



Developing Algorithmic Thinking in the Hungarian Language Course – ICT and Chatbots in Teacher Education

Orsolya DÖRYNÉ ZÁBRÁDI

Széchenyi István University
(Győr, Hungary)

Department of Education and Psychology
zabradi.orsolya@sze.hu

<https://orcid.org/0000-0003-1203-4278>

Szilvia PETZNÉ TÓTH

Széchenyi István University
(Győr, Hungary)

Department of Methodology
toth.szilvia@sze.hu

<https://orcid.org/0000-0003-0124-3891>

Bernadett PÁPAI

Széchenyi István University
(Győr, Hungary)

Department of Methodology
papai.bernadett@sze.hu

<https://orcid.org/0000-0002-4892-4697>

József REIDER

Széchenyi István University
(Győr, Hungary)

Department of Methodology
reider.jozsef@sze.hu

<https://orcid.org/0000-0002-4179-7656>

Judit SIPOS

Széchenyi István University
(Győr, Hungary)

Department of Methodology
sipos.judit@sze.hu

<https://orcid.org/0000-0001-5245-5881>

Abstract. Today, education, the teaching-learning process, is undergoing many changes. 21st-century skills increasingly emphasize the importance of collaboration, self-development, and lifelong learning. In addition, new information and communication technologies are emerging, and the potential for using artificial intelligence in education is growing. Open-ended questioning is also coming to the fore as one of the modern theories of learning and teaching. The information gained through self-construction helps to develop one's own appropriate representations for deeper learning. The learner reorganizes his/her own existing knowledge for understanding and learning.

Linked to quality education as a sustainability guideline, we rethink our subjects year by year and use methodological and technical innovations to strengthen and enrich teaching-learning processes.

In teacher training, we have combined the teaching of semantics and grammar (vocabulary, morphology, syntax) in the Hungarian language course with

the development of algorithmic thinking in mathematics. This gives scope for integration between subjects and the theory of multiple intelligences. Furthermore, using modern technological advances and rethinking the traditional frontal, paper-based teaching, we redesigned our lessons based on the SAMR model, giving students the task of playing the role of a chatbot and creating flowcharts and mind maps using a computer application. After the theoretical introduction, students were introduced to the decision tree and how NLP-based chatbots work. Then, they were given two fictitious topics to choose from (making an appointment at school or at the study department), based on which, after defining the goals, they had to create the thinking algorithm, flowchart, and decision tree of the chatbots. A basic prerequisite for all these complex tasks is a thorough understanding of the structure of the language, which we wanted to illustrate with this course adaptation. The description and results of this experimental research, and within it the complex development, are summarized in this presentation and article.

Keywords: ICT, chatbot, algorithmic thinking, languages, lifelong learning

1. Introduction

Due to economic and social transformations, the field of education and the teaching-learning process are undergoing significant changes. Instead of frontal teaching, cooperation, teamwork, self-development, and lifelong learning are coming to the fore. The appropriate use of new information and communication technologies and the increasingly widespread use of artificial intelligence are also gaining ground in education. Today's modern theories of learning and teaching are moving away from precisely defined closed-ended questions towards open-ended questions (Mabbott and Bull 2007). Through teamwork and collaboration, learners reorganize their own existing knowledge in order to understand and study. In the academic year 2022–2023, the Hungarian Language II course – which was a major subject for teacher candidates at Apáczai Csere János Faculty of Pedagogy, Humanities, and Social Sciences within Széchenyi István University – was adapted and combined with the development of algorithmic thinking in the framework of interdisciplinary integration. In this research, the basics of artificial intelligence (AI) and, within this, the functioning of chatbots were used.

The present study addresses the research problem of how chatbot technology and the development of algorithmic thinking can be integrated into the Hungarian language course to enhance pre-service teachers' digital competence and linguistic awareness. The aim is to explore the impact of this approach on students' motivation, collaboration, and professional skills.

In the rapidly changing world, both educational methodologies and technological advances are changing at a rapid pace. Different techniques and methods have the property that after a quick uptake, interest in them slowly wanes and settles down to a normal level. This can be illustrated by the so-called

hype cycle (Figure 1). Expectations about technologies, whether they appear in the media or in public discourse, describe a particular curve over time as they go through five “hype phases”, which are as illustrated below.

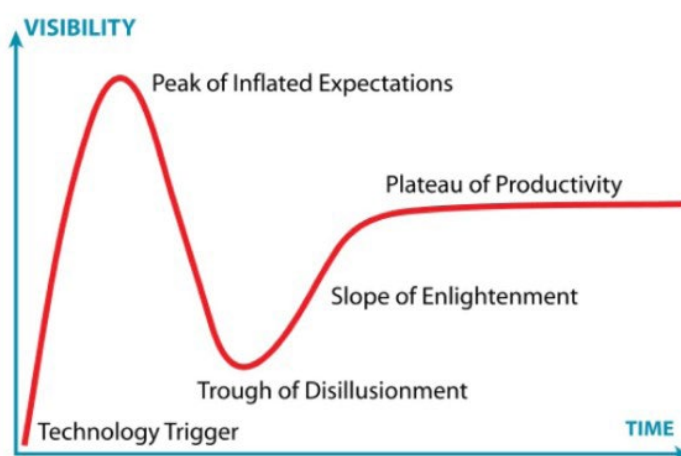


Figure 1. *Hype phases (Dancs 2019)*

When a new technology is introduced, public interest in it tends to increase rapidly, and it becomes a frequent topic of public discourse, even though it is often still intangible and not yet available for practical use. Then, as the number of people familiar with the new tool or programme grows exponentially, the media also gets involved in the success story, with successive news stories about fantastic breakthroughs, but potential problems and questions about the technology are not yet raised. Later, after the initial enthusiasm, the problems of immaturity increase, the product fails to live up to the heightened expectations, innovation develops more slowly as knowledge is accumulated, the scope and ways in which the technology can be used becomes more sophisticated, with the technology becoming more widely adopted as efficiency increases, while critical users remain cautious. At the end, when the product becomes part of everyday life and its benefits become clear, its use becomes slightly more widespread.

The same line of thinking can be applied to the world of AI, including the use of chatbots. Suddenly it became a big sensation, but then it gradually lost people's interest. News of its drawbacks and dangers began to appear. In order to make the most effective use of these technologies, it is necessary to reconsider both the curriculum and teaching methods, as well as how they can be adapted to incorporate emerging tools such as chatbots. At present, chatbots appear to be situated between the Trough of Disillusionment and the Slope of Enlightenment within the hype cycle. This disillusionment is partly due to a justified fear of chatbots, as the almost

unstoppable advance of AI could lead to job losses similar to those of the industrial revolution, as robots take over many positions that were once held by humans. In addition, there are other dangers in education: AI is now capable of producing full assignments, poetry analyses, reading journals, and performing other tasks, so teachers will have to pay even closer attention to the assignments they receive and face a different kind of plagiarism challenge than it had been dealt with so far.

Nevertheless, chatbots in education hold a significant, untapped potential that, if recognized and effectively leveraged, could lead to a new height of enlightenment. For this reason, the integration of modern technology into students' learning processes has already begun. The extent of students' mastery increases with the incorporation of diverse intelligence domains, following Gardner's multiple intelligences framework (Gardner 1993). It also used the SAMR (S – Substitution, A – Augmentation, M – Modification, R – Redefinition) model in experimental teaching, which involves reorganizing in teaching methods to emphasize digital technologies in the learning process rather than frontal teaching. Before describing this research, the used methodological approaches and applications are presented.

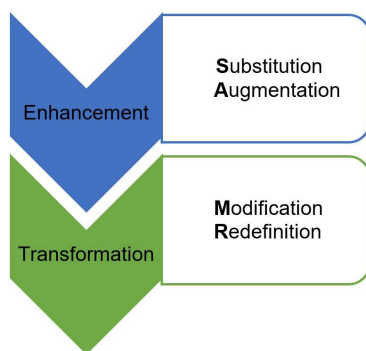
2. Teaching methods and approaches

In the 2022–2023 academic year, the Hungarian Language II course was experimentally redesigned. The initial approach aimed to build upon the theory of multiple intelligences to address as many learning domains as possible. To this end, the SAMR model was incorporated, which entails a comprehensive rethinking of the teaching methodology and its digitalization. This will replace face-to-face teaching with teamwork and collaborative document editing using ICT tools. Finally, to tie it all together, the grammar curriculum is based on the interpretation of the chatbot algorithm.

The study involved 29 second-year pre-service teachers. Data collection included student-produced artefacts (flowcharts, NLP-based tables (NLP – Natural Language Processing)) and classroom observations. Student performance was assessed using criteria such as grammatical accuracy, logical coherence of algorithms, and the quality of digital tool application.

2.1. The SAMR model

A relatively new approach is the SAMR model developed by Ruben R. Puentedura (2013), which uses new technologies and ICT to enhance or even transform the educational process. It is a model in which the impact of technology on learning becomes visible. It allows four distinct steps, as shown in *Figure 2*.



Source: authors' editing; Puentedura (2013)

Figure 2. *The SAMR model in education*

To gain a clearer understanding of this model, one should analyse examples of activities implemented under the SAMR model (Wolf 2017):

S – Substitution

Technology substitutes a traditional process in the practice of education without creating a substantial change. Such an activity could be a projection in the form of a presentation, an online test, or a textbook uploaded as an e-book instead of writing a lesson plan on a blackboard in teacher training.

A – Augmentation

The use of technology offers additional possibilities and functions compared to previous practice, but essentially the traditional methodological environment is the characteristic one. This may occur when, upon completing an online test, the student receives an immediate feedback on their performance from the teacher or his/her peers, for example by using a digital device, so students can check whether their answers were correct or not. This kind of feedback can be an extra motivation for them to get confirmation of their knowledge and shortcomings. Related applications include, but are not limited to, Tankocka, Quizizz, and Kahoot.

M – Modification

This is the first step in technology-assisted pedagogical change, whereby teachers modify learning tasks and activities according to modern possibilities. The use of 21st-century competences is already strongly present in this section. When thinking in terms of project-based tasks, this level involves students working in teams, collaboratively editing an online document, searching for information, and

creating a shared product through joint thinking. Important skill components, online collaboration, and cooperation can also be developed at this level.

R – Redefinition

This section refers to teaching, re-thinking, and redefinition of activities, whereby learners can be given creative tasks and problems to solve that were not previously possible. Students can think about problems on a larger scale. Integrated teaching of several disciplines, such as mathematics and science, can also be achieved. Students can become involved in solving real-world problems that affect their lives, thereby enhancing the relevance and applicability of their learning (Petzné et al. 2022).

2.2. Educational uses of AI and chatbots

When designing an educational process, two key questions should be kept in mind. One is the question “What?” and the other is “How?” The complex development mentioned earlier will influence the answer to the What? Our development has to focus on broad, deep, and multifaceted education, as the aim is not to teach a specific subject but to ensure its relevance, applicability, and to arouse and retain students’ motivation and knowledge transfer.

Modern approaches to language learning and teaching emphasize the complex, dynamic, and context-dependent nature of linguistic competence, which Larsen-Freeman (2015) conceptualizes as an ever-evolving and adaptive system. This perspective aligns closely with the development of algorithmic thinking, as both prioritize flexibility, problem-solving skills, and adaptability. According to Larsen-Freeman, language is not merely a set of rules but a complex system that learners construct through their own experiences and interactions. This constructivist view resonates with the interdisciplinary learning environment presented in this study, where the integration of linguistic elements and digital skills fosters not only knowledge acquisition but also deeper understanding and creative application. Consequently, learners are empowered to communicate more effectively and to engage critically with both linguistic and technological processes, leveraging digital tools and AI to enhance their language development.

Traditionally, relevant curricula should be selectively applied to knowledge, focusing on core content and essential concepts, while ensuring interdisciplinarity in the development of skills. The “how” question can help to master the wealth of content listed. How can AI help to improve or even transform education?

However, the integration of AI and chatbots into education raises several ethical concerns, including issues of data privacy, the authenticity of student work, and the shifting role of the teacher. It is essential to ensure that students are

made aware of the limitations and potential biases of AI and are guided towards the responsible and critical use of these technologies (Selwyn 2019).

Although artificial intelligence is a hot topic in public discourse, it is often misunderstood and known only on a superficial level. AI supports learning through a variety of systems, such as analysing students' writing, designing intelligent game-based environments, the support of chatbots or AI-assisted teaching-learning functions for self-improvement and self-learning. A central area of research on artificial intelligence is the mapping of the digital brain as opposed to robots that can move. Artificial intelligence can be applied in many different ways in many different environments. Some researchers prefer the term "augmented intelligence", which retains the human brain as the primary source of intelligence, while computers and their programs are viewed as sophisticated tools that help enhance or supplement human cognitive abilities. In this approach, computers are used in areas where humans have difficulty, such as finding patterns in the face of massive amounts of data (Holmes et al. 2019).

The term "chatbot" comes from the words chat and robot, meaning a robot that can talk to someone. A chatbot can automatically answer questions, search for information on the Internet without any further human intervention. Different companies use so-called avatars, small pictures or animations to make the chatbot seem less artificial. Nowadays, chatbots use various artificial intelligence (AI) applications to make conversations as smooth as possible. This allows chatbots to store information that chatbots can use to teach themselves. For example, there are already chat systems that are designed to support education, knowledge, control, and experimentation. One such system is TuTalk, which can also be used for performance assessments. In this process, the system annotates knowledge components, distinguishes between different initiatives, and applies semantic tags to answer the solutions. This is necessary because, by linking items with similar meanings, the machine is able to respond to repeated matches and alternatives. This system can also assess students' past performance (Luckin 2007) (qtd. in W. Jordan et al. 2007).

Building on the previous overview of chatbot applications, the following section presents how these tools were adapted for educational purposes. Some possible applications of chatbots are shown in *Figure 3* below:

For customer services, chatbots can help shopping online, are available around the clock, and can even suggest gift ideas or check if a product is in stock. Psychological and mental health support is provided by therapeutic chatbots. Chatbots can help students who may be at risk of developing anxiety (examples include Eliza and Woe-bot). Chatbots have also been developed that are used to monitor community interactions, such as Mitsuku. These robots can already handle mood swings to some extent, and their speech reflects the tone of voice, inflection, and even humour. In addition, chatbots can already be found on

Instagram or Twitter that automatically comment on likes. With this bot, unlike the previous one, there is no interaction. It is very important to be aware of social and ethical norms, and it is always important to know that the “person” someone is chatting to is not a living person. Furthermore, it should be taken into account that although chatbots themselves are not dangerous, the large amount of data stored means there is a risk of criminal activity and data theft (ENARIS n. y.).

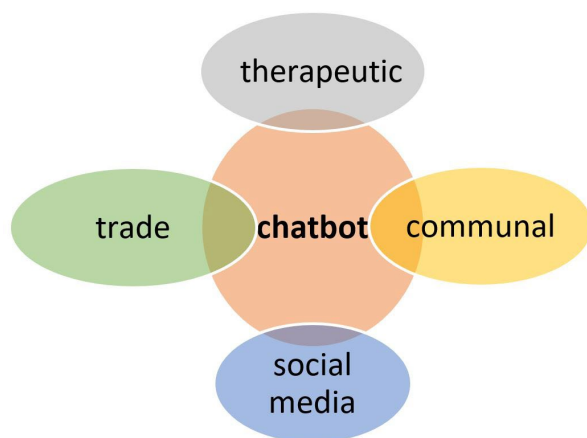


Figure 3. *Some types of chatbots (authors' editing)*

There are two types of chatbots depending on how they work. The first, called a rule-based chatbot, uses a fixed click structure, where the user cannot type text but simply “clicks” through the conversation using buttons, following a prescribed flowchart or algorithm. The other one is based on natural language processing (NLP). To use a chatbot based on natural language processing, verbal input is required via keyboard or voice. The chatbot analyses the received words and converts them into information. This consists of Natural Language Understanding (NLU) and Natural Language Generation (NLG). It allows free text input and is usually based on natural language processing, called a process-based chatbot.

Decision-tree-based chatbots cannot engage in personal interactions, as they follow a pre-programmed process that can be either very simple or complex. Such chatbots use pre-selected widgets to offer different ways of answering. The user has to choose from predefined options. These chatbots are often used by companies because they are cheaper to set up.

A chatbot based on NLP does not know the meaning of words, which are nothing more than a set of letters for it. When it receives a sentence, it starts to analyse it structurally. *Figure 4* below shows this language-processing process.

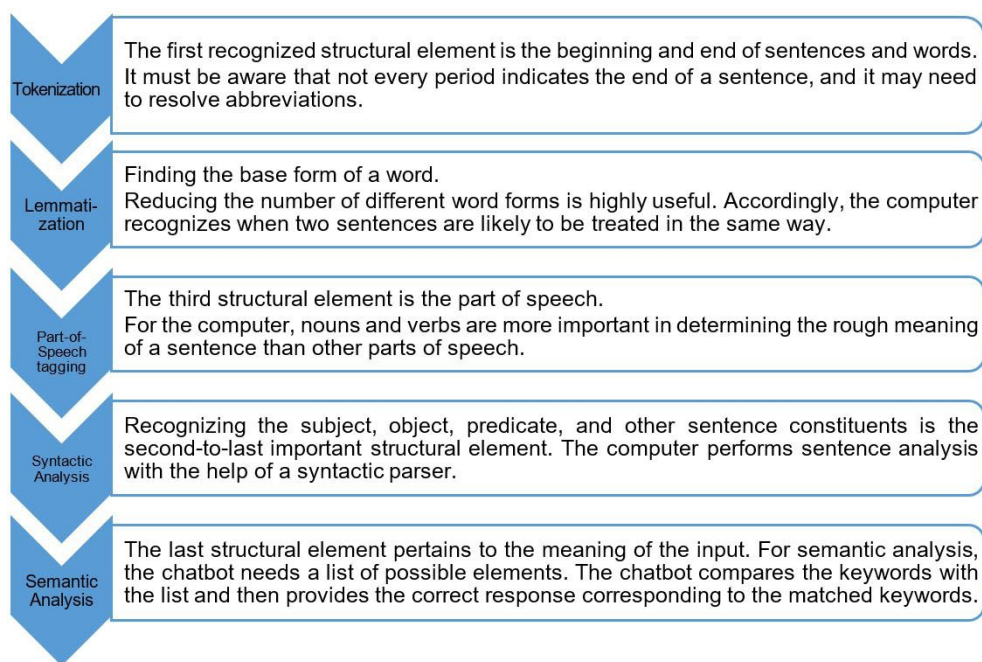


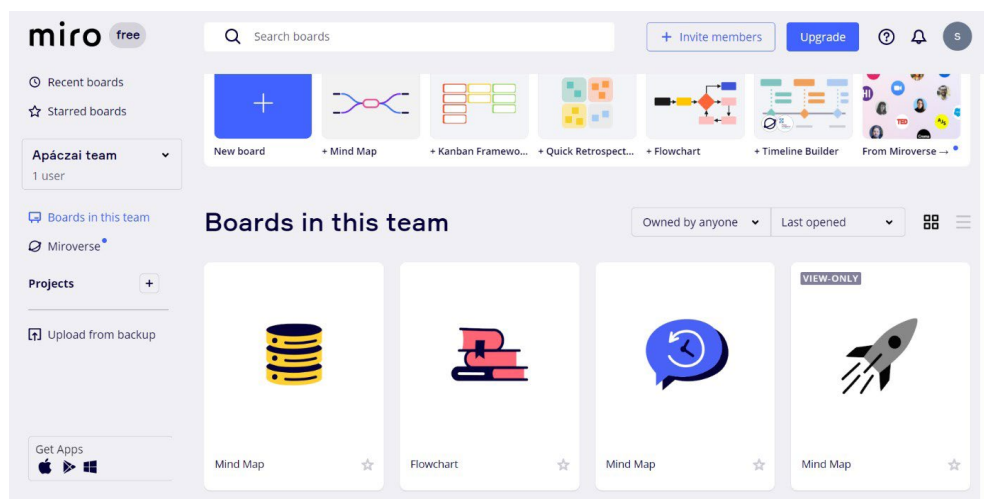
Figure 4. *The Process of NLP (authors' editing)*

As language assistants, Alexa or Google Assistant work the same way. For these, the first step is speech recognition. This converts the microphone input signal into a string of characters. Subsequently, the creation of each structural element (structure) is done in the same way.

2.3. Digital tools used

Not only for the development of digital literacy but also for sustainability reasons, it is important to use less paper in education. Students will be introduced to a number of applications during their studies. We have used the Miro application to create flowcharts (*Figure 5*).

Using Miro, students can collaborate on whiteboards where they can link projects. For example, students can create digital notes to reduce paper use and support collaborative work. Miro can be used to present concepts, ideas, and solutions as a team anywhere. With Miro's online whiteboard, teams can synchronize their work and stream ideas as they work – whether side by side or remotely in online and hybrid work environments.



Source: authors' editing; Miro (2023)

Figure 5. Miro application

3. The research

The 29 full-time students of the second year of teaching were enrolled in a compulsory Hungarian Language II course in the spring semester of the 2022–2023 academic year. The composition of the course was quite complex: it included knowledge of vocabulary, word syntax, sentence structure, and textual knowledge. The first part of the semester was devoted to grammar (word class, morphology), after which students began working with AI and chatbots concurrently with sentence construction exercises. Within the framework of the Hungarian Language II course lectures, students were introduced to the concepts of AI and the operational principles of chatbots. Building on the theoretical framework introduced earlier, the pilot focused on developing grammatical and algorithmic thinking through chatbot-based tasks.

3.1. Description of the pilot course

The Hungarian Language II course was adapted and introduced the methods mentioned above. Now the course covers the whole grammar of the Hungarian language, so students acquire knowledge and analysis of word variety, morphology, sentence structure, and textual structure. The teaching and deepening of semantic elements is introduced by the new and now ubiquitous chatbot.

The course design process was the following:

- (1) First, students were introduced to the basics of grammar (word types, the concepts of syllables and subjunctions, the breakdown of words into word elements). In this context, they looked into the grammatical elements that chatbots observe.
- (2) Then the definition and interpretation of AI was discussed.
- (3) After introducing the possible applications of chatbots, it was discussed how chatbots were structured and the algorithm on which they were based.
- (4) Then the students became chatbots. One student played the role of the user and the other one the role of the chatbot. The student playing the role of the live user wanted to book an appointment in a school or at the university's study department for some fictitious case. Students also had to create a flowchart-based and NLP-based chatbot and then act it out. These were solved by joint document editing. The flowchart-based task was solved using the Miro program presented earlier, while the NLP-based task was solved by the students using a spreadsheet.

The effectiveness of the pilot course was monitored through continuous classroom observation and analysis of students' digital artefacts. The evaluation focused on collaboration, creativity, and the accuracy of algorithmic and linguistic representations. These observations later informed the informal assessment process described in sections 3.3–5.

3.2. Results of the pilot course

After the theoretical introduction and the context in which the research was carried out, the results of the research are shown in this subchapter. Following the SAMR model framework introduced earlier, the course initially applied the substitution phase through traditional presentations.

3.2.1. Introduction to the grammatical foundations

All natural languages are built up of levels. The lowest level is made up of phonemes, i.e. sounds. These form the word elements, or morphemes (Dőryné 2018). The word elements can be divided into 2 large groups: syllables and subordinators (this will be important in our later analysis). Words, or lexemes, are made up of word elements. Words form word structures, or syntactic structures, which are the constituents of sentences. Sentences make up the text, which is the highest of the language levels. Linguistic levelling is therefore as follows:

- Level 1: sounds (phonemes),
- Level 2: word elements (morphemes),
- Level 3: words (lexemes),
- Level 4: word structures (syntagms),

Level 5: sentence,

Level 6: text.

From language level 2 onwards, all linguistic elements carry meaning, except phonemes, which do not have semantic content themselves but serve solely to differentiate meaning between words. It can also be said that each linguistic element acquires its final meaning at the level one level above it, i.e. the word elements in the words, the word structures in the sentence, the sentences in the text.

The phonemes at language level 1 have already been studied with the students in a previous semester, so this semester only morphemes, lexemes, syntax, sentences (both simple and compound), and text have been analysed.

3.2.2. Discussing the features of artificial intelligence

As it is difficult to find a single definition of AI, the second-year students in the teaching programme were asked to formulate their own definition of AI in groups and to describe what comes to mind when they hear the term. They worked in three groups and came up with the following answers and results:

- (1) The first group associated the words ‘robot’, ‘emotionless’, and ‘objective’. Their definition was: “It performs an activity controlled by a program. It is not safe because it can be hacked, but it makes our lives easier.”
- (2) The second group associated with the following terms: unemotional, ubiquitous, a small mistake can lead to big chaos. And their definition was, “Man-made, technically programmed knowledge, command.”
- (3) The third group, when hearing the term artificial intelligence, thought of the following terms: future, commands, disappearance of privacy, data storage, widespread information, replacement of people, loss of jobs. They were defined as “computer-based, unfeeling robots that take control and produce more quantitative but lower-quality products.”

After reviewing and discussing their own ideas, we provided the additional information necessary to advance: artificial intelligence refers to a computer system’s combination of software and hardware capable of performing tasks that humans recognize as intelligent behaviour. Examples include retrieving relevant data from large datasets, recognizing patterns, and identifying people or objects with similar characteristics. Facial recognition operates on a similar principle and can also support additional functions such as monitoring, signalling alerts, and notifying relevant systems. Additionally, computers can perform handwriting recognition by receiving and interpreting intelligible handwritten input from sources such as paper documents, photographs, touchscreens, and other devices. There are two types of character recognition. In the first one, the image of written text is detected “offline” from a sheet of paper by optical scanning. In the second case, the movement of the pen tip is detected “online”, for example, on the

screen of a pen-based computer. The third case is speech recognition, where the machine converts spoken words into text. An example of this is a call centre system capable of recognizing any voice.

The advantages of artificial intelligence are often cited, as it does not need sleep and can weigh up problems without emotion. A major drawback and danger are that if robots start to replace human resources in all areas, we will have to face serious problems such as unemployment. Intelligent machines may not be the right choice for customers' service. Many people fear that intelligent machines will overpower humans.

3.2.3. How chatbots work

Based on the SAMR model, the course was in the augmentation phase when students were asked where they perceived they might encounter a chatbot. They could enter their opinions in the word cloud of the Mentimeter application. As you can see in *Figure 6* below, although it appears in several places because of the different word forms, customer service comes up the most often, followed by websites and applications. We believe that students are aware of the areas where AI-based chatbots are already being used.



Figure 6. Students' knowledge of chatbots (authors' editing)

3.2.4. Preparing a flowchart

As described earlier, students applied the same process when designing their own chatbot flowcharts, focusing on simple appointment booking scenarios relevant to school settings. To find a solution, students had to think of the purpose of the chatbot at the beginning. For this purpose, they created their own table to collect keywords related to the topic. One student acted as the user, the other student as the chatbot. For example, the student playing the role of the live user wanted to book an appointment with a teacher at school and wrote down his request on a piece of paper. The human chatbot then scanned the sentence and selected the important keywords from its table. It could respond using the keywords in the table. If the human chatbot did not find any keywords in the table, a suitable answer had to be selected.

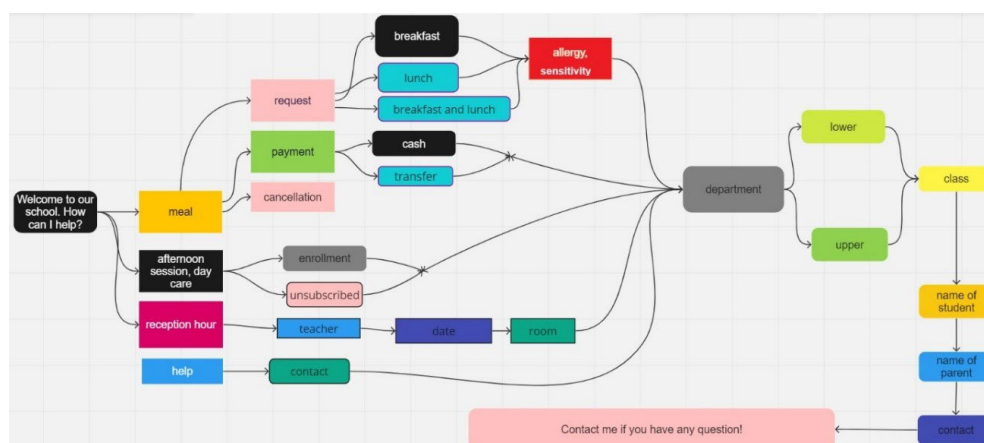


Figure 7. Students' solution 1 (authors' editing)

Creating a flowchart

- (1) Start drawing the flowchart.
- (2) Make sure that each step of the decision-making process makes sense and that the user does not get into an (infinite) loop that one cannot get out of.
- (3) Avoid dead ends in the flowchart. The user should eventually reach a termination point.
- (4) Make the flowchart as simple as possible, but at the same time give the user enough meaningful choices.
- (5) Do not forget to include a closing sentence so that the user does not end up in a dead end. At the same time, the conclusion should be open enough to let the user know that more questions can be asked at any time (ENARIS n. y.).

(6) Students were divided into eight groups, but only two of the works of the teams were presented as examples. One is almost perfect, and the other is a bad solution. The two figures below illustrate how difficult it was for the students to create the flowchart and meet the many conditions. *Figure 7* shows a relatively good process. They do not end up in an endless cycle, and the process did not end without being able to complete the given tasks. Perhaps there was one small part that can be considered a mistake: the data capture (contact) was shown twice in the figure, and after the first mentioning (contact in the help menu) the figure continued and was switched back to the data capture.

Figure 8 immediately shows how differently this team worked. Unfortunately, logical problems were found here. The idea of “to look forward to seeing you at the agreed time” was attached to the “unfortunately already full” date and the algorithm was already over for “booked for you”. In addition, the group definitely wanted to close the “program”; even after the prompt, they were still waiting for the fictitious subject at the agreed time. And on the other branch, it can be seen that after selecting the person for the meeting, a parallel appointment was booked, but nobody knew who the person to talk to was and for what reason. Furthermore, on this branch, unfortunately, the person and the object of the meeting itself were not connected.

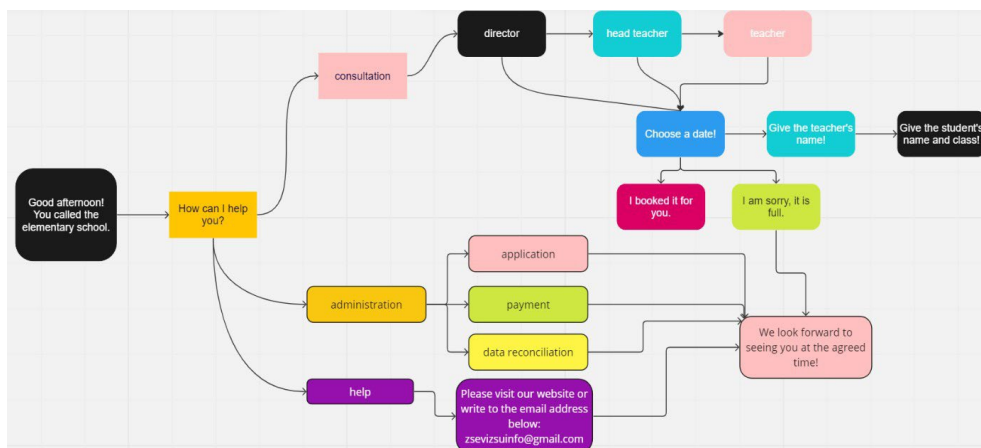


Figure 8. Students' solution 2 (authors' editing)

3.2.5. The NLP-based model

The second task was to develop an NLP model. In this task, learners collected in a table the expressions that the chatbot needed to recognize and also how and what response to the input the chatbot would give in order for the conversation to flow smoothly. It can be seen that there are many gaps. For example, when

choosing a date, instead of saying “enter the date”, the expression “choose from the following dates” is used. But no appointment was offered. Furthermore, after reading it all the way through for booking an appointment or making an appointment on that basis, we encounter further difficulties. When choosing an input from the days, it could be found that the robot immediately said in which room the appointment would be held even though it was not said what the topic was. From these bad examples, it is clear that it is easier to create a flowchart-based chatbot algorithm, since there is a process to follow. The working principle of an NLP-based chatbot is much more difficult, as it is not always the same what kind of input is being recognized and what response is taught to it (*Table 1*).

Table 1. *Students’ solution to the NLP model (authors’ editing)*

Input (from the user)	Output (from the chatbot)
Good morning! Have a nice day! Good afternoon!	Hello, how can I help you?
Reception hour	Please choose which teacher you would like to see!
... Teacher	Please choose one of the following appointments!
Monday Tuesday Wednesday Thursday Friday	... will be held in ... classroom. Please choose your child’s level of education!
afternoon session, day care, day care drop-out, enrolment, meals, cancellation, cash, transfer, allergy sensitivity, special education	Please select your child’s level of education!
Catering, payment	Please choose between: transfer or cash payment!
Catering, request	Which catering do you wish to use?
Snack, lunch, lunch and snack	Please indicate your child’s sensitivity, allergies
Afternoon activities, enrolment	Please indicate which activities you would like to enrol your child in!
class	Please indicate your child’s class
1, 2, 3, 4, 5, 6, 7, 8.	Please state your child’s name and then “ready”
....., ready	Please enter your own name and say “I am”!
..... I am	Please enter your contact details!
0 1 2 3 4 5 6 7 8 9 thank you	I am glad I could help!
Good bye!, questions, enquiries	If you have any questions you can contact me anytime
No keywords found.	I am sorry, I do not understand. Please rephrase!

The findings indicate that while students quickly mastered the basics of flowchart design, they encountered considerable difficulties in constructing NLP-based models. This suggests that chatbot-related tasks effectively illustrate the structural complexity of language yet highlight the need for further pedagogical scaffolding to support deeper linguistic and algorithmic understanding.

3.3. Evaluation of the pilot course

To evaluate the outcomes of the pilot course, an informal, observation-based assessment was conducted throughout the semester. The instructors continuously monitored students’ progress during group activities, flowchart design, and chatbot development tasks. Evaluation focused primarily on qualitative indicators such as collaboration, creativity, problem solving, and the ability to apply linguistic and algorithmic concepts in practice. Students’ completed artefacts (flowcharts, NLP tables, chatbot dialogues) were analysed for logical coherence, grammatical accuracy, and consistency between linguistic structures and algorithmic steps. In addition, reflective classroom discussions served as a form of self-assessment, allowing participants to articulate what they had learned and how they perceived the relevance of the task. Although no formal rubric or standardized measurement tool was applied, this multi-perspective evaluation process provided reliable insights into students’ digital competence development and the pedagogical effectiveness of the intervention.

3.4. Comparative summary of students’ results

To illustrate the outcomes of the pilot course more clearly, the following table compares the performance of two student groups: one that successfully designed a coherent chatbot algorithm (Group 1 – Good solution) and another that encountered structural and linguistic difficulties (Group 2 – Weak solution). *Table 2* highlights key evaluation criteria and qualitative differences observed during the intervention.

Table 2. *Comparative summary (authors’ editing)*

Evaluation criteria	Group 1 (Good solution)	Group 2 (Weak solution)	Comment / Outcome
Logical structure	✓ Coherent, no loops or dead ends	✗ Several logical errors and loops	Clear difference in reasoning and logical planning
Grammatical accuracy	✓ Correct syntax and consistent phrasing	⚠ Inconsistent phrasing and structure	Need for greater linguistic awareness

Evaluation criteria	Group 1 (Good solution)	Group 2 (Weak solution)	Comment / Outcome
Algorithm design	✓ Follows flowchart logic accurately	✗ Missing steps, unclear flow	Indicates varying levels of algorithmic thinking
Team collaboration	✓ Active and well-coordinated teamwork	△ Uneven participation and limited discussion	Teamwork strongly influenced final quality
Final chatbot output	✓ Functional and clear dialogue flow	✗ Confusing dialogue, unclear logic	Results reflect contrast in chatbot usability
Overall summary	High coherence and integration of linguistic and algorithmic understanding	Highlighted typical beginner challenges and need for further scaffolding	Demonstrates effectiveness of task for differentiation and reflection

This comparative summary clearly demonstrates that students were able to connect linguistic knowledge with algorithmic reasoning to different degrees. The contrast between the two groups highlights the pedagogical potential of the pilot course and offers directions for refining the integration of ICT tools and language teaching in future implementations.

The main insights from classroom observation and reflective discussion are summarized in the following SWOT (S – Strength, W – Weaknesses, O – Opportunities, T – Threats) analysis.

3.5. Analysis of the results

To synthesise the insights gained from classroom observation and reflective discussions, a SWOT analysis was conducted (*Table 3*). This analysis summarizes the internal and external factors that influenced the effectiveness of the pilot course. It integrates the teachers' field notes, students' reflections, and overall classroom experiences to evaluate both the pedagogical value and the challenges of integrating chatbot-based tasks into language teaching.

This SWOT analysis highlights that the pilot course effectively supported the development of students' linguistic awareness, collaboration, and digital competence. However, it also revealed areas requiring further scaffolding and methodological refinement, particularly in relation to balancing technological innovation with linguistic depth. Future implementations should focus on extending the reflective dimension of the course and ensuring equal access to digital resources.

Table 3. *SWOT analysis (authors' editing)*

Strengths	Weaknesses
- High student motivation and engagement during interactive chatbot design tasks. - Visible improvement in teamwork and problem-solving abilities. - Effective integration of linguistic and algorithmic reasoning. - Increased awareness of linguistic structures through AI-based modelling.	- Uneven levels of digital competence among students. - Time constraints limited deeper discussion and refinement of chatbot solutions. - Some students found the NLP-based task overly abstract and technically demanding. - Occasional overlap between linguistic and technological explanations caused confusion.
Opportunities	Threats
- Potential for long-term curricular integration in teacher education. - Expanding interdisciplinary cooperation between linguistics and informatics. - Possibility to introduce AI literacy as a transversal competence. - Development of reflective teaching methodologies based on digital tasks.	- Rapidly changing technological landscape may render tools obsolete. - Risk of overreliance on AI solutions without sufficient linguistic grounding. - Limited institutional support or technical infrastructure. - Ethical concerns regarding data use and AI-based content generation.

4. Summary

In this experimental research, it was shown what kind of new methods were introduced in the Hungarian language course to improve students' motivation, cooperation, and digital competence on the basis of using the SAMR model and on the basics of building chatbots to familiarize students with grammar rules. By developing students' own flowchart- and NLP-based chatbots, they understood how complex a language could be, while also developing a program that could respond to this complexity. Human language is certainly a challenge for the artificial intelligence. No one has yet succeeded in building a machine that can simulate a human interlocutor in a completely authentic way, but there are already very good, almost perfect programs – though language editing often does not work perfectly even between humans. Other models that can be embedded in the university courses include Schulz von Thun's four-sided model, which is a good example of how complex language can be for humans and how the ideas of the sender and the receiver often differ significantly. Through the experiment and the implementation of new methods to adapt the Hungarian Language II course, the authors believe they have achieved their goal, as the students not only mastered the course content but also enriched their approaches and methodological

knowledge while developing their digital competence and collaborative skills through these new methods.

References

- Dancs, Gábor. 2019. <https://neteducatio.hu/hype-cycle-a-szenzacio-ciklus/> (Last accessed: 30 April 2025).
- Dőryné Zábrádi, Orsolya. 2018. Egy- és többértelműség a magyar helyesírásban [Clarity and ambiguity in Hungarian spelling]. In Tamás Gecső–Mihály Szabó (eds), *Egy- és többértelműség a nyelvben* [Clarity and Ambiguity in Language], 68–72. Budapest: Tinta Könyvkiadó.
- Enaris. (n. y.) *ENARIS – Education and Awareness for Intelligent Systems*. Available at: <https://www.enaris.org/> (Last accessed: 30 April 2025).
- Gardner, Howard. 1993. *Multiple Intelligences: The Theory in Practice*. New York: Basic Books.
- Holmes, Wayne–Maya Bialik–Charles Fadel. 2019. *Artificial Intelligence in Education. Promises and Implications for Teaching and Learning*. Boston: The Center for Curriculum Redesign.
- Jordan, Pamela W.–Brian Hall–Ringenberg, Michael–Yui Cue–Carolyn Rosé. 2007. Tools for authoring a dialogue agent that participates in learning studies. Rosemary Luckin–Kenneth Koedinger–Jim Greer (eds), *Proceedings of the 2007 Conference on Artificial Intelligence in Education: Building Technology Rich Learning Contexts that Work*, 43–50. Amsterdam: IOS Press.
- Larsen-Freeman, Diane. 2015. Complexity theory and language development: A methodological framework. *International Journal of Applied Linguistics* 25(2): 1–21.
- Mabbott, Andrew–Susan Bull. 2007. Comparing student-constructed open learner model presentations to the domain. In Rosemary Luckin–Kenneth Koedinger–Jim Greer (eds), *Proceedings of the 2007 Conference on Artificial Intelligence in Education: Building Technology Rich Learning Contexts that Work*, 281–288. Amsterdam: IOS Press.
- Miro. (2023). *Miro*. Available at: <https://miro.com> (Last accessed: 30 April 2025).
- Petzné Tóth, Szilvia–Bernadett Pápai–József Reider. 2022. Problémamegoldó gondolkodás fejlesztés a tanítóképzésben a SAMR-modell segítségével [Problem-solving thinking development in teacher education using the SAMR model]. In Emese K. Nagy–Ida Zagyváné Szűcs (eds), *Reflexiók a neveléstudomány legújabb problémáira* [Reflections on Recent Problems in Educational Science], 73–85. Eger: Eszterházy Károly Katolikus Egyetem Líceum Kiadó.

- PuenteDura, R. Ruben. 2013. *SAMR: Getting to Transformation*. Available at: <http://www.hippasus.com/rrpweblog/archives/2013/04/16/SAMRGettingToTransformation.pdf> (Last accessed: 30 April 2025).
- Selwyn, Neil. 2019. *Should Robots Replace Teachers? AI and the Future of Education*. Cambridge: Polity Press.
- Wolfné Borsi, Julianna. 2017. A DPMK szerepe a digitális átmenet támogatásában [The Role of DPMK in Supporting the Digital Transition]. <https://www.slideshare.net/dpmk/wolfn-dr-borsi-julianna-a-dpmk-szerepe-a-digitlis-tmenet-tmogatsban> (Last accessed: 30 April 2025).