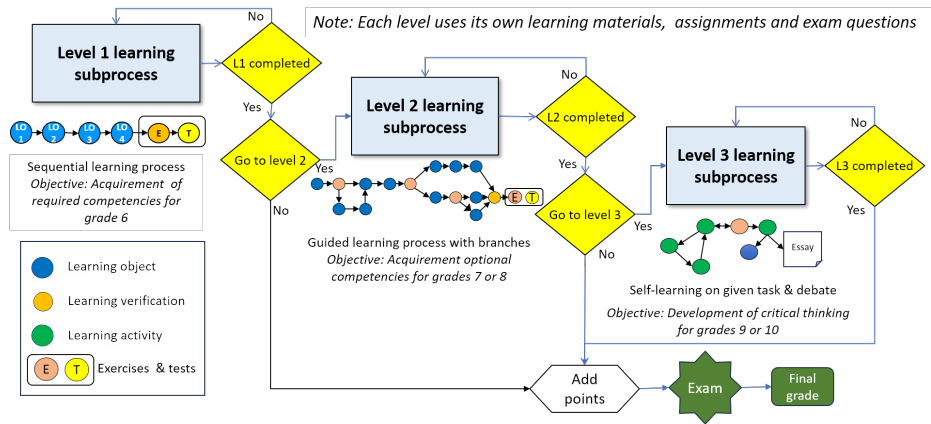


Fig. 7. Typical learning sub-processes applied at L1, L2 and L3 competence levels.

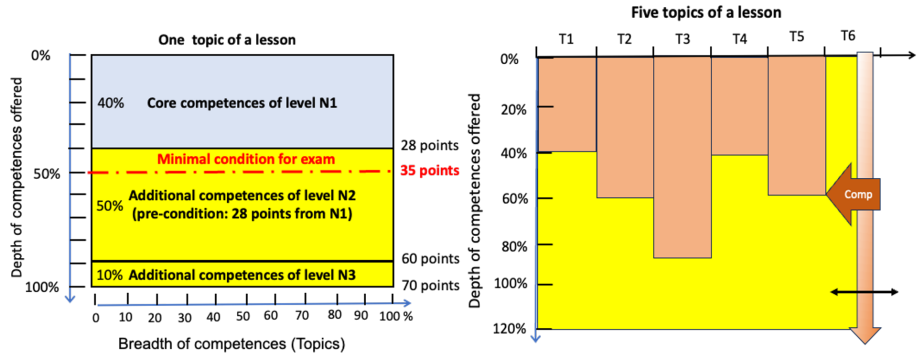
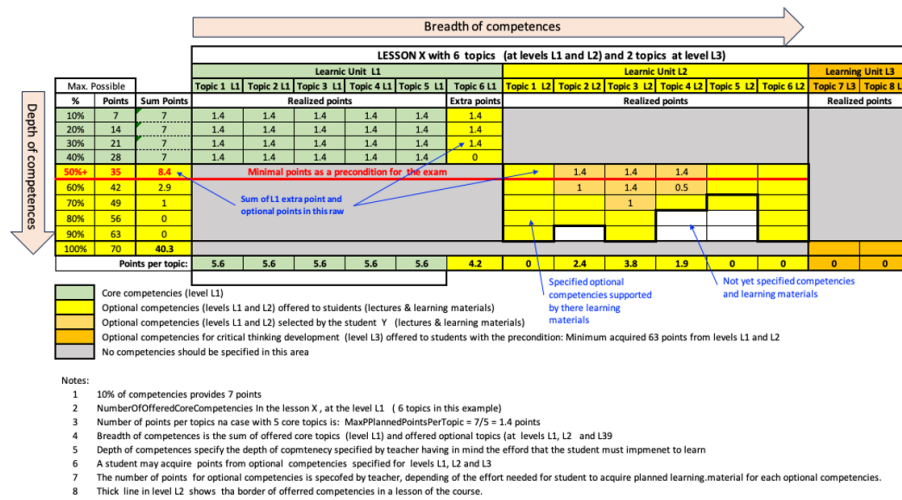


Fig. 8. Setting the competence level of the planned topics of one lesson with 5 mandatory and one optional topic.

least 28 points (40% of all competencies). Each topic is planned for more than 28 points, because students must be able to obtain a maximum of 70 points. In the example in Figure 8.b, topic 6 is optional and can be left for the subsequent specification of its competencies, after the students' request.

A more detailed Excel model of competencies is shown in Figure 9. In this example, 10% of the depth of competencies corresponds to 7 points. The last 10% of competencies (for level 3) correspond to the last 7 points of competencies. The analyzed lesson of the course has 5 basic topics, and the 6th is an optional topic. This model is used by the teacher to plan the organization of his/her lectures and exercises.

Students also use an Excel model to select optional competencies. An Excel model is created for each lesson of the SE201 Introduction to Software Engineering course and is created for each student. The student can use it to select,



**Fig. 9.** Excel model of topics and their competencies with levels L1, L2 and L3 of one lesson of the course SE201 Introduction to Software Engineering.

plan and manage their competencies during the semester. The same possibility is provided by the inter-face of the iMET system, which manages work and data related to students and all other processes and services at the university.

Figure 10 shows the acquired competencies of three students. In this example, the course has up to 8 topics, 6 are compulsory and 2 are optional and can be offered at all three competency levels. Each of the three students has different acquired elective competencies.

### 3.2 Organization of learning objects

Figure 11 shows the organization of learning elements in the case of lesson 1 of the course SE201 Introduction to Software Engineering planned for the first week of the semester (which lasts 15 weeks). The lesson has 5 compulsory learning topics (planned for 90 minutes of teaching), one of which is intended for exercises lasting 90 minutes. The L1 and L2 competence levels have the same structure. In this case, the only difference is that the L1 level offers only compulsory competences and for which learning material is provided, and the L2 level offers only additional optional teaching materials of the same compulsory competences. Level 3 obliges the student (if he wants to gain the points that level N3 offers) to choose two specific topics planned for the development of critical thinking. Within each lesson topic, one or more suggested essay topics and appropriate references for their preparation are offered. For each topic, the student must prepare an essay on a given assignment, which is offered each week. The student chooses two of the several essay topics offered during the semester and presents them to other students at a specially organized debate. The teacher must provide a list of

		Learnic Unit L1						Learnic Unit L2						Learnic Unit L3	
Max. Possible	Student 1	Topic 1 L1	Topic 2 L1	Topic 3 L1	Topic 4 L1	Topic 5 L1	Topic 6 L1	Topic 1 L2	Topic 2 L2	Topic 3 L2	Topic 4 L2	Topic 5 L2	Topic 6 L2	Topic 7 L3	Topic 8 L3
%	Points	Realized points						Realized points						Realized points	
10%	7	1.4	1.4	1.4	1.4	1.4	1.4								
20%	14	1.4	1.4	1.4	1.4	1.4	1.4								
30%	21	1.4	1.4	1.4	1.4	1.4	1.4								
40%	28	1.4	1.4	1.4	1.4	1.4	1.4								
50%+	35	Minimal points as a precondition for the exam						1.4	1.4	1.4					
60%	42							1	1.4	0.5					
70%	49							1							
80%	56														
90%	63														
100%	70														
Points per topic:		5.6	5.6	5.6	5.6	5.6	4.2	0	2.4	3.8	1.9	0	0	0	0

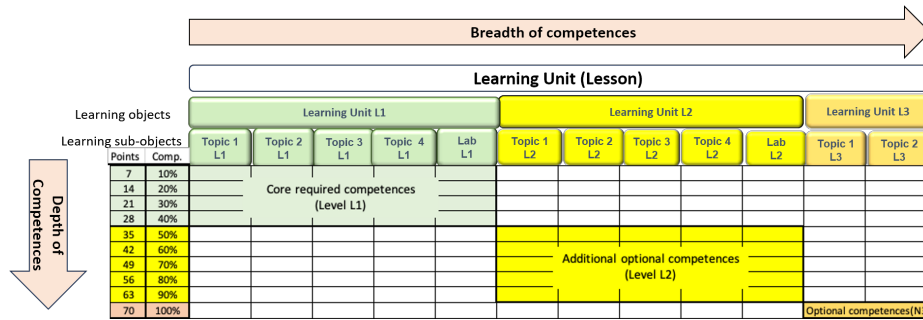
		Learnic Unit L1						Learnic Unit L2						Learnic Unit L3	
Max. Possible	Student 2	Topic 1 L1	Topic 2 L1	Topic 3 L1	Topic 4 L1	Topic 5 L1	Topic 6 L1	Topic 1 L2	Topic 2 L2	Topic 3 L2	Topic 4 L2	Topic 5 L2	Topic 6 L2	Topic 7 L3	Topic 8 L3
%	Points	Realized points						Realized points						Realized points	
10%	7	1.4	1.4	1.4	1.4	1.4	1.4								
20%	14	1.4	1.4	1.4	1.4	1.4	1.4								
30%	21	1.4	1.4	1.4	1.4	1.4	1.4								
40%	28	1.4	1.4	1.4	1.4	1.4	1.4								
50%+	35	Minimal points as a precondition for the exam						0.9	1.4	0.8	1.4	1	1.4		
60%	42							0.8			1.3		1.2		
70%	49							0.9			1.3		1		
80%	56										1.2		1.3		
90%	63										1.2		1.3		
100%	70														
Points per topic:		5.6	5.6	5.6	5.6	5.6	5.4	0.9	3.1	0.8	6.4	1	6.2	0	0

		Learnic Unit L1						Learnic Unit L2						Learnic Unit L3	
Max. Possible	Student 3	Topic 1 L1	Topic 2 L1	Topic 3 L1	Topic 4 L1	Topic 5 L1	Topic 6 L1	Topic 1 L2	Topic 2 L2	Topic 3 L2	Topic 4 L2	Topic 5 L2	Topic 6 L2	Topic 7 L3	Topic 8 L3
%	Points	Realized points						Realized points						Realized points	
10%	7	1.4	1.4	1.4	1.4	1.4	1.4								
20%	14	1.4	1.4	1.4	1.4	1.4	1.4								
30%	21	1.4	1.4	1.4	1.4	1.4	1.4								
40%	28	1.4	1.4	1.4	1.4	1.4	1.4								
50%+	35	Minimal points as a precondition for the exam						1.4	1.4	1.4	1.4				
60%	42							1.2	1	1.4	0.5				
70%	49							1	1.1	1					
80%	56							1		1.2					
90%	63							0.5							
100%	70														
Points per topic:		5.6	5.6	5.6	5.6	5.6	1.4	5.1	3.5	5	1.9	0	0	0	0

Fig. 10. Acquired basic and optional competencies in the case of 3 students and their results.

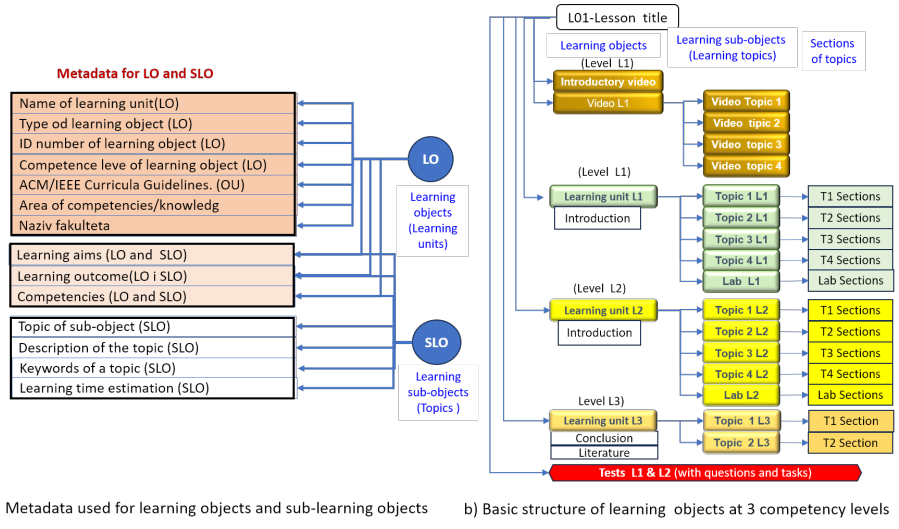
references for each proposed essay topic, but the student may suggest his own topic and may use additional references.



**Fig. 11.** An example of the structure of learning objects used in lesson 1 of the course SE201 Introduction to Software Engineering.

Figure 12.a shows the learning object (LO) and sub-learning object (SLO) metadata currently used to search for lessons in the Learning Object Repository (LOR). Figure 12.b shows the structure of learning objects (levels of competence L1, L2 and L3) and their sub-objects. At the L1 competency level, the learning material also offers videos for each L1 topic. This structure of LOs and SLOs provides students with all the learning material needed for their learning. There is some overlap between L1 and L2 sections (usually L1 sections are shorter), but since the learning material is in digital form (web and PDF forms), it is feasible for students to use it. Tests are given for each lesson and for L1 and L2 levels separately.

As already mentioned, the tests provide one question (out of at least 5 possible) for each topic. Therefore, the teacher must prepare at least 5 alternative questions for each lesson topic and competency level. The test can be multiple choice or essay type. These tests are used to assess the learned knowledge acquired in each lesson. The course SE201 has 13 weeks of study and uses 13 tests to assess the knowledge of its students. In addition to these tests with randomly asked questions, the course also uses tests for randomly selected short tasks from the database of tasks related to one topic, which the student must solve. In this way, the teacher assesses the level of acquired skills of the student, i.e. his/her ability to apply learned knowledge. These tests are given after teaching a group of related lessons. In the case of SE201, 3 tests with tasks are used. Similar to question tests, task tests provide at least 5 alternative tasks, for each group of lessons in the course. Students do not have access to test questions and tasks. They are obtained through a random selection of testing software and are only done during a limited testing time under controlled conditions. The questions and tasks for both types of tests are different for L1 and L2 competency levels.



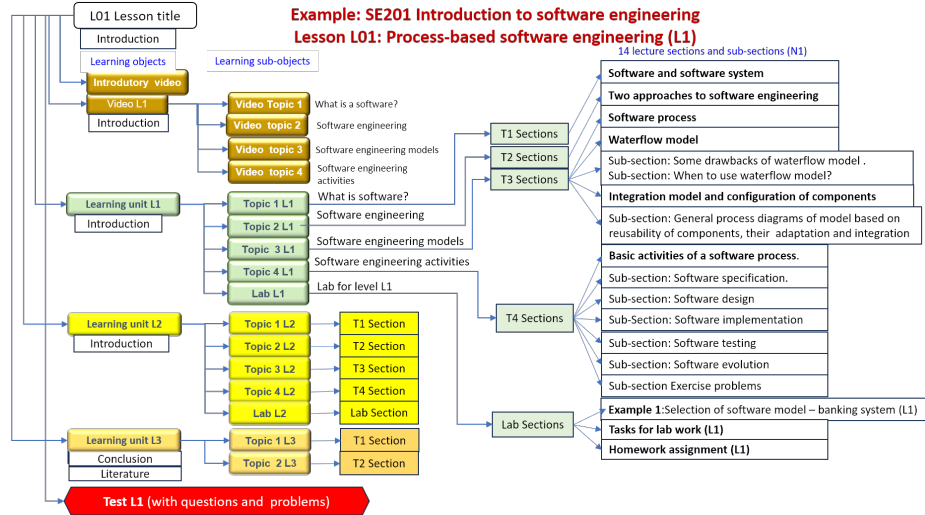
**Fig. 12.** Meta data of LO and SLO and basic structure of competences of 3 levels for the example given in Fig. 11.

Figures 13 and 14 show the headings of sections and sub-sections used by sub-objects, at the L1 level and the L2 level, separately. Section titles are given in bold font, and sub-section titles in normal font.

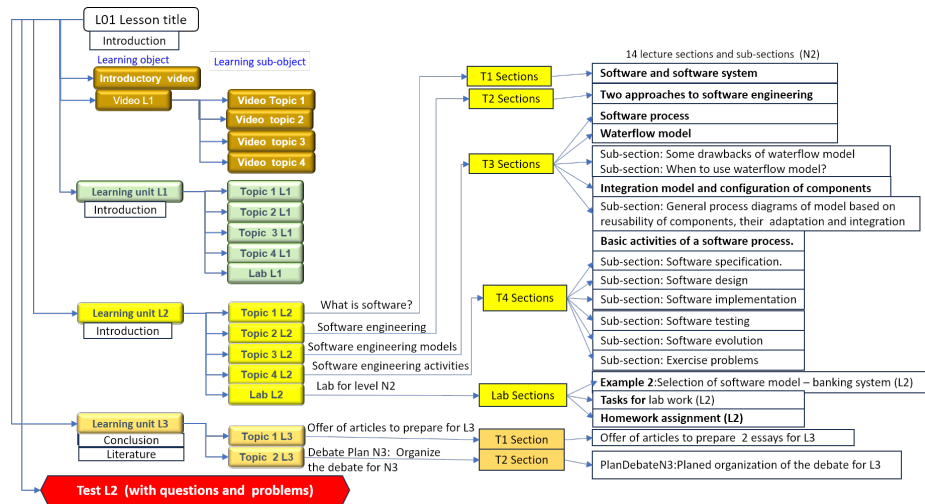
### 4 Repository of learning objects

Our goal is to track the mapping of learning outcomes (LOUT), learning competencies (COMP) and their knowledge and skill components (KNOW and SKILL), for each created topic at all competency levels for each lesson (learning unit) and each course at the university (Fig. 15). Obviously, this is not an easy task, but it is an important requirement for implementing personalized learning, because we need to control the goals, learning outcomes, and competencies of each new learning object we create when developing new optional lesson topics. Figure 15 shows an example of the created metadata (TC) for the topic T3 of the L2 competency level containing pointers to the LOUT, COMP, KNOW and SKILL components of the associated learning object (LO) stored in the university’s learning object repository (LOR).

Figure 16.a shows the developed compulsory and optional topics of the teaching material of the course SE201-L04. The course has five basic topics and teaching material (LM) must be developed for them. Learning material for other elective topics (T5, T7 and T8) can be developed later, for the next academic year, if a student is interested in a new elective topic. Figure 16.b shows the compulsory and optional topics chosen by student 1. He/she also decided to develop learning material (LM) for the optional topic T6 for all three competency levels.



**Fig. 13.** Example of knowledge content of learning objects and their L1 sections of lesson SE201-L01.



**Fig. 14.** Example of knowledge content of learning objects and their L2 sections of lesson SE201-L01.

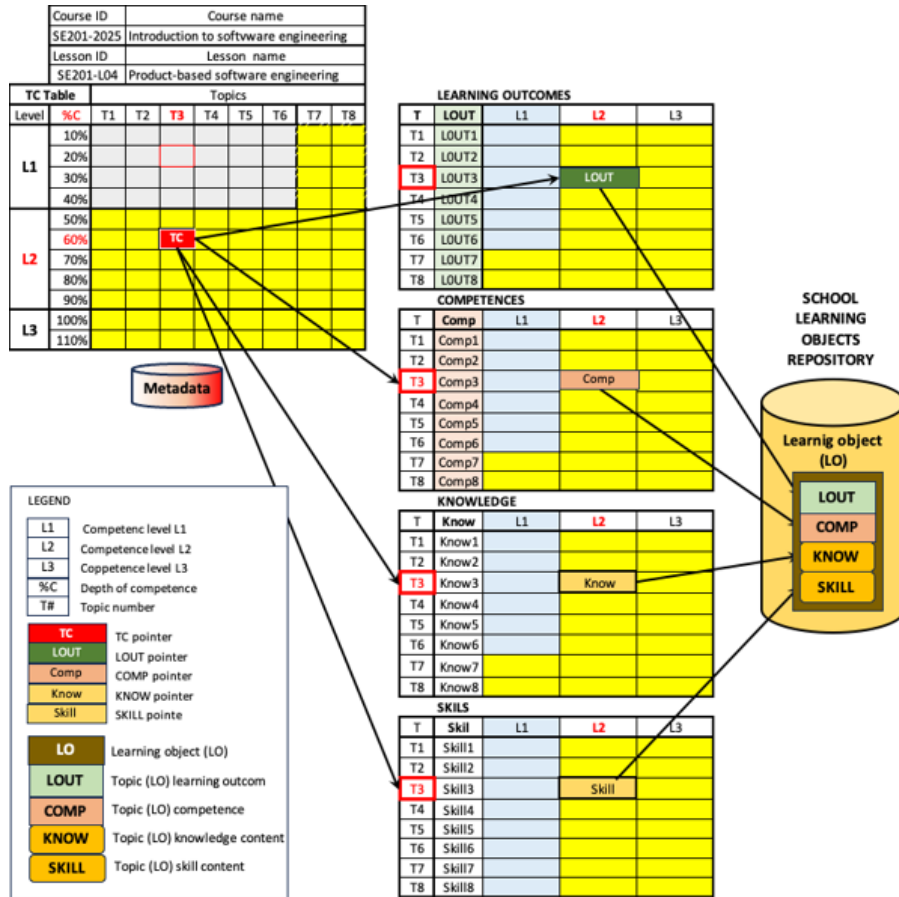
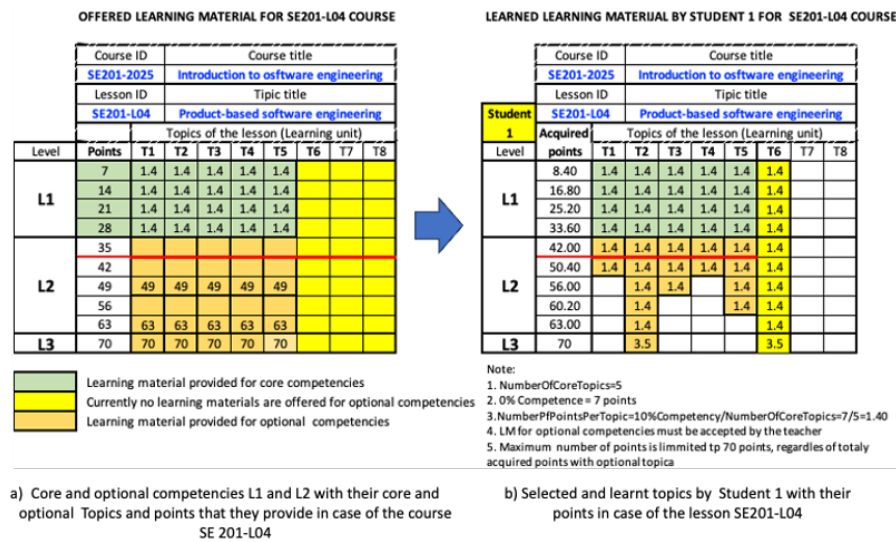


Fig. 15. Conceptual data model for creation of learning topics of a lesson by selecting their level of offered competences.

As explained in the notes on Figure 16, the 7-point competencies are represented as table rows. Each new row shows a new (deeper) competency that LM offers. Each field in a row gives 1.4 points (out of a total of 70 points). This number is the ratio between the 7 points related to each row (10% of 100% of the total planned competence) and the number of core topics (5 in the case of lesson SE201-L04). When new optional topics are added (such as T6 in Figure 16b), the same number of points are used as for core competencies (1.4 in the case shown). Since the course can provide a maximum of 70 points for all pre-exam tasks, the learned competences and acquired points of the offered learning material must not provide more than 70 points for the pre-exam tasks even in cases where they offer more than 70 points.



**Fig. 16.** Offered (a) and selected and learned (b) student 1 learning material for subject lesson SE201-L04.

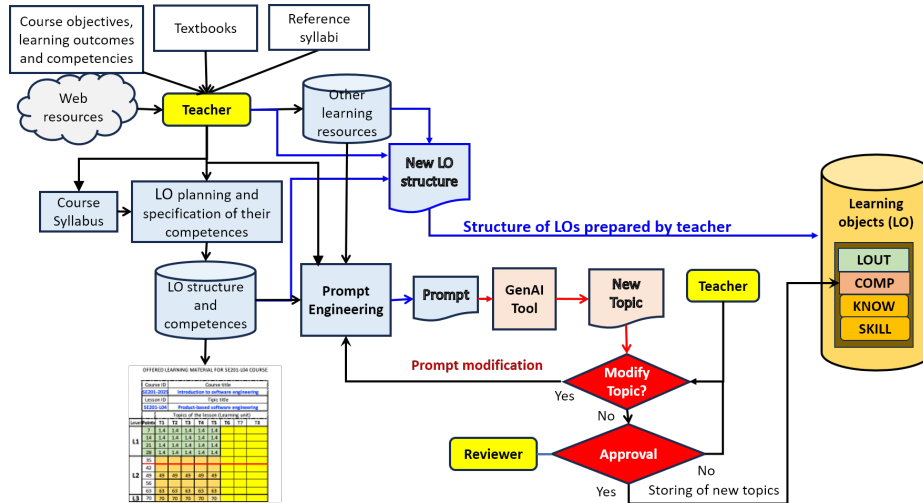
## 5 Use of Prompt Engineering for preparation of teaching materials by teachers

### 5.1 Preparation of learning materials for the mandatory topics of each lesson at all three levels of competencen

As seen in Figure 17, the teacher, before starting to use Prompt Engineering for the preparation of learning materials, must have in mind the competencies that the course and each of its lessons should provide to the student (Fig. 1), he analyzes text-books used for similar courses by renowned universities and

publishers in the world, analyze reference syllabi, used by renowned universities. In addition, he searches for information sources on the web, as well as other learning resources.

Based on this preparation, the teacher creates the curriculum of his/her course and defines the teaching topics for each lesson (as a learning unit) and, in accordance with Figure 5, creates the structure of each lesson with its topics at all three competence levels. For all mandatory topics, which are defined for level L1 (Fig. 16.a), the teacher should provide deeper competences for each mandatory topic at levels L2 and L3 as well. In this way, he/she enables the student to obtain a maximum of 70 points on each topic. Based on this preparation, the teacher creates the syllabus for his course, defines teaching topics for each lesson and, in accordance with Figure 5, creates the structure of each lesson with its topics at all three levels of competence, and students, following the learning procedure shown in Fig. 17 can earn up to 70 points.



**Fig. 17.** Hybrid procedure for development of core L1 and supported optional topic in levels L2 and L3.

If, due to the specificity of mandatory topics, the teacher cannot provide the possibility of obtaining 70 points in this way, then he/she is obliged to provide learning material for optional topics at the L1, L2 and/or L3 level (Figure 16.b). It is important that the sum of points on all mandatory and optional topics, and all levels of competence, is at least 70. If new optional topics are added over time, the total sum of points is greater than 70. In these cases, the student does not have to earn all possible points (70 or less) on mandatory topics, because by working on optional topics, he/she earns, in total, the required 70 points, or less, if he/she did not manage to achieve the maximum 70 points.

Table 1 shows the learning materials and pre-exam assignments that the teacher must provide for each lesson to students in SE201 Introduction to Software Engineering. As each lesson can be gradually expanded with new optional topics to the level of L1, L2 and L3, the work of the teacher is too much, and it becomes unacceptable. In order for it to be acceptable, in addition to teachers, it is planned that students who want to earn new and specific competences, they can develop appropriate learning materials under the supervision of teachers.

The teacher and students may use generative intelligence, according to university rules, in order to reduce their workload, and to significantly increase the efficiency of development of new, optional learning objects at levels L1 and L2, and essays at level L3. The university's internal standards define the technical, ethical and legal requirements that the author of learning materials must apply when preparing learning materials. Compliance with these requirements in case the author is a student is checked by teacher, and when the author is a teacher, it is checked by a specially appointed reviewer. More than 60 criteria for evaluating the quality of the prepared teaching material have been defined, adapted to the specifics of the course. Depending on the quality assessment, the financial compensation to the teacher, as the author of the learning material, is determined every year, in the event that he has re-revised the learning material at least 5%.

**Table 1.** Learning materials, pre-exam assignments and exam points for SE201.

Learning material offered to students and pre-exam assignments	Number of instances	Points	Total points
<b>Online learning material offered to all students</b>			
1. Video introduction L1	1		
2. Video lecture L1	1		
3. Multimedia web lecture L1	13		
4. Multimedia web lecture L2	13		
5. PDF lecture L1	13		
6. PDF lecture L2	13		
7. PPT lecture presentation L1	13		
8. PPT lecture presentation L2	13		
<b>Pre-exam assignments</b>			
1. Question tests L1	13	1	13
2. Question tests L2	13	1	13
3. Task test L1	3	1	3
4. Task test L2	3	1	3
5. Project (1, part) L1	1	8	8
6. Project (2, part) L2	1	12	12
7. Essays L3	2	4	8
8. Student activity	1	10	10
<b>Total pre-exam points:</b>			<b>70</b>
<b>Examination</b>			
Examination: 13 questions and 3 tasks	1	30	30
<b>TOTAL POINTS:</b>			<b>100</b>

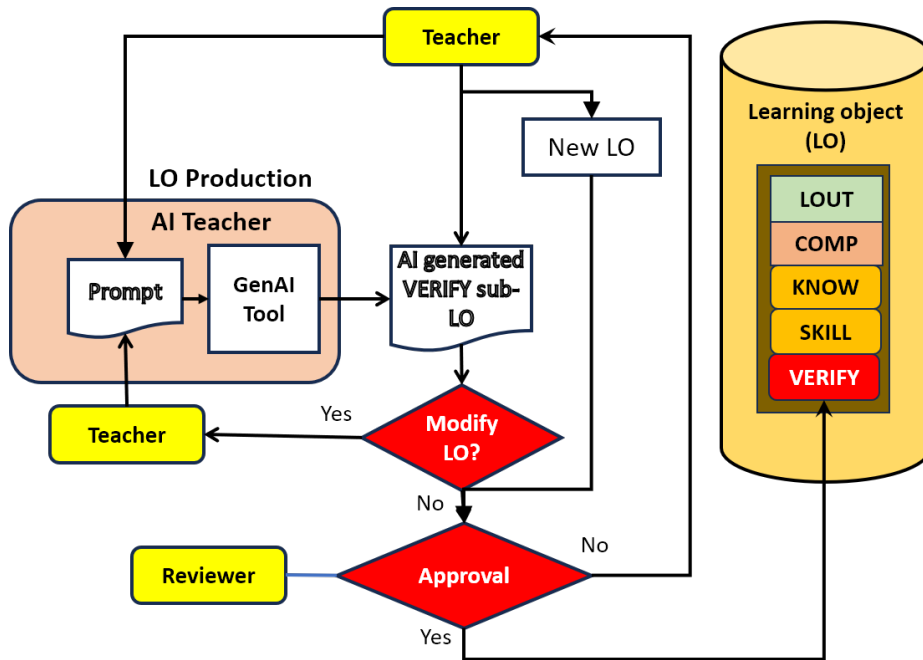
When preparing the learning material, it is taken into account that it is based on the recommended textbooks that have been selected for each subject. The scope of the learning material is taken into account, depending on the specifics of the subject, because students today are looking for as short learning materials as possible to read or watch video clips. The volume of learning material for compulsory topics at the L1 level, as a rule, is at least two times smaller than the corresponding learning material prepared for the L2 level, which also includes the learning material prepared for the L1 level. A special edition of teaching material at the L1 level is prepared for students who want to just pass the exam, while securing the minimum required 35 points. Within these 35 points, at least 80% of the points must be provided by learning on compulsory topics (which provide up to 28 points). The difference of up to 35 points students should earn from the optional teaching material intended for the L2 level, of his own choice.

In addition to the summary presentation of the learning material for which the teacher used the selected textbooks, the teacher can add his own contributions to the content of the teaching material, as well as processed parts generated by the GenAI tool. When creating online teaching material, the teacher is obliged to indicate the use of sources, and to emphasize especially the parts that are not contained in the recommended textbooks (if there are such parts), i.e., that he created himself or was created by the GenAI tool. He is obliged to carefully study and approve the learning material generated by GenAI, which are not contained in the selected textbooks. This part of learning material is very limited in relation to the one that is generated on the basis of the specified textbooks, which should be major source for learning material.

After preparation, the teacher defines the structure of each lesson (as in Figures 5, 10 and 16), and in accordance with the recommendations for writing prompts (prompts), specifies a prompt on the basis of which the selected generative artificial intelligence tool GenAI generates the text (with images) for the topic for which the prompt is specified. It usually takes several iterations of improvement of the prompt to get acceptable learning material. In this way, texts are generated for all topics of one lesson, and then the procedure is repeated for each lesson. If the teacher is well trained in preparing prompts for his course, the application of generative intelligence can drastically reduce the time for preparing learning materials, i.e. learning objects for all three levels of competence.

In accordance with the university's standards, the final approval for the teaching material is given by a specific reviewer who thus checks whether the teacher has done his work in accordance with the internal standards for the preparation of learning materials and with the prescribed criteria for evaluating the quality of teaching materials. Every academic year, the process of applying and evaluating the revised learning material is repeated. Within 7 years at most, the teacher is required to prepare completely new teaching material (at least 80% of the content should be new). In the event that due to some reasons (new technologies, new requirements, etc.) there is a need for significant changes to the existing learning material, then after the dean's approval, the teacher prepares a new

version of the learning material. Changes in the content of the learning material are controlled by software. In addition to learning materials, the teacher is required to prepare tests and pre-exam assignments for students for each learning topic of a lesson and for all course lessons, using appropriate prompts and GenAI tools (Fig. 18).



**Fig. 18.** Specifying of VERIFY elements of learning objects and their contents for L1 and L2 competence level.

In a similar way, the teacher must prepare at least five times more exam questions and tasks than there are topics in all lessons of the course (Figure 19). On the exam, each student receives randomly generated special questions and tasks, it depends on the portfolio of competences acquired in the subject, i.e., the topics and their depth, which he chose and studied, taken from student learning object repository. In this way, the repository of all learning objects contains all the necessary learning materials, for verifying what has been learned and the database of questions and tasks for the exam.

All learning materials are available to students, but they cannot access learning verification materials (e.g. question or task tests, exam questions and tasks). They only can access the obtained grades and possible explanations of the obtained grades.

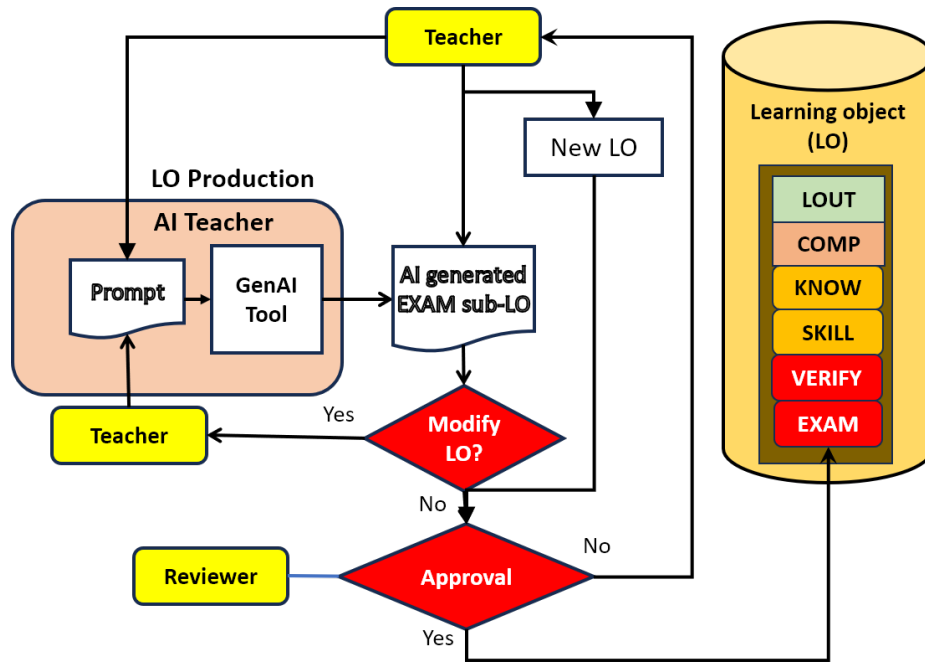


Fig. 19. Specification of the database of exam questions and tasks.

## 5.2 Preparation of learning materials for optional topics of each lesson

As already mentioned, in addition to compulsory courses, optional courses can be offered at L1, L2 and L3 levels. For some of them, the teacher can prepare the necessary learning contents, and in most cases, the student is expected to prepare them, under the teacher's supervision, according to his wishes. Based on the student's proposal for new competences, the teacher should determine optional topics for each lesson that the student has to develop (Figure 20).

In a demonstrative way, the structure of each lesson (teaching unit) is determined, which is the basis for creating learning materials. As you can see, in addition to the mandatory topics, optional topics for levels L1, L2 and L3 are defined for each lesson. Over time, that number of optional topics will probably increase, in accordance with the wishes of students and employers to acquire some specific competencies.

Now the student can create the missing mDita lessons with their own topics and use their learning objects to prepare tests and the exam questions and tasks. It is important to note that each student must receive different exam questions and tasks in the exams, depending on the optional competences he has chosen and studied, which contain his special lessons and topics, as well as special exam questions and tasks. That is why there are student learning facilities that support all these specificities and are necessary during the studies

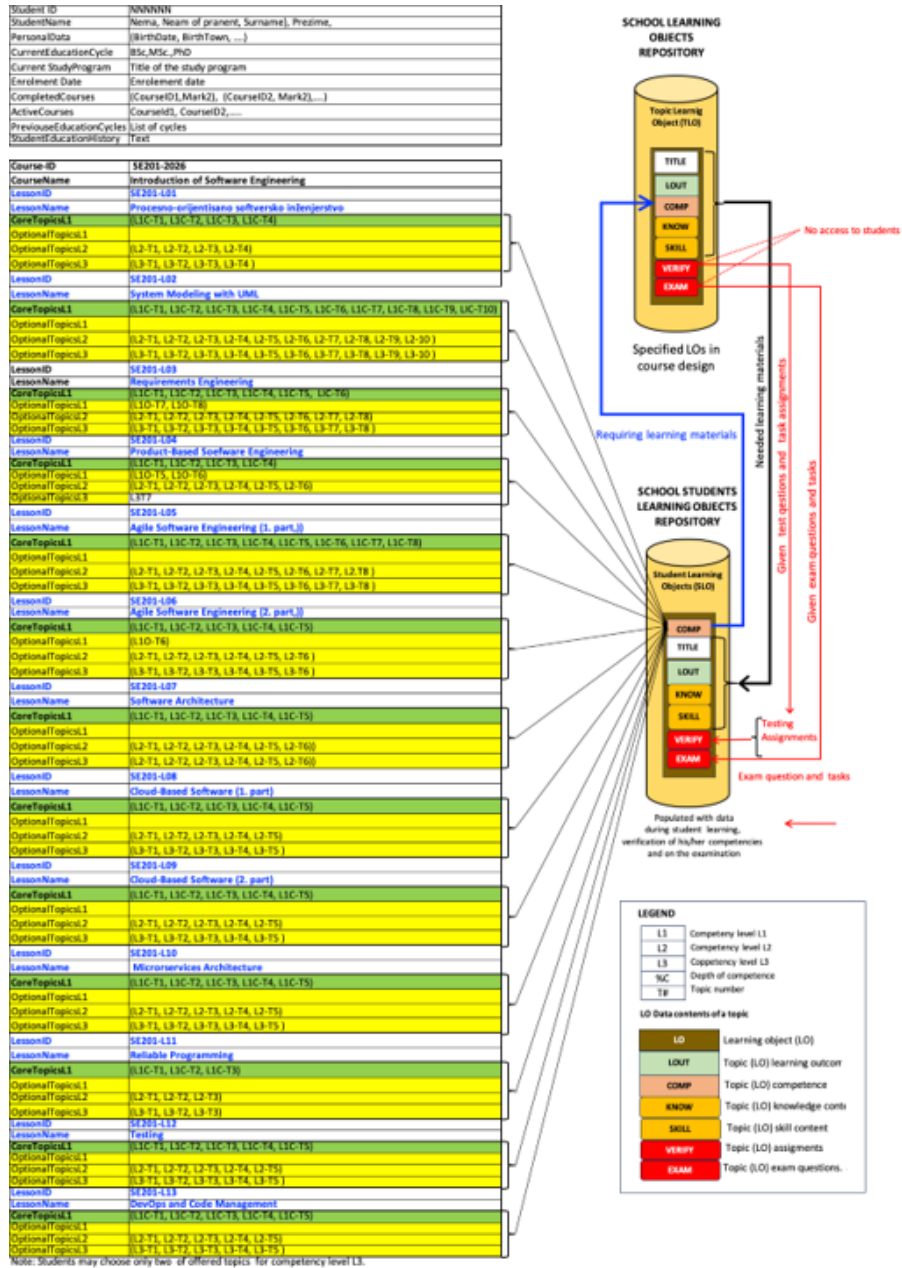
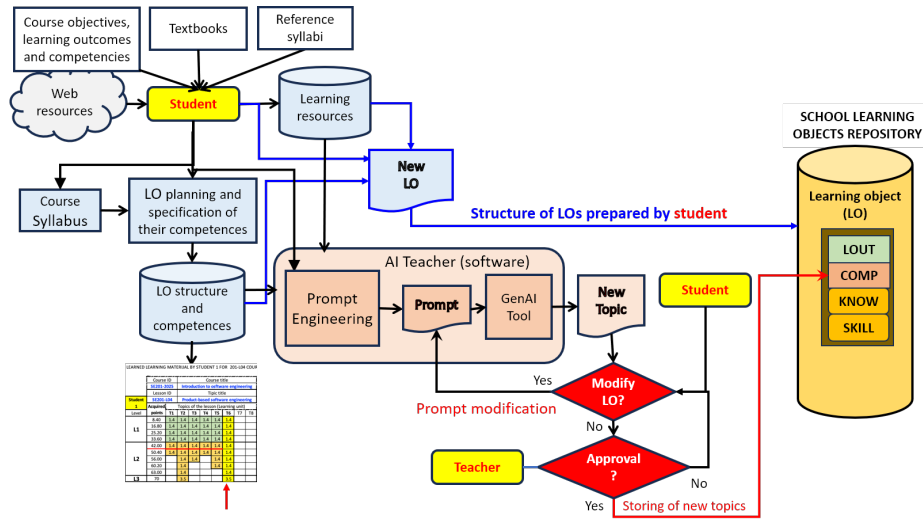


Fig. 20. Creation of Student Learning Objects.

of every student. Of course, created learning objects that have been prepared and placed in the university repository of learning objects can be shared and used by other students who have chosen the same optional competencies and their learning objects later during their studies.

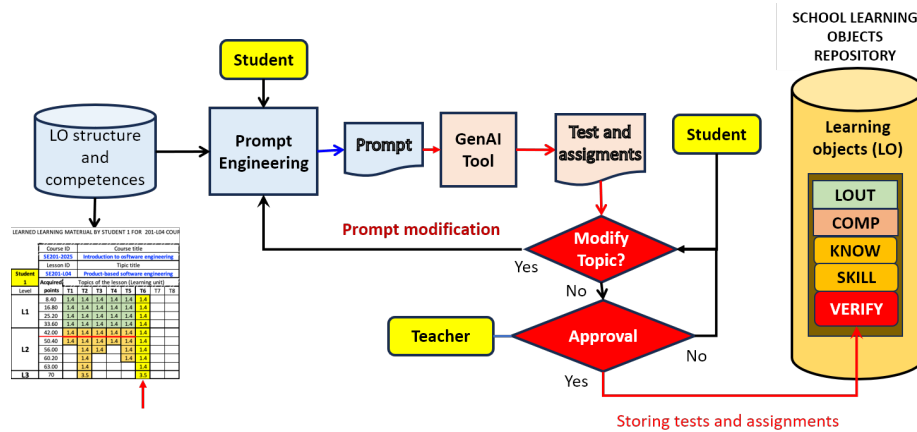
Figure 21 shows, in a simplified way, the hybrid process of preparing and submitting learning material for optional and specific topics of each lesson in the course. Teaching materials are placed in the repository of learning objects of the university, but links to these learning materials are placed in a separate student's repository of links to learning materials, which each student has and which is filled during the entry of new learning materials. In this way, it is known exactly which optional teaching materials the student chose during his studies in each subject, in each lesson.



**Fig. 21.** Hybrid development procedure of optional teaching materials of specified optional competencies (L1, L2, L3).

Figure 22 shows, in a simplified way, a hybrid process in which a student prepares learning material for optional competencies for one or more courses, their lessons and topics. He also prepares tests and pre-exam assignments for these lessons and topics. The teacher verifies the defined pre-exam tasks that are part of the learning material and are given for further use by all students who choose the same specific competency.

Figure 23 shows a similar procedure for preparing all possible exam questions and tasks (with correct solutions) that the student prepares for the optional competencies and topics he has chosen. After verification by the teacher, the tests with exam questions and tasks are placed in the repository of the university's learning facilities, and they become inaccessible to students. The student who



**Fig. 22.** Preparation of pre-examination requirements for optional competencies and topics, and their placement in the repository of the university’s learning facilities.

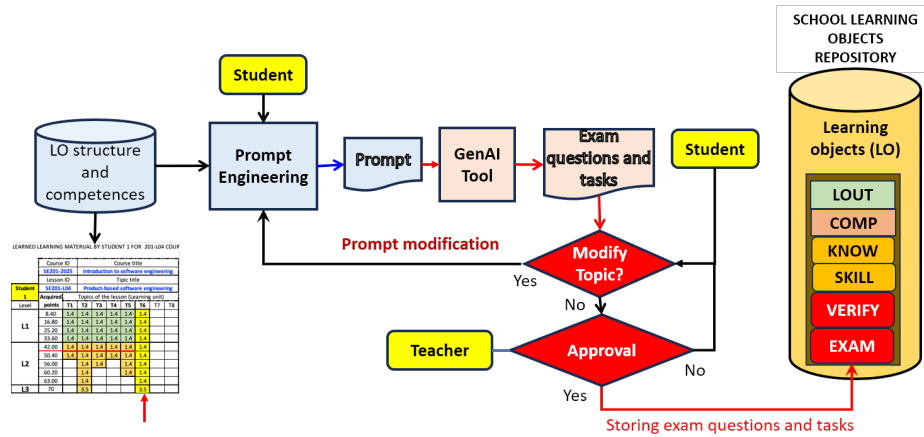
prepared them is obliged to sign a statement on the confidentiality of the exam questions and answers he pre-*pared* (as part of his learning process).

## 6 Automatic generation of prompts for GenAI tools when preparing teaching materials

Applying prompt engineering increases work efficiency, but it is highly dependent on the skill of the user of the GenAI tool. Depending on the problem he wants to solve by applying it, he must apply the appropriate prompt structure. Even so, it often takes several iterations to perfect it and provide application results of the chosen GenAI tool that are good for practical application in a particular field. The question arises, is the field of application of the GenAI tool in the preparation of learning materials possible for the creation of software that will itself, without human intervention, generate the appropriate prompt for the application of the selected GenAI tool in certain narrower areas of education, and especially in certain narrower areas of higher education?

These researches are now in the preparatory phase at our university. Figure 24 shows a conceptual model of the process of possible automatic obtaining of instructions in the preparation of learning materials in higher education. The goal is not to completely remove the teacher from the process, but to assign him an appropriate role that slows down the efficiency of the work as little as possible, and can significantly affect the quality of the final results of the application of the selected GenAI tool.

As you can see, the preparatory part of the process is the same as in the case of applying prompt engineering. The difference is that instead of using prompt engineering, here an AI software module is introduced to automatically generate the prompts. It should provide fully automatic generation of the needed prompt,



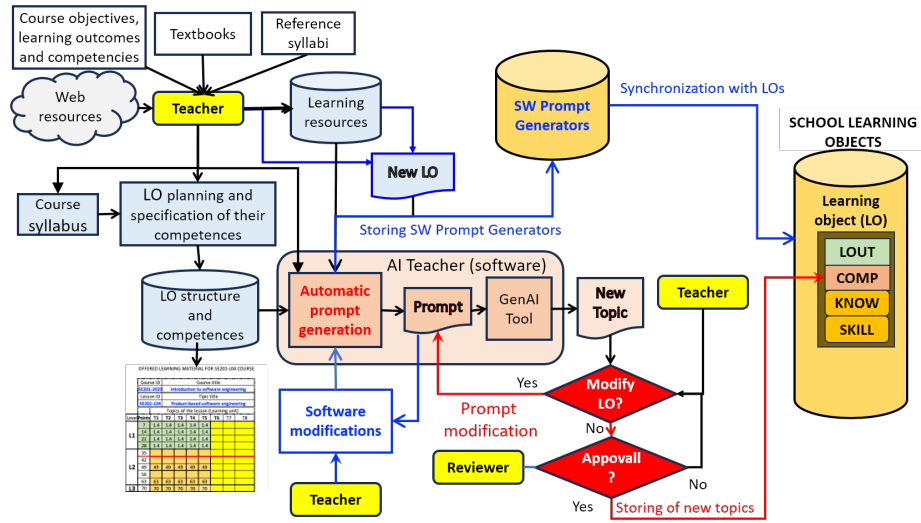
**Fig. 23.** Preparation of exam questions and assignments for optional competencies and topics, and their placement in the repository of the university’s learning facilities.

with which GenAI will generate the desired learning material. The prompt is the query text based on which the GenAI tool produces, in our case, the text of certain topics. So, we have two cycles of iterative improvement of the query, but also the software which, now, instead of the teacher, should produce the appropriate text of the query (prompt).

The acceptability of the text of the material for the topic is assessed by the teacher. If he is not satisfied, he now does not make direct changes in the text of the prompt, but in the software that should generate a new prompt that will produce either an acceptable prompt or a new modification of the software, until an acceptable result is obtained - acceptable teaching material in the opinion of the teacher. The teacher’s decisions and the obtained result - new teaching material, are checked by a reviewer whose role is to ensure, in addition to the teacher, the obtained quality of the teaching material, but also to check whether the teacher carries out the prescribed procedure according to the given rules and restrictions. The human factor is often an element of risk in maintaining the quality of the process of preparing teaching materials, so this additional control is desirable and is standardly applied in the preparation of learning materials at BMU.

If the reviewer has objections to the quality of the generated learning material, he submits his objections to the teacher, who then once again modifies the prompt generation software that generates a new prompt and repeats with which the GenAI tool generates new teaching material with a single topic. If, after that, the reviewer has no more objections, the obtained learning material is archived in the university’s repository of learning materials. At the same time, the software for automatically generating prompts is also archived.

The question arises: what is gained by specifying software to generate prompts instead of directly and iteratively specifying the prompts that will produce ac-



**Fig. 24.** Hybrid procedure of automatic development of learning materials for specified L1 and L2 competencies.

ceptable learning material with a selected GenAI tool? This research is currently in its infancy, but the smart software is expected to provide a much greater speed of producing the needed prompt than when using manually and iteratively specification of a needed prompt. Future research will hopefully confirm these expectations. Similarly, as for generating teaching materials for learning, teaching materials can be generated for verification of what has been learned (tests, tasks, and other pre-exam home-work assignments of students), as well as tasks and questions for exams (Figure 25).

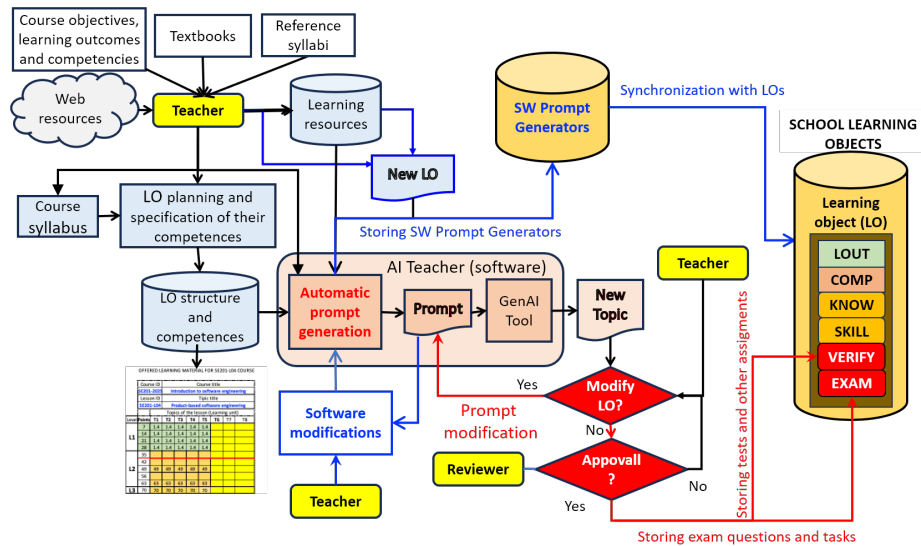
When a student decides to create optional learning material for optional specific competencies, he/she uses the same procedure for automatic prompts generation as the teacher (Fig. 24 and Fig. 25). The role of teacher is assumed by the student, and the role of reviewer is assumed by the teacher.

## 7 Using the system for personalized learning by students

The student uses the personalized learning system in two ways:

- Use as an author of teaching material, if he has been assigned to prepare, with the help of the teacher, teaching material for a specific competence for which he wants to acquire competence, and
- Use as a student who has chosen an optional competency for which there is already teaching material, noted by the teacher, or a student who first re-requested the acquisition of that specific competency.

Figure 26 shows the procedure for preparing the teaching material in the case that the student has the role of the author of the teaching material, which



**Fig. 25.** Procedure for automatic generation of prompts for generating tests and tasks for pre-exam assignments, as well as test questions and tasks for exams.

includes the preparation and evaluation of the students' pre-exam assignments, as well as their exam questions and assignments. As already mentioned, the procedure is the same as in the first case of the teacher. The only difference is that the teacher, in addition to his advisory role, also has the role of a reviewer of the received teaching materials.

Figure 27 shows the procedure of using the system for personalized learning in the case that the student has his usual and most common role, i.e. to learn and use developed learning materials. In this case, through the student interface for using the iLearn system, he searches, finds and access the lesson he needs to learn.

As each student has his own specific portfolio of competencies that he acquires (due to the use of optionally offered competencies and learning materials), the student must have his own special repository, which contains links to learning materials that are stored in the university repository. These links are created when the student determines, for each year of study, which optional competencies he wants to acquire. Most often, students can access prepared learning materials, for which the necessary links are then created. If they made a request to acquire optional specific competences for which the needed learning material was not developed yet, then they need to develop learning materials for new optional topics according the procedure of creating learning material described in Figure 26. Students also may prepare pre-exam assignments and, exam questions and tasks, verified by their teacher. On exams, students may receive only exam questions and tasks that correspond to their portfolios of acquired competencies.

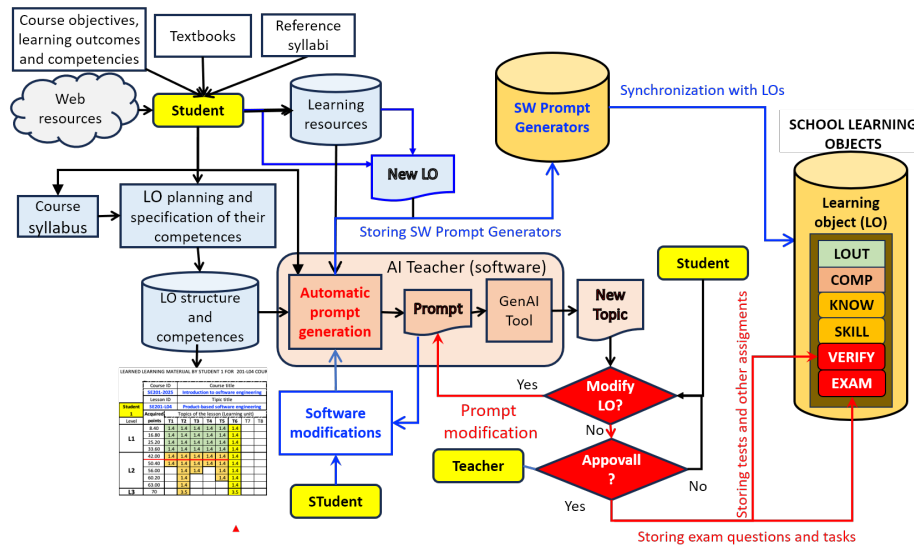


Fig. 26. Hybrid procedure of automatic development of learning materials for specified L1 and L2 competencies.

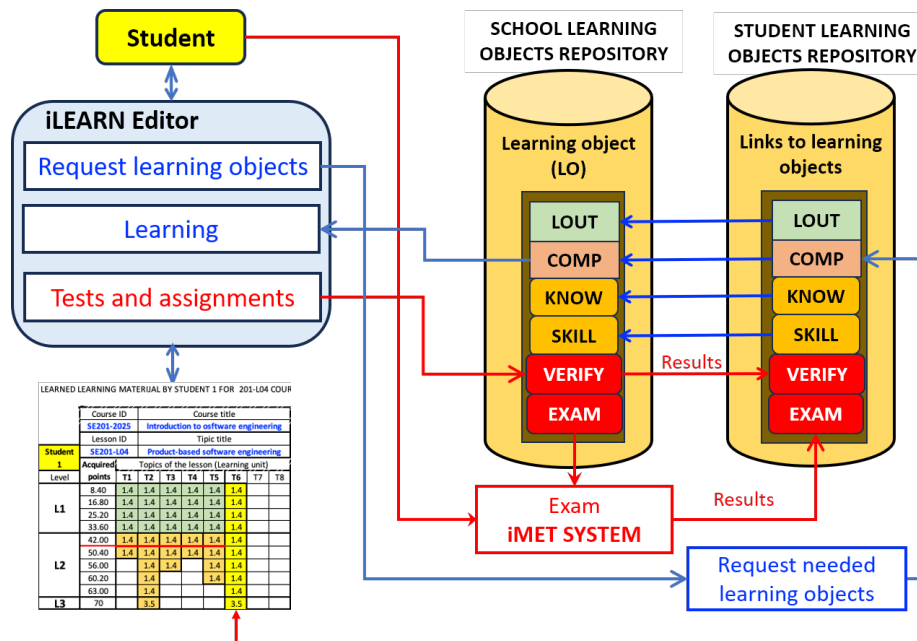


Fig. 27. Student needed learning objects, gets and learn their content, get and submit tests and assignments and do exams.

## 8 Conclusion

The paper presents a conceptual model of a system for hybrid personalized learning guided by competences and supported by the GenAI tool of the generative artificial intelligence system. The aim of the paper was not to provide an overview of research in the field of research and development of systems for personalized learning, but to devote itself entirely to a more detailed exposition of the concept of such a system that is under development and partially implemented at the Metropolitan University in Belgrade.

The paper presents the concept of the system as a whole, i.e. which provides conceptual solutions to the most important research and development challenges for the application of personalized learning in higher education. In the last two academic years, the concept was tested in the case of the application of prompt engineering using several models of generative intelligence, but GenAI tool of the CharGPT4.0 system was used. The results of the experimental application on the SE201 course showed that a significant increase in efficiency is achieved in the preparation of teaching materials, including the preparation of tests, but that the teacher must be well trained in the preparation of prompts. The goal is to train the students to use GenAI tools for the needs of their future job, but to do so with a full understanding of the problem they are solving, i.e. to acquire the appropriate competencies that are defined for each topic studied in the course.

The challenge is also how to hold F2F teaching in classrooms when students study different teaching topics, within their personalized learning in each course. The development of pedagogical models of F2F teaching on personalized syllabi is also necessary. The current F2F lectures can only cover the compulsory part of the program, and for the personalized parts, the practice of student consultation with the teacher and his assistants must be introduced.

By applying engineering prompts, useful experiences were gained, and encouraging results were achieved, especially in the efficiency of creating learning materials and tests. This enables rapid adaptation of syllabi and their courses to the demands of students and employers.

In the next phase of the research, research into the automatic generation of prompts will be carried out using intelligent software for generating appropriate prompts. The following research and development activities are planned:

1. Development of a software system that implements the set conceptual model of learning personalization using prompt engineering
2. Research and development of an intelligent software generator of the required prompts for obtaining learning materials necessary for the acquisition of new and required competencies.
3. Pilot application of the developed system for personalized learning based on the conceptual model presented here in different syllabi and groups of specific courses, in order to determine new challenges in application and find new solutions based on new experience in application.

These researches are demanding and extensive, because BMU always strives to apply the results of its research projects in teaching in all university programs. As of this academic year, all learning materials (except in the education field of art and design) support the application of three levels of competence. In the preparation of learning materials, the concepts presented in this paper are applied, and for each teaching unit, the goals, learning outcomes and competencies that the teaching unit must provide to students are clearly defined, while their mapping is carried out starting from the reference corpus of knowledge, as described in this paper.

BMU is open to cooperation in further research in the field of application of artificial intelligence in the personalization of learning with other universities, with the support of appropriate funds to support planned research.

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## References

1. Ayeni, O.O., Al Hamad, N.M., Chisom, O.N., Osawaru, B., Adewusi, O.E.: Ai in education: A review of personalized learning and educational technology. *GSC Advanced Research and Reviews* **18**(2), 261–271 (2024)
2. Cardone, M., Rodriguez, R., Ishmad, K.: Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations. Tech. rep., U.S. Department of Education, Office of Educational Technology, Washington, D.C. (2023)
3. Chan, C.K.Y., Colloton, T.: Generative AI in higher education: The ChatGPT effect. Taylor & Francis (2024)
4. Chen, L., Zhang, Y.: The impact of delay on user engagement in educational technology. *IEEE Transactions on Learning Technologies* (2024)
5. Cheng, B., Wang, M., Yang, S.J., Peng, J., et al.: Acceptance of competency-based workplace e-learning systems: Effects of individual and peer learning support. *Computers & Education* **57**(1), 1317–1333 (2011)
6. Cooper, G.: Examining science education in chatgpt: An exploratory study of generative artificial intelligence. *Journal of science education and technology* **32**(3), 444–452 (2023)
7. DeepSeek: DeepSeek (2025), <https://www.deepseek.com/en>, [Online; accessed 11-Sep-2025]
8. Adinda, D.: A competency-based approach to support e-learning during the covid-19 situation. In: 20th European Conference On E-Learning (2021)
9. Domazet, D., Gavrilović, N.: Personalization of e-learning by using of learning processes with branching. In: EDULEARN19 Proceedings. pp. 10432–10442. IATED (2019)
10. Domazet, D., Gavrilović, N., Jović, J.: Efficiency of development of e-learning materials based on learning objects. In: Proceedings of the 10th International Conference on eLearning (eLearning-2019). pp. 26–27 (2019)

11. Sluijsmans, D.M., Prins, F.J., Martens, R.L.: The design of competency-based performance assessment in e-learning. *Learning environments research* **9**(1), 45–66 (2006)
12. EU Commision: Law on artificial intelligence. Tech. rep.
13. Farahani, M.S., Ghasmi, G.: Artificial intelligence in education: A comprehensive study. In: *Forum for Education Studies*. vol. 2, pp. 1379–1379 (2024)
14. García-Peñalvo, F.J., Llorens Largo, F., Vidal, J., et al.: The new reality of education in the face of advances in generative artificial intelligence. In: *Asociación Iberoamericana de Educación Superior a Distancia (AIESAD)* (2023)
15. Giannini, S.: Generative ai and future of education. Tech. rep., UNESCO (2023), <https://unesdoc.unesco.org/ark:/48223/pf0000385877>
16. Gocen, A., Aydemir, F.: Artificial intelligence in education and schools. *Research on Education and Media* **12**(1), 13–21 (2020)
17. Goel, A.K., Polepeddi, L.: Jill watson: A virtual teaching assistant for online education. In: *Learning engineering for online education*, pp. 120–143. Routledge (2018)
18. GROK-DeepSearch: GROK-DeepSearch (2025), <https://grok.com/>, [Online; accessed 11-Sep-2025]
19. Harry, A.: Role of ai in education. *Interdisciplinary Journal & Hummanity (INJURITY)* **2**(3) (2023)
20. Holmes, W., Tuomi, I.: State of the art and practice in ai in education. *European journal of education* **57**(4), 542–570 (2022)
21. Hsu, Y.C., Ching, Y.H.: Generative artificial intelligence in education, part one: The dynamic frontier. *TechTrends* **67**(4), 603–607 (2023)
22. Hwang, G.J., Chen, N.S.: Exploring the potential of generative artificial intelligence in education: applications, challenges, and future research directions. *Educational Technology & Society* **26**(2) (2023)
23. Jovic, J., Milic, R.M., Cvetanovic, S., Gavrilovic, N., Domazet, D., Nikolic, R.: Intelligent Recommender System for Personalized Online Learning (IREP). In: *Proceedings of the Eleventh Internacional Conference on E-Learning*. pp. 22–29 (2020)
24. Jović, J., Milić, M.R., Cvetanović, S.: Multidimensional concept map representation of the learning objects ontology model for personalized learning. *Journal of Internet Technology* **24**(5), 1043–1054 (2023)
25. Leyking, K., Chikova, P., Loos, P.: Competency—and process-driven e-learning—a model-based approach. *Electronic Journal of e-Learning* **5**(3), pp183–194 (2007)
26. Li, D., Zhang, H.: Adaptive learning systems: Impact on student outcomes. *Computers and education* (2023)
27. Mao, J., Chen, B., Liu, J.C.: Generative artificial intelligence in education and its implications for assessment. *TechTrends* **68**(1), 58–66 (2024)
28. MarketsandMarkets: Artificial intelligence market in the education sector 2023-2030. Tech. rep. (2023), <https://www.marketsandmarkets.com/Market-Reports/artificial-intelligence-education-market-200912291.html>
29. McGehee, N.: Ai in education: Student usage in online learning. Michigan Virtual Learning Research Institute (2024)
30. OpenAI: Technical report: Performance and baseline evaluations of gpt-oss-safeguard-120b and gpt-oss-safeguard-20b. Tech. rep. (2025), [https://cdn.openai.com/pdf/08b7dee4-8bc6-4955-a219-7793fb69090c/Technical\\_report\\_\\_Research\\_Preview\\_of\\_gpt\\_oss\\_safeguard.pdf](https://cdn.openai.com/pdf/08b7dee4-8bc6-4955-a219-7793fb69090c/Technical_report__Research_Preview_of_gpt_oss_safeguard.pdf)

31. Qadir, J.: Engineering education in the era of chatgpt: Promise and pitfalls of generative ai for education. In: 2023 IEEE global engineering education conference (EDUCON). pp. 1–9. IEEE (2023)
32. Ruiz-Rojas, L.I., Acosta-Vargas, P., De-Moreta-Llovet, J., Gonzalez-Rodriguez, M.: Empowering education with generative artificial intelligence tools: Approach with an instructional design matrix. *Sustainability* **15**(15), 11524 (2023)
33. Samala, A.D., Rawas, S., Wang, T., Reed, J.M., Kim, J., Howard, N.J., Ertz, M.: Unveiling the landscape of generative artificial intelligence in education: a comprehensive taxonomy of applications, challenges, and future prospects. *Education and Information Technologies* **30**(3), 3239–3278 (2025)
34. Thomson, S.R., Pickard-Jones, B.A., Baines, S., Otermans, P.C.: The impact of ai on education and careers: What do students think? *Frontiers in Artificial Intelligence* **7**, 1457299 (2024)
35. UNESCO: Global student survey on ai in education. Tech. rep. (2024), <https://www.digitaleducationcouncil.com/post/digital-education-council-global-ai-student-survey-2024>
36. Vieriu, A.M., Petrea, G.: The impact of artificial intelligence (ai) on students' academic development. *Education Sciences* **15**(3), 343 (2025)
37. Walter, Y.: Embracing the future of artificial intelligence in the classroom: the relevance of ai literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education* **21**(1), 15 (2024)
38. Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., Du, Z.: Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications* **252**, 124167 (2024)
39. Yu, H., Guo, Y.: Generative artificial intelligence empowers educational reform: current status, issues, and prospects. In: *Frontiers in Education*. vol. 8, p. 1183162. Frontiers Media SA (2023)
40. Zhang, K., Aslan, A.B.: Ai technologies for education: Recent research & future directions. *Computers and education: Artificial intelligence* **2**, 100025 (2021)