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## DIPLOMA THESIS

### Promoting Differentiation in the English Classroom with the Help of Generative AI

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Study Program: Specialisation in Education

Branch of Study: English Language Oriented at Education – Information Technologies  
Oriented at Education

2024

I hereby declare that this diploma thesis, “Promoting Differentiation in the English Classroom with the Help of Generative AI” is an original work, written by the author of this thesis under the supervision of Mgr. Martin Mikuláš, Ph.D., using the works cited on the “Sources” page. I also declare that this thesis was not used to attain any other university degrees.

Prague, 8 July 2024

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Signature

I would like to thank Mgr. Martin Mikuláš, Ph.D. for his patience during the initial discussions regarding the topic of this diploma thesis, the help with the content and formal structure of this work, and for the invaluable feedback he has provided during our consultations.

## **Abstract**

This diploma thesis deals with the topic of artificial intelligence within the field of education in relation to differentiation. In the theoretical part, current approach to differentiation is described, and is complemented by the justification of the use of digital technologies within a classroom, including artificial intelligence. The practical part then suggests an alternative approach to the creation of differentiated tasks by utilising generative AI. Finally, the analytical part explores whether these AI generated differentiated tasks could potentially have any positive effect on the learning process. The research is done via a survey conducted amongst students of English language at both lower- and upper-secondary schools. The tasks and the process of their creation will also be introduced to English teachers and evaluated via interviews. Based on the results of the survey and feedback from the teachers, the thesis will assess the appropriateness of the use of AI for the stated purposes.

## **Keywords**

Differentiation, Artificial Intelligence, Multiple Intelligences, Digital Technologies, GPT

## **Abstrakt**

Tato diplomová práce se zabývá tématem umělé inteligence ve školním prostředí s důrazem na diferenciaci. V teoretické části je popsán současný přístup k diferenciaci, a také je zde uvedeno zdůvodnění výběru a důležitosti digitálních technologií ve výuce s přesahem do umělé inteligence. V praktické části je následně navržen alternativní přístup k vytváření diferencovaných úloh s využitím umělé inteligence. Tyto úlohy jsou dále testovány v analytické části, která zkoumá, zda by tyto úlohy mohly potenciálně mít pozitivní vliv na proces výuky. Tento průzkum je realizován mezi žáky anglického jazyka pomocí dotazníkového šetření, které proběhlo na základních a středních školách. Jak úlohy, tak i proces jejich tvorby budou představeny také učitelům, kteří je zhodnotí v závěrečných rozhovorech. Na základě výsledků šetření a zpětné vazby od učitelů bude poté vyhodnoceno, zda-li je AI použitelné jako nástroj pro zlepšení diferenciaci ve školním prostředí.

## **Klíčová slova**

Diferenciace, Umělá Inteligence, Teorie Vícenásobné Inteligence, Digitální technologie, GPT

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## 1 Introduction

Teachers should be able to properly address student differences and plan language lessons with respect to their individual needs. This was identified as one of the main competences of a language teacher in a document produced by the European Centre for Modern Languages (Bleichenbacher et al. 19). Accomplishing this is a difficult task for an experienced teacher, but even a greater challenge for someone who has just started a career in education. With all the duties which need to be done every week, there seems to be almost no time during which it would be possible to further adjust English tasks in order to make them reflect the individuality of each student.

Despite the complexity of this concept of differentiation, its implementation in the classroom can definitely have a positive impact on the learning process. Various researchers who have studied this phenomenon have mainly reported higher student engagement during lessons, increased motivation, but also improvements in terms of academic performance.<sup>1</sup> While the author of this text recognises these benefits, the cost which is currently associated with the adoption of differentiation in the English classes is still excessively demotivating. For that reason, there is presumably a need for a more efficient approach and this thesis believes that the solution is to make use of modern digital technologies, namely generative artificial intelligence (ref. AI).

As the main characteristic of this technology is its ability to generate any desired text, the author had an idea that it could be used for the creation of differentiated tasks and greatly reduce the time needed for the preparation of differentiated lessons. Nevertheless, while the generated content is generally very impressive, the technology is known for having occasional issues with accuracy regarding language and topic relevance. Therefore, knowing both the opportunities

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<sup>1</sup> Described further in the theoretical part

and challenges, the goal of this thesis is to verify whether this suggested approach could become a viable option and whether it could actually solve the aforementioned issue of differentiation.

The work starts with a theoretical part covering all the topics related to the proposed approach. In the section about differentiation, the thesis discusses its theoretical background and offers arguments supporting its use. The next section covers the topic of digital technologies and describes how they are becoming increasingly important for both teaching and learning. The last section then focuses on generative AI, addresses the controversy surrounding the topic and examines its potential impact on the field of education.

In the empirical part, the thesis explores the appropriateness of the suggested approach. The author tests if the current generative AI models are able to create differentiated tasks. As there are multitudinous frameworks for differentiation, the thesis selected Howard Gardner's theory of Multiple Intelligences as the one which is primarily used for further testing and research. Following this section, the generated tasks are given to students of lower- and upper-secondary schools for evaluation to see how the tasks perform compared to standard textbook exercises. In the end, the work evaluates the AI approach from the perspective of English teachers via interviews, while showing them that it could help them differentiate more effectively.

## 2 Theoretical Part

### 2.1 Differentiation in Education

Generally, there are two types of differentiation: external, where differentiation occurs outside the classroom and involves the distribution of students into different types of schools, such as grammar schools or vocational school, or classes based mostly on their abilities, and internal, where the differentiation happens within the classroom (Navrátilová 159-160). An example of the latter approach would be that for major subjects the class is divided into two or more groups, again, based on their skill level and these groups are then taught separately, usually for a smaller part of the day (Navrátilová 159-160). Yet, none of these terms properly address the possibility to adjust the learning process to different students within a heterogeneous class without any additional administrative mechanisms. This described approach is usually referred to as Differentiated Instructions (ref. DI)<sup>2</sup> (Navrátilová 160) and it serves as the basis for this thesis.

The first theoretical section aims to justify why teachers should differentiate their lessons and why DI is presumably the best approach. It gives an overview of several theoretical frameworks and with their help suggests areas where the concept of differentiation can be applied. At the same time, it discusses potential issues and obstacles standing in the way of successful implementation of differentiation in mixed-ability classes.

#### 2.1.1 Rationale for Differentiated Instructions

The need for differentiation stems from the fact that there will always be significant differences between individual students, be it their socio-economic background, culture, race, interests, skills, language, specific learning style or type of motivation (Votavová et al. 7). Students in the same classroom will then most likely also have diverse needs and preferences (Tomlinson 3-4). This presupposes that teachers and educational institutions must somehow

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<sup>2</sup> The Czech equivalent for this term is *Diferencovaná Výuka*.

respond to this reality and try to offer an appropriate challenge to everyone in the educational process (Tomlinson 5).

External differentiation somewhat seems to resolve this issue. High-achieving students are often placed into advanced classes, or leave early for schools which tailor curricula specifically to reflect their superior abilities and consequently, the average and low-achieving students are left and bundled together (Navrátilová 162). This may seem appropriate, as the classes are more homogeneous with regard to the level of readiness and teachers are not forced to respond to such a large variety of learner needs. Nevertheless, research suggests that there are significant downsides to this approach. One of the main ones is the further extension of the gap between the better performing students and the weaker ones (Schleicher 20, Navrátilová 162). While the high-achievers are indeed performing better in the new environment, but not significantly according to Navrátilová (161-162), low-achievers' performance often suffers more in homogeneous classes, in the absence of their more skilled peers (Schleicher 20).

Having said that, according to the PISA research, external differentiation is still common in many countries (OECD 88). The Czech Republic falls into this category as well, presumably due to students' possibility to leave early for grammar schools after five or seven years of compulsory education (Navrátilová 161). However, PISA results generally indicate that countries with higher performing students are rather moving away from this type of differentiation towards more inclusive and diverse classrooms (OECD 38-39). Schleicher, the Director for the Directorate of Education and Skills for OECD, further comments that future of education does not lie in early stratification, but in embracing student diversity and enhancing the learning process by "personalising educational experiences" (56).

One of the ways of implementing this approach is by using DI, which works with the premise that the teacher can properly differentiate within heterogeneous classes and can utilise different

strengths, interests and speed of individual students (Tomlinson 5, Navrátilová 160). Tomlinson strongly advocates for DI with the support of publications from authors such as Piaget, Vygotsky, Gardner or Sternberg (8-9), stressing that without it, there are potential downfalls for both advanced and struggling learners (11-12).

For example, Vygotsky argued that learners can progress faster and achieve higher goals if they solve tasks which are slightly above their current skill level and receive adequate support from a more knowledgeable person, e.g. the teacher (Was and Golding 672). This creates a necessity for the teacher to identify which tasks or topics the student has already mastered and can complete even without additional help, and those which cannot be completed even if support is provided. The space between these two identified states is then defined as the Zone of Proximal Development and should contain optimal tasks for accelerated collaborative learning (674). Since Vygotsky's theory suggests that this zone varies from student to student, it becomes apparent that differentiation is necessary and that only a series of tasks of differing difficulty will ensure that each learner can be appropriately challenged (Morgan 35).

Furthermore, there are studies which show that DI can lead to the enhancement of the learning process. Valiandes' and Little et al.'s research showed positive effect on overall student achievement (22, 398), Chamberlin and Powers' paper supports the use of DI in mathematics (130), Karadag and Yasar managed to improve students' attitudes towards Turkish language courses (1397), and Azimah and Sujannah reported positive improvement of students' reading skills in an EFL classroom (941).

Apart from that, internal differentiation is included in the document created by the European Centre for Modern Languages of the Council of Europe (ECML) which was mentioned at the beginning of the thesis (Bleichenbacher 19). There it appears in a proposed framework of

necessary language teacher competences which should help learners effectively develop their language skills.

Despite the extent of external differentiation in the Czech Republic, major educational institutions also consider proper differentiation within the classroom important. Firstly, in the document *Strategie Vzdělávací Politiky České Republiky do Roku 2030+*, The Ministry of Education, Youth and Sports (MŠMT in Czech) declares that they will strive to make adjustments to current curricula to support differentiated teaching based on student needs (19) and interests (46), which should subsequently lead to more “effective fulfilment of educational objectives” (90). Secondly, the National Pedagogical Institute of the Czech Republic included DI and tiered tasks in their *Desatero úspěšné práce s heterogenní třídou*.

Lastly, published under the National Institute for Education (NÚV in Czech), *Rámec profesních kvalit učitele cizího jazyka*, which serves as a complex overview of all desirable traits of a competent teacher of foreign languages in the environment of Czech schools, highlights differentiation in two chapters. The first mention is in chapter 1 concerning lesson planning and the second in the part dealing with classroom interaction. The former describes that teachers should prepare and offer a variety of adequately challenging activities and instructions so that they cater to a range of students with individual differences (Klečková et al. 13). The latter then focuses on the in-class application and lists recommendations for differentiation such as offering tasks of varying difficulty, focusing on the enhancement of individual learning strategies or giving students the ability to choose a preferred way of approaching a particular task or topic (Klečková et al. 19).

#### *2.1.1.1 Differentiation and Student Motivation*

Following the previous chapter, there is yet another rationale for using DI in a classroom environment and that is their ability to have a positive impact on student motivation. This is

suggested e.g. in the works of Tomlinson and Imbeau, Harmini and Effendi or Mok. Tomlinson and Imbeau describe that motivation tends to be higher when tasks reflect students' interests ("Differentiated Classroom" 21), Harmini and Effendi found a significant effect of DI on students' motivation to learn mathematics (145) and Mok's study suggests similar results, this time within a programming course (216).

With the help of the concept of task motivation, which appears to be closely related to DI, it is possible to explain further why the form, and also content, of assignments is very likely to influence the level of student motivation.

In their overview of task motivation, Kormos and Wilby describe that students evaluate assigned tasks based on several variables: the perceived value of the task, the cost of its completion, its ability to reflect their interests and students' own belief in their ability to complete the task (268). Consequently, the combination of these variables, alongside clarity and comprehensibility of the task instructions (Poupore 85), determines the overall motivation the task can produce (Kormos and Wilby 268). This indirectly implies that tasks which follow the one-size-fits-all approach might not be appropriate, as the same task will probably be evaluated differently by different students and will then most likely also have varied motivational effects within the classroom (267, 273).

This brings us back to the method of differentiation, which, in this context, should ideally lead to the creation of tasks which would be optimised for each student based on the aforementioned motivational parameters, and this maximisation of the motivational potential of each task should in turn positively affect other aspects of the learning process (273). In their article, Kormos and Wilby cited numerous studies which support this claim from the perspective of second language acquisition (276-279).

For example, Renniger and Hidi argue that optimisation of content to be more interesting and motivating to the learners results in higher engagement during the task, better understanding of the topic and increased quality of learning outcomes (283). Dörnyei and Kormos found a positive correlation between the motivational aspect of the task and the length of the final linguistic output (290-292). Skehan reports that the selection of a familiar topic for the student might increase the fluency of oral performance (73), and Maad discussed tasks in terms of the optimisation of their cognitive demands and reported that an appropriate cognitive challenge for everyone also leads to higher motivation and engagement (11). In his study, mastery oriented students demanded more difficult tasks otherwise the levels of motivation and engagement decreased, while performance oriented students felt more motivated while solving easier assignments.

Apart from the research focused on task motivation in the context of second language acquisition, there are also more general studies discussing the positive effects of motivation on student performance, namely Stránská and Blažková (7), Tokan and Imakulata (1) or Hattie (47-48).

To specify, all of the task modifications, and DI in general, promote so-called intrinsic motivation. Intrinsic motivation arises when learners engage in an activity because they derive satisfaction just from completing it due to its challenging or interesting nature, and not because they are externally pressured (Ryan and Deci 56). This potential state stems mainly from the fact that people are inherently curious, seek opportunities to acquire new knowledge and skills, and have a psychological need for feeling competent, but as the concept of DI correctly assumes, a single task will most likely fail to respond to the individual needs of each student in the classroom (Ryan and Deci 56).



### 2.1.2 Types of Differentiation within a Heterogeneous Classroom

As was mentioned earlier, students within the classroom will differ in many aspects and teachers should be ready to respond appropriately to their needs. According to Tomlinson and Imbeau, there are at least three areas which would differentiate one student, or group of students, from another and which should be adequately addressed (“Differentiated Classroom” 20). These areas are student’s learning profile, readiness and interests (Tomlinson and Imbeau, “Differentiated Classroom” 20-21).

#### 2.1.2.1 Learning Profile

Learning profile refers to the preferred way of learning and there are many frameworks which deal with this phenomenon (Tomlinson and Imbeau, “Differentiated Classroom” 21). Howard Gardner formulated a theory of Multiple Intelligences (ref. MI) where he proposed that there are eight distinct intelligences, such as verbal-linguistic, spatial, etc., in contrast to one general intelligence measurable in terms of IQ points which was firstly described by Andre Binet at the beginning of the 19<sup>th</sup> century (Gardner “Intelligence Reframed” 183). Alternatively, Robert Sternberg makes a distinction between memory-analytic, practical-contextual and creative-synthetic intelligences (Sternberg and Clinkenbeard 256). What could also be included in this category is the idea of learning styles represented e.g. by the VARK framework introduced by Fleming and Mills and based on the modal preference of the learner (140-141), or students’ inclination towards convergent or divergent thinking described by J.P. Guilford in his work *The Structure of Intellect* (274).

##### 2.1.2.1.1 Gardner’s Theory of Multiple Intelligences

Gardner’s framework will be used in the empirical part and thus deserves a slightly more detailed introduction. The idea of MI reflected Gardner’s dissatisfaction with the contemporary definition of a single intelligence and the fact that one IQ test built around a specific set of tasks could influence and alter the academic, and potentially professional, future of an individual,

who may score low but can otherwise be very apt in another specific domain. This prompted him to design a new framework which would serve as a basis for a more appropriate way of assessing human intelligence (Gardner “Frames of Mind” 4-5).

This framework originally established seven intelligences: linguistic, musical, logical-mathematical, spatial, bodily-kinaesthetic, intrapersonal and interpersonal. Later, a naturalistic intelligence was added and several more were listed as potential candidates (Gardner “Intelligence Reframed” 47). These eight intelligences were not chosen randomly but had to meet a specific set of criteria in order to be included in the framework, such as having an identifiable set of core operations, support from psychometric findings or potential isolation of the intelligence based on the damage done to a specific area of human brain (Gardner “Frames of Mind” 67-71). The definitions of these rules were supported by Gardner’s neuropsychological research, which focused on distinct areas of human brain, their development, interconnectedness and potential effects of pathological means on these areas, and his research on cognitive development of young children (Gardner “Intelligence Reframed” 33).

The theory of MI might at first suggest that each person possesses only one of these eight intelligences. However, Gardner explained that everyone possesses all eight intelligences, but due to genetic or experiential reasons, one or more intelligences will be more dominant (Gardner “Frames of Mind” xii). This obviously presented a new opportunity, but also a challenge, in the field of education. Even though MI was not originally an educational theory, in its nature it promotes differentiation and individualisation (xvi).

Despite its potential positive implications, Gardner’s MI theory has also faced a great deal of criticism, at least in terms of its use in a classroom (Gardner “Intelligences Reframed” 97, Armstrong 191). There are arguments that his theory lacks empirical evidence, that there are no

well-established articles proving its effectiveness or that the concept of MI is trying to simplify school content “to make all students mistakenly believe they are smart” (Armstrong 197). Nevertheless, authors such as Armstrong or Davis et. al responded to these critical claims and provided counter arguments in which they tried to clarify some of the misconceptions which they believe lie behind this criticism (Davis et al. 486). Both authors highlight the fact that the theory is actually supported by Gardner’s extensive neuropsychological research and the lack of studies describing the actual effects of MI is ascribed to the variability of MI across different classrooms and the difficulty to set up a proper statistical environment.<sup>3</sup> Finally, the question of content simplification is seen as very short-sighted, as it is believed to be highly dependent on teachers who use MI and how well they manage to implement it in the actual classroom (Armstrong 193-199, Davis et al. 489-490).

#### *2.1.2.2 Readiness*

Returning back to the previously mentioned areas, different readiness levels would refer to the varying “proximity to specific learning goals, targets, or outcomes” (Tomlinson and Imbeau, “Differentiated Classroom” 20). In other words, individual students in the classroom might require more time, practice or attention due to various reasons, be it their overall abilities, struggle with specific subject matter, or simply school absence or a health related indisposition (Tomlinson and Imbeau, “Differentiated Classroom” 20-21). It is important to notice that student’s abilities are just one of the influencing factors.

In practice, the teacher can encounter classes in which several students have already mastered a particular topic, some who are still trying to understand the basics and those who have been absent for two weeks. These students will have different needs and all of them should be meaningfully included in the learning process (Tomlinson and Imbeau, “Differentiated

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<sup>3</sup> Having said that, academic articles supporting MI exist, such as the ones by Karaduman and Cihan, or Bas and Beyhab.

Classroom” 20-21). One of the ways to adjust the learning process for classes with different readiness levels could be the employment of tiered tasks (Tomlinson 80). These could be tiered based on the amount of work, difficulty level (Tomlinson 80) or more formally based on a learning theory such as Bloom’s taxonomy of educational objectives (Heacox 2, Scigliano and Hipsky 85).

#### 2.1.2.3 *Interests*

The last area, differentiation based on students’ interests is quite self-explanatory. The goal is to incorporate students’ favourite topics into the educational process or product (Tomlinson 52). This is not only motivational for students, as studies suggest that they are more engaged when they work with content they are interested in, but also helps them better realise the connection between school learning and the outside world (Tomlinson 52-53).

Despite the three-way distinction made by Tomlinson, it is definitely possible to combine two of the described areas or differentiate based on all of them at the same time (58). Although for teachers who are just starting to explore these differentiation techniques, it is advised to start with just one and gradually make more complex adjustments (Scigliano and Hipsky 86).

#### 2.1.3 *Difficulties Associated with Differentiation*

In spite of all the described advantages and strategies, the adoption of DI and its use in practice is often not a smooth and straightforward process. A complex overview of these problematic areas can be found in the work of Tomlinson and Imbeau named *Common Sticking Points about Differentiation*. In this document, the authors have listed and addressed the ten most frequent issues mentioned by other teachers in relation to differentiation. Among these issues are the high number of students in the class, inability to create differentiated materials and tasks due to the lack of time, the insistence on the use of one particular textbook with the whole class or the teachers’ argument that the students should be prepared in the same manner, as they will all

take the identical standardised test (Tomlinson and Imbeau, “Common Sticking Points” 19-21). Most of the identified issues are supported by Aldossari’s study among 275 teachers from various educational stages (77). At the same time, the study adds several other items to Tomlinson and Imbeau’s list. These include insufficient training of pre-service teachers in terms of differentiation, perceived students’ preference for traditional methods or the lack of model lessons showcasing the proper use of this approach (Aldossari 78-79). Navrátilová similarly confirms the observations made by Tomlinson and Imbeau as she herself sees the main obstacle in the high student count in current classes, which, according to her, makes the implementation of DI very difficult (160).

Manivannan and Nor also contributed to this topic with their review of literature dealing with perceived difficulties of DI. Their findings and proposed problematic categories are largely in alignment with what has already been discussed in the previous paragraph (Manivannan and Nor 292-293), but the authors also proposed a framework in which they classify the barriers as internal or external, and this classification is further subdivided into governable or ungovernable issues (295). As the authors describe, internal barriers are those which are teacher related, such as preferred personal teaching method or the lack of expertise in differentiating instructions (295). Everything else then fits into the external category, such as the size of the class, time constraints, administrative challenges or the lack of teaching resources (295). The second distinction, governable and ungovernable, refers to the possibility (and ease) of alteration (295).

Manivannan and Nor propose a number of solutions to the governable issues (295-296), but it is Tomlinson and Imbeau’s work which provides specific counter arguments for several of the described problems and which tries to offer advice on how to resolve them, including some of those which were listed as ungovernable in Manivannan and Nor’s framework (“Common Sticking Points” 19-21). Both Tomlinson and Imbeau actually devoted part of their research to

student diversity and DI, and throughout their careers published numerous publications offering further support to other teachers in these complex areas (“Carol Ann Tomlinson”, “Marcia B. Imbeau”).

## 2.2 Digital Technologies in Education

By the year 2030, 90 % of job positions on the Czech labour market will have demanded employees with digital skills. That is the prediction made in the study *Budoucnost českého pracovního trhu* published by Boston Consulting Group in collaboration with the Ministry of Labour and Social Affairs (Wiedermann et al. 5). In the European context, this prediction has already become true as over 90 % of job positions demand at least basic digital literacy (“Digital Literacy in the EU”). Due to these anticipated changes, the field of education faces the challenge of appropriately responding and reforming itself to meet the contemporary needs (“Přípravme Děti Na Budoucnost”). Because as the document *Reimagining Our Futures Together: A New Social Contract for Education* emphasises, “Learning must be relevant to the world of work.” (UNESCO 42).

This part of the thesis intends to provide evidence why digital technologies are an essential part of current educational frameworks and to create a base for the next part dealing with AI. The upcoming chapters will use the example of the educational changes in the Czech Republic to show why all teachers and students should be familiar with digital technologies. They will also outline the potential impact of digital technologies on the field of education and examine their usefulness for English teaching.

### 2.2.1 Response to These Changes – Example of the Czech Republic

The Czech Ministry of Education responded with the updated educational framework for the lessons of Information and Communication Technology (ref. ICT) and introduced a new key cross-curricular competence – the digital competence (“Do Škol Přichází „Revoluce“”). As Daniel Lessner, the chairman of Jednota Školských Informatiků, explains in an online article, digital technologies are now intertwined with all parts of everyday life and cannot be treated as an isolated phenomenon (“Do Škol Přichází „Revoluce“”). The same should be reflected in education. Some of the responsibilities related to the development of general digital competence

were therefore indirectly delegated to teachers of other, even non-technical, subjects and ICT's primary goal became to cultivate students' computational thinking through programming, robotics and data literacy ("Do Škol Přichází „Revoluce“"). The website iMyšlení, created as a cooperative project of the main Czech universities, states that all teachers should naturally implement modern technologies in their subjects and demonstrate their actual purpose for given situations – e.g. Excel for mathematics or Word in language lessons<sup>4</sup> ("iMyšlení: FAQ"). Consequently, teachers can both broaden the specific subject-related knowledge and also enhance the much needed digital literacy of the learner (iMyšlení: FAQ).

However, the Czech Republic is not the first country to adjust its curricula. The United Kingdom replaced their ICT lessons with a new subject called Computing already in 2014 ("Research Review Series"), and the digital competence has been in the national curricula of Slovakia since 2008 (Přichystalová).

### 2.2.2 Impact of Using Digital Technologies on Learners and Teachers

Preparing the students for a future labour market is one of the major reasons justifying the inclusion of digital technologies in the learning process. That is however not the only advantage. Timotheou et al. reviewed published literature dealing with this topic and cited sources which found a degree of positive correlation between technologies and areas ranging from students' achievement and motivation to educators' teaching practices (6699). For example, the use of mobile devices within the classroom had a medium positive effect on the performance of the students (Sung et al. 265), another article found that digital technologies may be used to increase "student achievement, attitude, and motivation", at least in the context of teaching mathematics (Higgins et al. 308), and multiple sources reported their positive effect on language learning, specifically on writing and reading skills (Timotheou et al. 6701).

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<sup>4</sup>There are other software applications apart from Microsoft Office pack which can be utilised



One of the other possible benefits of digital technologies, which is yet to be properly explored, is seen in their capability to enhance individualisation and differentiation in the school context (Holmes et al. 5). Holmes et al. propose that the effective employment of these concepts in traditional classrooms with higher student count is very challenging (28) and that when used appropriately, technology-enhanced learning (ref. TEL) could ameliorate some of the issues (93). Having said that, the general implementation of technologies into the learning process brings about other difficulties which need to be addressed, such as additional cost and broadening teachers' digital skills (Holmes et al. 49), and that is probably why the positive effect of the concept of TEL is not yet fully confirmed (Holmes et al. 81).

### 2.2.3 Proper Use of Digital Technologies and Their Role in an English Classroom

As was already suggested, language teaching can also benefit from the use of digital technologies. However, their implementation into the EFL teaching process might not be as straightforward. For example, one of the most common roles of digital technologies is their use for presentation purposes (Ding et al. 10). Although digital projectors, active boards and presentation software indeed offer numerous advantages over the regular blackboard, if their only use is to passively present information, their benefits are almost nullified and they become very similar to the traditional resources, such as the aforementioned blackboards or textbooks (Li et al. 33).

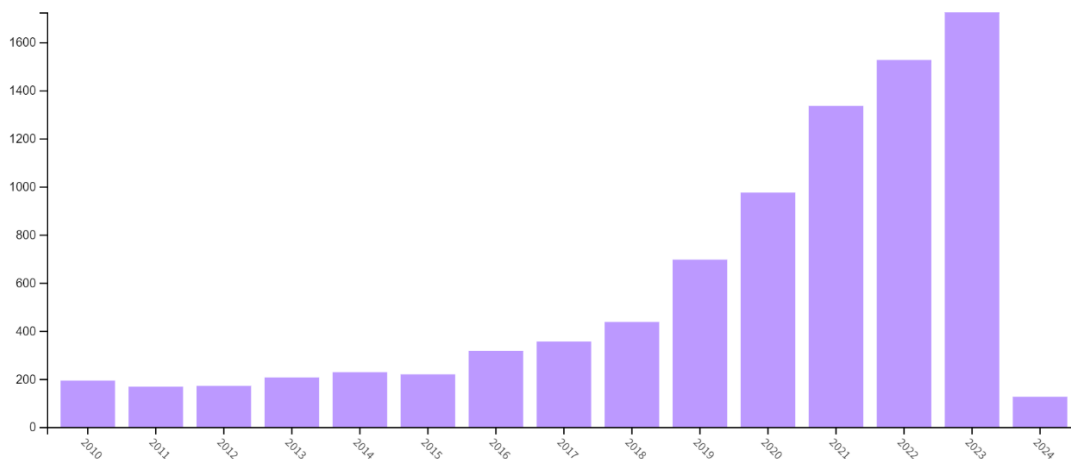
On that account, as Chun et al. and Preis et al. suggest, technology should not be incorporated into English, and any other subjects, without a clear purpose and even then it should be viewed primarily as a supportive element (Chun et al. 77; Preis et al. 60). Other authors also propose that it is important for teachers to receive support regarding the use of digital technologies within the classroom and help with identifying specific areas which could be actually improved with proper digital tools (Ding et al. 17; Huang et al. 100).

On the other hand, if used properly, digital technologies can potentially boost in-class motivation (Huang et al. 98; Ilter 155), and “improve learners’ knowledge and understanding of linguistic texts and concepts” (Bui 5). Besides, there are numerous other perceived advantages. Reynolds et al. analysed the effects of a game-based student response system Kahoot! on learners’ performance and motivation, and confirmed a positive effect on the motivational part of their hypothesis (49). The work *Using mentimeter to enhance learning and teaching in a large class* suggests that the student response system Mentimeter can be utilised for improved formative assessment, student interaction and active participation within the lesson (55-56). Additionally, collected Mentimeter answers from the students can be further analysed to determine their specific needs, and teachers can then accordingly adjust their English courses (Mohin et al. 53). Another notable example is the use of learning platforms, whose potential, according to Jewitt et al., lies in effective organisation of learning and opportunities for collaborative, personalised and autonomous learning (342-344). These findings are supported further by Moonma in her work focusing on a specific learning platform – Google Classroom (46). Lastly, Watkins and Wilkins explored the YouTube platform with regard to EFL and proposed lesson ideas which could lead to the improvement of all English macro skills (115-116).

The digital technologies have gradually become a daily occurrence in people’s lives and the field of education has been forced to transform and adjust its traditional ways. There are countless modern tools and applications which can be utilised within the classroom for various purposes, and their number will probably continue to grow. One of the most recent and revolutionary additions to the digital toolbox is generative AI.

## 2.3 AI and GPT

The beginnings of AI can be traced back to the 1950s, when Alan Turing introduced his concept of a program which could alter and gradually improve itself (Copeland). As time and technology progressed, first real, but quite basic, AI programs started to appear, such as those which could simulate a conversation or play a particular game (Copeland). Nevertheless, a substantial growth of interest in the topic of AI is marked by the year 2019 and the trend still continues to this day. According to the database of Web of Science, the number of published articles per year with the keyword AI has almost quadrupled since the year 2018, and the same is true for articles combining the topics of AI and education (Figure 1).



*Figure 1 - Number of Published Articles per Year Combining the Keywords AI and Education (Web of Science)*

This increased popularity mainly stems from the visible advancements made in the field of AI in 2019, overall shortage of workforce, need to reduce costs, Covid-19 pandemic and later democratisation of AI via tools such as ChatGPT or Google Bard (IBM 6). Since this onset, AI has been under constant development and has spread into various fields such as marketing, content-writing or programming (Wamba-Taguimdje et al. 1910-1911). Education was obviously greatly influenced as well and with the general availability of generative AI, schools were forced to act and decide whether to integrate this modern technology into their curricula

or take measures to forbid its use (Yu 3). However, this uncertainty is fairly rational, as the widespread use of AI raised a number of ethical questions.

To help with the general understanding of this topic, this section aims to introduce the technology and try to address some misconceptions associated with its functionality. As there is no need for a deep technical analysis for the purposes of this thesis, only a simplified description will be provided. It will also examine potential issues commonly discussed in relation to AI. Conversely, it should provide an overview of the advantages of generative AI and highlight the importance of raising awareness about this phenomenon. Lastly, it will discuss AI and its connection to the field of education.

### 2.3.1 GPT and Large Language Models

The two most notable competitors on the market, ChatGPT and Google Bard, are both examples of Large Language models (ref. LLMs) (Naveed et al. 1). LLMs are a subcategory of AI which excels at processing and generating text, and can be used to complete tasks such as text transformations and translations, human-like conversing or even programming code generation (Naveed et al. 1-2). These models are designed to reflect the language as if it were used by a real human being, thus the whole interaction between the user and the machine can be achieved without the need for specialised technical knowledge, as the model is able to both analyse and produce natural language (Baker 8-9). This is largely achieved by showing the model a vast amount of text material and making it create a network of related words in different contexts (Baker 31-32). Once this initial network is created, the model can respond to user's prompts by means of statistical calculation, and selection of the most appropriate words and their word order based on the inferred context (Baker 10). Therefore, in simple terms, GPTs' intelligence lies purely in complex mathematics, algorithms and very accurate statistical predictions (Baker 13). To achieve even better results, the generative algorithm is being optimised through extensive use and feedback from developers, as well as users, who evaluate

generated responses and mark those which are potentially incorrect, misleading or inappropriate (Baker 33).

### 2.3.2 Controversy Surrounding AI

As fascinating and revolutionary this technology may be, it is also widely discussed in terms of concerns associated with its adoption. Just the information mentioned at the end of the previous paragraph, that OpenAI uses users' prompts to improve their models ("How Your Data Is Used"), could pose a serious threat to data privacy (Wu et al. 7). Another contentious topic is the question of copyright infringement, as the data for training LLMs come from multitudinous sources which were often used without any specific consent from the original authors (Lucchi 14-15). Furthermore, ChatGPT and similar technologies reinitiated the discussions about an upcoming wave of increased unemployment, which is believed to follow all major breakthroughs in technology, not just advancements in AI (Frank et al. 2). There are many other perceived negative impacts of generative AI, ranging from the loss of interpersonal skills (Yu 3) to its ability to assist in creation of malicious software (Wu et al. 4-5), but it is the question of plagiarism which is at the forefront of academic concerns (Yu 3). Several universities across the world have already decided to ban the use of ChatGPT altogether with the primary aim to prevent future authorship issues regarding essay writing, homework completion or research paper generation, others have opted for the implementation of strict regulations (Yu 3).

To help mitigate these fears, AI detection tools were soon developed to help teachers and other people distinguish between AI-generated text and original content produced by human writers (Wu et al. 9-10). Among these are GPTZero, which started as a side school project by Edward Tien and Alex Cui and was one of the first tools of this kind (Shrivastava), Originality.ai or ZeroGPT (Weixin et al. 8). Although in the recent study *GPT detectors are biased against non-native English writers*, the authors evaluated these tools and found that there is still room

for improvement regarding their accuracy, as they occasionally tend to provide false positives (Weixin et al. 2-3).

### 2.3.3 Benefits of AI

Despite this controversy, ChatGPT still remains highly popular with its audience of more than 100 million active users (Wu et al. 1)<sup>5</sup> and these people have found a wide range of possible use cases which can be at least enhanced with the use of AI. Businesses are adopting this technology to improve customer experience via automated conversations and simultaneously to reduce the costs for employing additional human members of customer care staff (Kalla et al. 828). It is also speculated that generative AI could find its place in healthcare services. Javaid et. al propose its application as an assistant to patients who would not be able to reach a human professional, e.g. due to their residence in rural areas (2). Moreover, medical staff could harness its power to transcribe medical records or to generate reports (Javaid et. al 2). Other affected fields include cybersecurity, data analytics, programming or research (Kalla et al. 832). With all these feasible applications, it is necessary to recognise current and future value of generative AI, and be prepared for the changes it may cause to the labour market (Kalla et al. 832).

Unfortunately, that might actually pose a great challenge due to the fact that the technology is rapidly evolving and staying up to date is becoming increasingly difficult. For example, in 2022, the models would only accept text as the initial input, but the latest ones are already multimodal, meaning that they can also work with image, audio and video inputs (Baker 29). Having said that, this could open even more possibilities for future projects.

### 2.3.4 AI's Impact on Education

As was mentioned in chapter 2.3.2, academics have their reservations about generative AI, with plagiarism being at the forefront of their concerns (Lim et al. 2). Nevertheless, there are no

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<sup>5</sup> As of July 2023

indications that AI will disappear from the online world and many authors believe that rather than imposing bans on its use, educational institutions should integrate it “responsibly and ethically into the learning process” (Alasadi and Baiz 2965).

Alasadi and Baiz make a claim that students and teachers should be adequately prepared for a future in which AI might play an important part and that they should be taught how to take advantage of the tool, but also how to deal with its limitations. They also argue that the learning process does not exist in a vacuum and that academics should acknowledge the major role that technologies play in contemporary society (2965). In their article, Alasadi and Baiz identify three major areas where AI could prove beneficial for both teachers and students: Personalized Learning Experiences and Adaptive Learning Materials, Real-Time Feedback and Assessment, and Overcoming Language Barriers (2966).

Lim et al. also offer a positive view on the implementation of AI while recognizing the associated challenges. They see the appearance of generative AI as an opportunity for an educational reform, which would enhance the traditional approaches to learning (Lim et. al 2). Similarly to Alasadi and Baiz, Lim et al. propose its employment, among other possible uses, to “diagnose gaps in student learning”, give students timely feedback (3) or translate pedagogical content for students from different language backgrounds (8). Despite seeing the potential benefits, the authors recommend the adoption of clear institutional guidelines and their constant revision consequent to any major development of generative AI (Lim et al. 9).

One more precondition to successful adoption of AI, which was already mentioned in the previous sources and which is further supported by an interview with two Cambridge researchers, is the importance of raising awareness. In the interview, both academics discuss how schools should “take the initiative” and come up with ways how to correctly utilise ChatGPT and other AI tools or otherwise “risk putting themselves and their students at

a disadvantage” (Kirk). According to them, the main challenge lies in cooperation between state institutions, and in educating the teachers on how to use the tool to their advantage and how to promote its safe use to their students (Kirk).

There are many areas of education where AI could potentially be used and apart from the commonly mentioned AI use-cases, such as content generation, personalisation of study materials, automated translations or essay assessment, there are several other interesting examples of generative AI already being used in the pedagogical context. Georgia Institute of Technology has developed a virtual assistant, Jill Watson, whose goal is to answer frequently asked student questions regarding a virtual study course and its requirements (“Meet Jill Watson”). Duolingo’s Max feature allows users to converse in various languages with a virtual partner empowered by GPT-4, who is also able to provide feedback and useful tips (“Introducing Duolingo Max”). The last example is then the online app Wisdolia, which allows users to automatically create study flashcards based on an inserted pdf file, website link or YouTube video (“Wisdolia”). These flashcards are then presented as questions whose answers are evaluated by AI based on the contents of the referenced input source.

### 2.3.5 AI in the Context of Education in the Czech Republic

The institution which was officially tasked with responding to the trend of AI in the Czech Republic was the National Pedagogical Institute. An expert group was formed in March 2023 with the goal of helping to integrate AI into schools and providing support to teachers, directors and students (NPI). Six months later, with the beginning of the new school year, NPI released a set of recommendations for the previously mentioned audiences fostering a positive, but responsible, approach (NPI). Simultaneously, it provided a variety of free courses on the use of AI at school and offered assistance through collaboration with IT experts and ICT methodologists (NPI). Consequently, the topic of AI was introduced into the revised educational framework (transl. *rámcový vzdělávací program*) as a part of the new



cross-curricular topic of digital competences under the chapter “Přínos a vývoj” (“Digitální Kompetence”). Over the course of their education, students should have ample time to properly explore the technology, and be able to demonstrate this required competence at the end of their upper-secondary studies.

Major universities in the Czech Republic responded analogically to the new trend and released their statements even earlier than NPI. Charles University in Prague, Masaryk University in Brno and Palacky University in Olomouc all published online statements with recommendations and guidelines on how to work with AI. The official posts state that the institutions are aware of the recent technological advancements and that they support the use of AI, but strongly emphasise responsibility and transparency.<sup>6,7,8</sup>

Palacky University even conducted a research among Czech educators (n=2175) from primary to upper-secondary schools about their attitudes towards AI (Kopecký et al. 4-11). They were interested mostly in three research questions – What is their current attitude towards AI?, Are Czech teachers ready for the implementation of AI? and Which AI tools are they already using?. The results mostly reflect the general division and differences between individual schools and teachers mentioned earlier. There are still many people who are afraid of AI or know very little about it, and 46.8 % think that the use of AI will have detrimental effect on people’s cleverness. On the other hand, 48.9 % of teachers agree that AI poses a great asset for them (only 13.1 % disagree) and 56.3 % of the respondents believe that AI has its place at school (against 19.3 % who believe otherwise).

What the respondents mostly agreed on is the fact that AI will change the traditional ways of teaching (83.4 %), but that it will not replace their profession (78 %) (Kopecký et al. 11).

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<sup>6</sup> <https://www.muni.cz/en/about-us/official-notice-board/statement-on-the-application-of-ai>

<sup>7</sup> <https://www.pdf.upol.cz/nc/zprava/clanek/pdf-up-k-problematice-vyuzivani-umele-inteligence/>

<sup>8</sup> <https://ai.cuni.cz/AI-17.html>

Despite that, there is still a lot of room for improvement before the generative AI can be fully utilised, as 82.3 % of teachers agree that the employment of AI demands additional skills on the side of the educators and only 24.2 % of them feel confident using it. The number is even lower when it comes to using it appropriately within the classroom (15.82 %) (Kopecký et al. 17).

### 3 Empirical Part

As was mentioned in the introductory part, and as the title states, the main idea behind this thesis is to assess the usefulness of generative AI in terms of its ability to support differentiation in the educational context. It follows the ideas of several authors, and not just academic, who believe that the employment of AI for such purpose could transform the modern classroom and make learning more effective, meaningful or at least more enjoyable (Pesovski et al. 4, Alasadi and Baiz 2966, Nikolopoulou 104). Besides that, the motivation to explore this topic comes from my personal difficulties with the implementation of differentiation in my classes due to the time-consuming nature of this pedagogical phenomenon and the perceived lack of proper practical training in this area during my teaching practice.

I still strongly believe, as 78 % of Czech teachers do<sup>9</sup>, that generative AI will not replace the human teacher in the classroom, at least not in the near future. There are still many specific personal traits which cannot yet be properly replicated by any generative AI model, such as intuition, empathy or social skills.<sup>10</sup> At the same time, AI's potential to become a transformational tool which can serve as teacher's valuable assistant should not be dismissed.

This part of the thesis endeavours to evaluate the potential of AI within an English classroom with regard to the aforementioned differentiation. The following research is primarily built around English tasks which were differentiated based on Howard Gardner's framework of Multiple Intelligences (ref. MI) and created with the help of generative AI. These tasks were then assessed by both sides in the educational process, students and teachers, alongside standard tasks which can be found in commonly used English student books. The research aims to prove that AI can be used to create appropriate and engaging differentiated tasks and that such tasks

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<sup>9</sup> According to study by Kopecký et al. 11

<sup>10</sup> Other limitations of the technology in terms of its position in education can be found, for example, in Chan and Tsi

can result in a positive effect on the learning process. Moreover, it proposes that AI could reduce the overall time needed to design differentiated tasks and this in turn could motivate teachers to differentiate more in their own classrooms.

Even though Gardner's theory was chosen as the primary method of differentiation, the research partially delves into other differentiating strategies as well. These strategies being the employment of tiered tasks according to Bloom's taxonomy and differentiation based on students' interests.

The upcoming chapters of this empirical part unveil the details of the whole research procedure. The first chapter describes the process of creation of the various differentiated tasks through ChatGPT. Following that, the thesis discusses the methodology behind the research, and the last chapters focus on the actual collection of the data and their subsequent analysis.

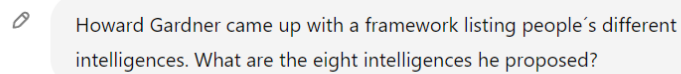
### 3.1 Creation of Differentiated Tasks with the Help of AI

There was no doubt that AI had the potential to create differentiated English tasks, as it can produce almost any text based on a given input (Naveed et al. 1-2). At the same time, whether this potential could be utilised for such purpose is to be evaluated in the following paragraphs. This provides an opportunity to set hypothesis number one (H1):

H1: AI can be used for the creation of differentiated tasks.

The first step was to test whether the major available LLMs do actually possess the knowledge about the theories which were selected for task differentiation. This was a straightforward process and a simple prompt in which the models were asked to explain the theories was enough to see that they indeed are aware of them. With the use of another prompt, they were even able to describe the developmental stages of each theory, such as the addition of new Intelligences in the later revisions of Gardner's theory or the revision of Bloom's taxonomy by Anderson

and Krathwohl. Surprisingly, both tested models, ChatGPT and Google Bard<sup>11</sup>, provided almost identical answers to these prompts, and because the former one offered more advanced features and better user experience at the time of writing of this thesis, it was selected as a primary tool for the following process of task generation.



Howard Gardner came up with a framework listing people's different intelligences. What are the eight intelligences he proposed?

Howard Gardner, a developmental psychologist, proposed a theory of multiple intelligences, suggesting that intelligence is not a singular entity but rather a collection of distinct abilities. In his framework, he identified eight different types of intelligences:

1. **Linguistic Intelligence:** This involves sensitivity to spoken and written language, as well as the ability to learn languages, manipulate syntax, and use language to express complex meanings.
2. **Logical-Mathematical Intelligence:** This intelligence entails the ability to detect patterns, reason deductively, think logically, and solve mathematical problems.
3. **Spatial Intelligence:** Spatial intelligence involves the ability to perceive the visual-spatial world accurately, manipulate and transform mental representations of spatial information, and

*Figure 2 - Prompt Used to Test Model's Knowledge of MI*

### 3.1.1 First Drafts and Problem Identification

Once it was established that the AI is able to operate with the necessary theories, the next step was to design a prompt which would instruct the model to create the tasks. The thesis will only use the example of generating tasks based on MI, as Bloom's taxonomy plays a secondary role and the whole process was very similar anyway.

The first draft of the prompt was simply another short instruction which followed the previous prompt<sup>12</sup> used to determine the model's awareness of MI:

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<sup>11</sup> Now Google Gemini

<sup>12</sup> Shown in Figure 2

I would like to create an English task on the topic of past simple which would be tailored to each of these intelligences. Could you suggest such tasks bearing in mind the different intelligences?

*Figure 3 - First Testing Prompt for the Creation of MI tasks*

The generated results from this prompt were already promising, but there were several identifiable issues. The first one was that the output was inconsistent when the prompt was used again in a new chat window. Meaning that the output would use a completely different format, generate tasks for only two or three intelligences or provide a guide for the teacher how to set up the task instead of the instructions meant for students.

Another issue was with the tasks for some of the more specific intelligences, mainly the musical and intrapersonal ones. While ChatGPT was able to come up with quite a wide variety of tasks for verbal, spatial and mathematical-logical intelligence, students with musical intelligence were receiving tasks which almost invariably lead to singing, rapping or rhyming. Similarly, intrapersonally dominant students were “doomed” to only write entries into their personal diary.

The final issue was that the tasks often lacked any specification regarding the required extent of the student’s output and the form of the final presentation. There was occasionally a detail about how long an essay or piece of text should be, but more often than not, the students were left with a choice to write two sentences or two pages of text. These issues were even more prominent within the bodily-kinaesthetic and interpersonal intelligence where the students were usually asked to perform a certain action, but were left without a chance to summarise and present their work.

It was also desirable to consolidate both prompts into one, in order to further decrease the time needed to prepare a differentiated lesson.

Certainly! Here are tailored English tasks focusing on the past simple tense, designed to engage each of the eight intelligences proposed by Howard Gardner:

1. **Linguistic Intelligence:**  
Task: Write a short story narrating a memorable event from your past using the past simple tense. Ensure that your story includes descriptive language and vivid details to engage the reader.
2. **Logical-Mathematical Intelligence:**  
Task: Create a timeline of significant events from a historical period, using the past simple tense to describe each event concisely and accurately. Arrange the events chronologically and include dates where possible.
3. **Spatial Intelligence:**  
Task: Design a storyboard for a short film or comic strip depicting a sequence of events from a past experience. Use visuals and captions to convey the story, and include the past simple tense in the narrative.

*Figure 4 - Example of the First Results*

The ultimate goal was to rectify all these issues and improve the prompt to such an extent that the output could immediately be used in the classroom. In order to achieve this state, the tasks had to follow the theoretical basis, be meaningful and achievable, reflect the given topic, provide clear instructions and, most importantly, use language which would be comprehensible to the students.

### 3.1.2 Final Form of the Prompt

The initial prompt underwent numerous changes and after many iterations, this was the final result which would rectify most of the previously listed issues:

Howard Gardner came up with a framework listing people's different intelligences. What are the eight intelligences he proposed? I would like to create an English task on the topic of {lesson topic} which would be tailored to each of these intelligences. Could you suggest such tasks bearing in mind the different intelligences? Create clear instructions for each task and adjust the language so that it is appropriate for a {CEFR level} English level student. The instructions should be clear but detailed and should provide an example. Also provide a detailed description of what is the desired form and length of the final outcome. The outcomes do not have to be a written essay. In the case of musical intelligence, do not ask the students to sing, rap, or rhyme.

*Figure 5 - The Final Version of the Prompt*

The instructions in this prompt would first force ChatGPT to queue information about the theory and only after that it would attempt to generate the tasks. Because of that, it was possible to consistently get tasks for all intelligences at once. Consistency was also achieved in terms of the form of the instructions, as after the adjustments, they usually followed the pattern of providing the main point of the task, additional details about what was required with the specified extent of the task's result and an example of the output.

With the addition of a command specifying the CEFR level of the class, it was also possible to somewhat control the complexity of the language used by ChatGPT. Although this visibly improved the appropriateness of AI's vocabulary, there were still occasional occurrences of words which were above the desired level and which would probably have to be replaced in a real in-class scenario.

Finally, the last part of the prompt aimed to eliminate the problem with ChatGPT's preference of assigning singing tasks to students with musical intelligence. Unfortunately, the results of this adjustment were ambivalent. For some English topics, usually of higher CEFR levels, the AI was able to come up with a different meaningful and interesting assignment, whereas for other topics, it would often ignore this command and proceed with a singing task.

## **5. Musical Intelligence**

**Task:** Comparative and Superlative Playlist Creation

**Instructions:**

Create a playlist of five songs. Write a short description for each song comparing it to the others using comparatives and superlatives.

**Example:**

"This song is more upbeat than the last one, but the next song is the most relaxing of all."

**Desired Outcome:**

A written playlist with descriptions, each containing at least one comparative and one superlative. The descriptions should clearly explain how the songs compare to each other in terms of tempo, mood, etc.

*Figure 6 - Better Musical Intelligence Outcome for B1-B2 Students*



## 5. Musical Intelligence

**Task:** Create a rhythm or beat to remember rules using modal verbs.

**Instructions:**

1. Choose three rules that use must, mustn't, and don't have to (e.g., "You must do your homework," "You mustn't run in the hallway," "You don't have to bring your own lunch").
2. Create a rhythm or beat using claps, taps, or any instrument you have.
3. Practice saying the rules in rhythm with your beat.
4. Present your rhythm to the class.

**Outcome:** A rhythm or beat presentation with spoken rules, 1-2 minutes long.

*Figure 7 - A2 Level Task Ignoring the Command in the Prompt*

We can only speculate why the issue is so persistent but one of the hypothesis is that the AI limits the range of available options for Musical Intelligence<sup>13</sup> based on the CEFR level of the students too much and is then stuck within a small set of tasks which mostly involve rhythmical creativity. Nonetheless, none of the changes which were made to the prompt managed to completely resolve this and the only solution was to re-generate the task multiple times until the AI provided an adequate replacement. This is definitely a hindrance, however, the task re-generation can again be done in a matter of a few seconds and teachers can even prompt the AI to give them a list of five or more tasks at once from which they can choose the most suitable one.

All of this implies at least two things. Trying to design a perfect prompt which would give a list of eight suitable tasks right away might not be the best strategy and a series of shorter prompts which would gradually alter the first raw output could even prove more time efficient. Secondly, there is still a need for a trained professional, the teacher, who can evaluate the suitability of the individual tasks.

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<sup>13</sup> It surely does the same for other intelligences as well, but in the case of Musical Intelligence, and similarly the Intrapersonal Intelligence, the constraints of what still fits into the category might be stricter.

In spite of these implications, this practical part of the thesis supports the hypothesis (H1) and therefore we can draw the following conclusion:

H1: AI can actually create differentiated tasks, even if the quality of these tasks might occasionally vary.

Either way, the tasks and the newly discovered details about their creation will serve as a basis for the subsequent research within the classrooms.

### 3.1.3 Prompt Alternatives

Up to this point, all of the prompting was done via the official ChatGPT chat.<sup>14</sup> The reason behind only using this option for the purposes of this thesis is that this approach attempts to keep the process accessible to a wide range of teachers who would like to adopt it. They can simply log in to the application for free, reuse the prompt from the previous chapter and get similar results.

Nevertheless, the official chat application is certainly not the only available way of interacting with the ChatGPT model. On the 6<sup>th</sup> of November 2023, OpenAI released an update in which they introduced the possibility to create personalised AI assistants whose overall behaviour can be defined with a system prompt (“Changelog”). Such a prompt provides the AI assistant with additional context which is taken into consideration during further user prompting. This way, teachers can potentially create their own virtual expert on differentiation based on the theory of MI and simplify the process of future task generation by transferring a large portion of the original prompt into AI’s initial context. The main benefit is that the assistant is defined only once and after that it becomes available to the user in OpenAI’s Assistant Playground (“Assistants Playground”). Moreover, users can also influence other parameters of the assistant,

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<sup>14</sup> Available at <https://chat.openai.com/>

such as temperature, which influences model's creativity, or they can switch to more advanced AI models like GPT-4.

Another option which can be utilised is the OpenAI API, through which users can communicate with the AI model programmatically and have even more control over the model's behaviour. Not only do users, teachers in this case, have more control, but they can build their own specialised (website) applications which can then be used throughout the entire school or be made available to students themselves.<sup>15</sup>

In any case, both of these described ways definitely require additional knowledge of the technology and are therefore presented only as possible alternatives for more advanced AI users. That being said, with proper technical skills, teachers could likely optimise the process of task creation even further and increase the accuracy and relevance of AI's responses.

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<sup>15</sup> This also presents an opportunity for cooperation between language and IT teachers

## 3.2 The Research

The previous chapter has already confirmed the first hypothesis (H1) of this thesis, that the AI can indeed be used to generate differentiated tasks, specifically based on Gardner's theory of MI. The next step was to test whether these tasks might replicate the usual effects of Differentiated Instructions (ref. DI).

As was described in the theoretical part, many studies have already conducted research on the effects of DI on the learning outcomes, but such studies usually require a long term cooperation with the same classes in which an experimental group is taught exclusively using DI and is then compared to a control group taught in the traditional way (Karaduman and Cihan, Reis et al.).

This thesis does not have the ambition to prove the effects of using DI on learners' performance in the classroom. First, it was not possible to gain stable access to a class where such an approach could be tested for an extended period of time. Second, the study aimed to uncover the potential of the AI-generated differentiated tasks first before any field-testing in the classroom could be done. Third, the researcher wanted to test the tasks in various classes to see whether they can be used universally or only in specific contexts.

So instead, the focus of the thesis was directed towards another measurable effect of DI and an important determinant of students' overall performance – motivation (Harmini and Effendi 145, Stránská and Blažková 7, Hattie 47-48). This variable would allow for a faster and broader assessment, as students can, in this regard, evaluate the tasks immediately, and at the same time still offer an estimate of the potential performance improvements.

The study intends to build upon the concept of task motivation, which states that inherently every task has a motivational value, but certain tasks will be more motivating for students than others. With this theory in mind, the research will try to confirm the second hypothesis (H2):

H2: Differentiated tasks are able to outperform standard tasks from common English student books in terms of motivation, even if they are generated with the help of AI, and their use in the classroom can be justified.

Nevertheless, the intention behind the use of AI in this thesis was not only the assessment of its ability to generate differentiated tasks which can reproduce similar effects as differentiated tasks designed by a human teacher, but also the belief that it can eliminate a major obstacle preventing the frequent use of DI, which is the time complexity of the preparation of differentiated materials (Tomlinson and Imbeau “Common Sticking Points” 19). This formed the third hypothesis (H3), which evaluates whether generative AI can actually reduce the time needed to prepare differentiated instructions and, if it can, then whether this fact would motivate teachers to take advantage of this technology and differentiate more within their English lessons.

H3: The AI approach to differentiation can reduce the time needed to prepare appropriate differentiated tasks and this fact can motivate teachers to differentiate more frequently in English classes.

H3 was to be evaluated in the second part of the research.

### 3.2.1 Methodology

#### 3.2.1.1 *Research Design – Part 1 – Survey*

The first part of the research focused on the second hypothesis (H2) of this thesis, which should evaluate the motivational potential of differentiated tasks created by generative AI. Every student included in the study was supposed to receive five tasks, three of which were tailored to the learner’s primary intelligence, based on Gardner’s theory, and two standard tasks which were adopted from an English student’s book. The students were then asked to assess them with regard to their motivation value.

A quantitative approach in the form of an online questionnaire was selected for this part, as this way, it was possible to gather a relatively large number of responses. The online survey was divided into two sections. The first was designed to determine student's main intelligence and in the second section, the student would receive the aforementioned tasks for evaluation.

Uncovering student's primary intelligence is not a straightforward task and an accurate estimation can be made only after a close observation of the student for an extended period of time (Armstrong 29). However, this option was not viable for this research and even though Armstrong claims that there is no standardised test which could replace the above-mentioned observation, he admits that the use of formal testing can still offer at least a rough estimate of student's preferences (29).

Following this claim, and taking into account the possible limitations, the study would opt to use a MI test which would categorise each student into one of the eight intelligences. The study is aware of the fact that the more precise approach of observation could certainly add significant value to the overall results, but with the limited amount of time available in each surveyed classroom, the test was seen as a sufficient solution. Besides, the appropriateness of this decision can be judged based on the final evaluations of the tasks. If the MI tasks exhibited a lower motivational value than the standard ones, then the presented inaccuracy could be seen as one of the potential reasons behind this result, as some students could have been assigned into an incorrect category.

The version of the test used in the survey was a combination of translated statements from Ruiz's questionnaire and Armstrong's descriptions of personal traits reflecting the individual intelligences (30-34). These descriptions were transformed into the same statement format as used in Ruiz and replaced some of his statements which were assumed to be either too distant from the intelligence they were supposed to be associated with, or which were just too vague.

The final test consisted of 56 statements and each of these was associated with a specific characteristic typical for one of the eight intelligences. It included items such as “Mathematics has always been my favourite subject” for Mathematical-Logical intelligence or “I like to build and design 3D models” for spatial intelligence.<sup>16</sup> Each statement also had a scale from 0 to 3 through which students would indicate how much they identify with it (0 meant no identification with the statement and 3 full identification).

From the selected values for each statement, the survey would calculate the final score for each intelligence. The maximum points which students could collect for each intelligence was 21 and the one with the highest final score would then be considered to be student’s primary intelligence. In case there were multiple categories with the same score at the end of this MI test, students were told to choose randomly from these options. The premise was that they would prefer tasks for any of these intelligences, as they were all highlighted as primary.

The result from the previous part then determined which set of differentiated tasks would be assigned to the student for evaluation in section number two. Two sets of MI tasks were created, one for lower- and one for upper-secondary schools. Both sets comprised eight subsets, according to the number of MI, and as was mentioned before, there were five tasks per subset. The distinction between the two ISCED levels was made to better respect the current English skills of both groups. The creation of only one set for both levels would possibly have meant that the instructions and topic could end up being overly difficult for one group while being too simple for the other and that this could negatively influence the results.

The topics for both sets were selected after an examination of the English student books which were used in the Czech schools selected for the survey. The books which were reviewed for ISCED 2 were Project 3 and English File Pre-Intermediate, for ISCED 3 Maturita Solutions

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<sup>16</sup> More examples can be seen in Appendix 1

Intermediate and English File Intermediate. The main condition for the selection of the topic was that it had to be included in both books for the specific ISCED level. In the end, the chosen topics were modal verbs (must, mustn't and don't have to – ISCED 2), and superlatives and comparatives (ISCED 3).

Alongside the topics, the review also selected a task from each book which would be included in the subsets together with the MI tasks.<sup>17</sup> These standard tasks (this term will be used for the rest of the thesis) were supposed to act as a control group, as they are an example of a one-size-fits-all approach.

The experimental group would be represented by the differentiated tasks based on MI. There is a reason why there are three of them in the subsets. The first task was created solely by AI and left without any further alterations. This AI-only task represents the fastest way of differentiating instructions and it should provide evidence whether AI alone can replace the human teacher in the process of differentiation. The second one was also created by AI, but was further adjusted by the researcher who, if necessary, improved its comprehensibility and supplied additional instructions.<sup>18</sup> This option offers a trade-off between the AI-only task and lengthy manual task creation, supposedly still greatly reducing the overall time needed to create the differentiated materials, but necessitating human review. The last task was created manually by the researcher and represented the traditional way of differentiation. It was to be used as a reference point for identifying the differences between AI-generated and teacher-generated differentiated content, and also for general comparison of differentiated and non-differentiated approaches to teaching.

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<sup>17</sup> One of the selected tasks can be seen in Appendix 2

<sup>18</sup> See Appendix 3



Approach	Avg. time to create one entire set of MI tasks
<b>AI only</b>	3 minutes
<b>AI with teacher review</b>	37 minutes
<b>Manual creation</b>	3 hours and 26 minutes

*Table 1 - Average Time Needed to Create a Set of Differentiated Tasks Using the Proposed Approaches. Based on the Creation of 5 Sets of Tasks per Each Approach (3 testing, 2 later included in the survey)*

For the assessment of both the standard and differentiated tasks, the study would use four scales, each being represented by a specific statement. These were selected based on the concept of task motivation and the list of important parameters influencing the motivational value of a task presented in Kormos and Wilby (268). An interest scale was used to evaluate the level of interest the task can evoke. A comprehensibility scale tested whether the instructions were understandable and provided all necessary details for successful completion of the task. The last two scales intended to assess the perceived difficulty and time complexity of the tasks.

A similar approach was adopted by Boekaerts who designed a task motivation questionnaire (77-78). It was then used by Crombach et al. to study the responses of Dutch students to curricular tasks (100-101), or Popoure who used a slightly adapted version and distributed it to Korean students who were asked to assess English exercises (75). Similarly to Crombach, this part of the study also uses a pre-task evaluation, as the tasks would be scored before their actual use.

With the theory of task motivation in mind, the study can then propose several predictions with which it would operate. Tasks with high scores on interest and comprehensibility scales, and average scores on the two other scales would be examples of optimal tasks. It is assumed that standard tasks would have high comprehensibility score, because they are reviewed<sup>19</sup>, and average interest score, as they offer the same experience for all students. The differentiated

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<sup>19</sup> All selected student books were approved by MŠMT

tasks should then score higher on the interest scale and at least similarly on the comprehensibility scale to justify their implementation. The comprehensibility scale was especially important for the AI-generated content, which is known for having occasional issues with accuracy and content relevance (Baker 80). The other two scales represented the perceived cost value of completing the task and also generated valuable assumptions (Kormos and Wilby 268). Tasks with both high difficulty and time complexity would probably decrease students' interest. Low difficulty, low motivation and high time complexity would signify a meaningless task which does not offer any value and is just time-consuming. Lastly, higher difficulty, low-to-average time complexity and high interest could mean that the task successfully triggered student's intrinsic motivation.

To end this chapter, a few more details about the survey should be provided. The purpose of the study was not to be revealed until after everyone had submitted the survey to reduce any potential bias. The task instructions were in English, but both the statements and the survey instructions were provided in students' native language in order to make sure that the questionnaire would be filled out and handed in correctly. Furthermore, the survey also gathered additional information, namely the gender of the student and the type of the class (homo/heterogeneous), which could be used to find possible correlations and discrepancies in the collected data.

### *3.2.1.2 Research Design – Part 2 – Teacher Interviews*

While the survey worked with the students' perspective on differentiated tasks, the interviews were supposed to provide a more qualitative approach to the subject matter from the perspective of English teachers.

Each teacher was interviewed on two occasions.<sup>20</sup> The first short sitting took place before the in-class survey, and teachers were mostly asked questions about the current state of differentiation in their classes and about the details of their pedagogical experience with this phenomenon. This initial dialogue had the goal of identifying whether teachers even feel the need to differentiate and whether there are any obstacles preventing them from using this technique more effectively. The assumption was that teachers avoid the frequent use of differentiation due to the same reasons as identified by Tomlinson and Imbeau, but mostly due to its time complexity (“Common Sticking Points” 19).

The second part of the interview took place after the survey. With practical examples, the researcher first explained the process of the creation of AI differentiated tasks and then the teachers had a chance to try it themselves. Apart from the tasks differentiated based on Gardner’s theory of MI, they were shown how the same process can be applied to tiered tasks or differentiation based on students’ interests. They were also given rough estimates of the times needed to generate AI-only tasks, reviewed version of the AI tasks and manual tasks<sup>21</sup>. Furthermore, they already saw the response of the class to the differentiated tasks used in the survey and the overall results of the survey for their class.

After this preparatory stage, the teachers were asked whether this technological approach changes their opinion on differentiation, and whether with such a tool, they would be motivated to differentiate more. If the answer would be positive, then the use of AI for the purposes of differentiation could again be justified.

### *3.2.1.3 Participants*

Four Czech schools participated in the study, all of them being located in Prague. The research group for the survey was composed of 89 students from seven different English classes. Three

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<sup>20</sup> The interview questions can be seen in Appendix 4

<sup>21</sup> See Table 1

classes were from lower-secondary schools (ISCED 2) and four from upper-secondary schools (ISCED 3). With regard to gender, 47 students were men, 41 women and 1 who identified as other. Both homogeneous and heterogeneous English groups were present in the study.

For the second part of the research, four teachers of different age and length of pedagogical experience agreed to participate in the interviews.

Students	ISCED 2		ISCED 3			-
	Male	Female	Male	Female	Other	Total
n	17	24	30	17	1	89
% of Total	19,1%	27,0%	33,7%	19,1%	1,1%	100,0%

Table 2 - Students Participating in the Survey

Teachers	Gender	Type of School	Age	Years of Ped. Experience
Teacher 1	Male	ISCED 3	25	3
Teacher 2	Female	ISCED 3	63	30
Teacher 3	Female	ISCED 2	26	5
Teacher 4	Female	ISCED 2	48	27

Table 3 - Teachers Participating in the Interviews

3.2.1.4 Data Collection

The data was collected over the course of five weeks. Each school was visited twice. During the first visit, the researcher would conduct the survey and the first part of the interview with the teacher. The second visit was dedicated to the second part of the interview.

3.2.1.5 Data Analysis

To analyse the results from the survey, the study compared the individual scales of each task group. The effect of MI tasks on the interest variable was described using Cohen’s D. The difference in the number of tasks in each group (2 standard and 3 differentiated) was addressed in the calculation of pooled standard deviation.

$$d_s = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)SD_1^2 + (n_2-1)SD_2^2}{n_1+n_2-2}}}$$

*Figure 8 - Formula Used to Calculate Cohen's D (Cohen 67)*

The comparisons between the other scales were primarily done based on their calculated means. Medians and Standard Deviations were also supplied for each scale. All calculations were further analysed from the perspective of the other collected dimensions – the primary intelligence, gender, ISCED level and the type of the English class. The entire analysis was performed in Microsoft Power BI and RStudio.

As for the interviews, the research primarily discussed how, and whether, the presentation of the survey's results and the demonstration of the process of AI task generation altered teachers' opinions on differentiation.

### 3.3 Results

Finally, the upcoming section of the thesis discusses the collected data with the purpose of either confirming or disproving the proposed hypotheses H2 and H3. In order to improve the overall readability of the following paragraphs, it will use the following naming convention to refer to the individual tasks:

Text Reference	Chart Reference (Task Categories)	Task Group	Description
AO	ai_only	Differentiated	MI tasks generated only by AI without additional adjustments
AWT	ai_with_teacher	Differentiated	MI tasks generated by AI with additional adjustments made by the researcher
TO	teacher_only	Differentiated	MI tasks created manually by the researcher
TB1	textbook1	Standard	Task 1 from a student's book
TB2	textbook2	Standard	Task 2 from a student's book

*Table 4 - Text References*

#### 3.3.1 Survey Results

The online survey provided data for the assessment of the potential of AI-generated MI tasks to increase students' motivation in English classrooms (H2). Before drawing any general conclusions, the study presents findings related to the individual scales which were used for the evaluation of all tasks.

##### 3.3.1.1 Interest

Following the general opinion of Tomlinson and Imbeau, and the proposed hypothesis (H2), differentiated tasks were perceived by the surveyed students as more interesting. As can be seen in Table 5, the differentiated tasks were generally evaluated more positively with regard to their interest value in comparison with the standard tasks, and if we calculate the effect size using Cohen's D, then the use of differentiation had a small-to-medium positive effect ( $d = 0.3880$ ).

<b>Task Group Type</b>	<b>Mean</b>	<b>Median</b>	<b>SD</b>
<b>differentiated</b>	3,36	4,00	1,25919
<b>standard</b>	2,91	3,00	1,01559

*Table 5 - Overall Results for Interest*

In order to see whether there was any approach to differentiation which produced significantly better results than the other options and whether the use of AI had any negative impacts, the study also analysed the individual task categories and measured their effect size compared to the standard group as a whole. Table 6 shows that the AWT tasks were the best performing category with the mean score of 3.45 and the effect size of 0.5031. Nevertheless, even the AO tasks, whose calculated mean and d were the lowest, outperformed the textbook exercises with an overall small-to-medium effect ( $d = 0.3517$ ).

<b>Task Category</b>	<b>Mean</b>	<b>Median</b>	<b>SD</b>	<b>d vs. Both standard tasks</b>
<b>ai_with_teacher</b>	3,45	4,00	1,177548	0,5031
<b>teacher_only</b>	3,34	3,00	1,305093	0,3812
<b>ai_only</b>	3,30	3,00	1,300389	0,3517
<b>textbook1</b>	3,16	3,00	1,054200	-
<b>textbook2</b>	2,66	3,00	0,916315	-

*Table 6 - Interest Scores for Each Task Category*

Quite surprisingly, the TO tasks scored similarly to the AO tasks ( $d = 0.3812$ ). The reason behind such a result is partly revealed when we look at the calculations in Table 5, visualise all student responses with a bar chart and later add the primary intelligence as another dimension.

Looking at the visible difference between the mean and median values for the differentiated group of tasks in Table 5, the chart showing the distribution of the values will certainly be negatively skewed. This is confirmed in Figure 9 which shows quite a large number of responses for values 4 and 5, particularly for AWT tasks. The TO tasks follow a similar trend, on the other hand, with the median value of 3.00 indicating more average results and with the highest count of very negative responses, this category failed to reach the same standard as the AWT. The same is true for the AO category.

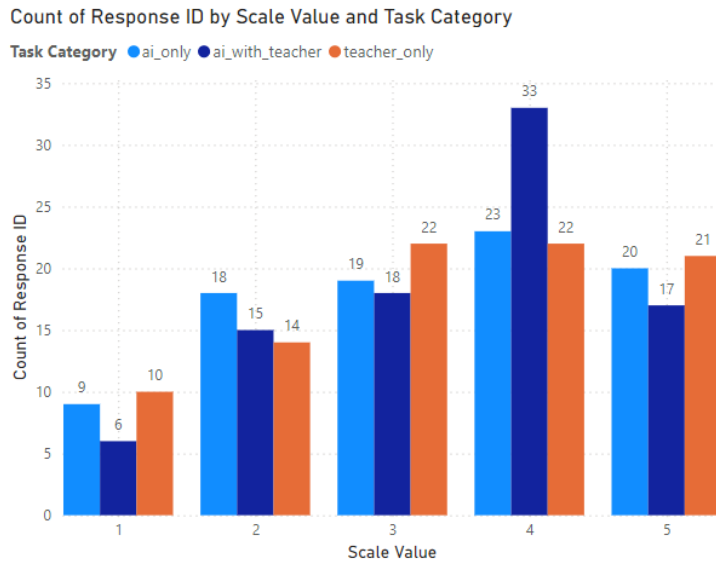


Figure 9 - Individual Responses from the Interest Scale for Differentiated Tasks

Further analysis of the low values uncovers that the majority of these responses were caused by respondents with three specific primary intelligences – intrapersonal, interpersonal and bodily-kinaesthetic.

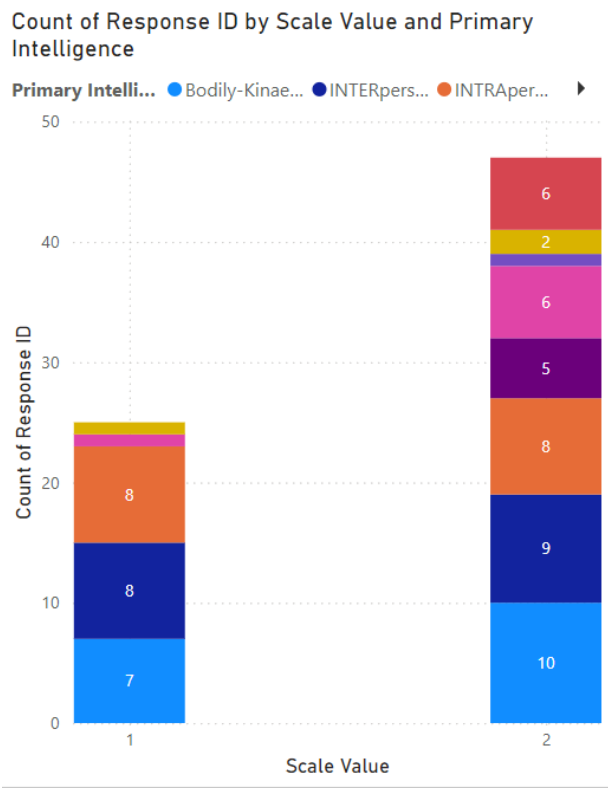


Figure 10 - Analysis of the Low Interest Values for Differentiated Tasks



While intrapersonal students were negative towards all categories, including the standard tasks (Stand mean = 2.33, Diff mean = 2.37), the low scores of the bodily-kinaesthetic group could possibly be seen as mere outliers, for the calculated effect size of differentiated tasks for this intelligence was still similar to the initial Cohen's D between the major task groups (Overall d = 0.3880, BodKin d = 0.3816). In the case of interpersonal intelligence, the occurrence of low scores was indeed high, but was complemented by a number of very positive reviews. In spite of this fact, both inter- and intrapersonal intelligence reported the lowest effect sizes, meaning that for these categories, task differentiation did not result in any visible improvements. The overall effect for the other intelligences can be seen in Table 7.

Task Group Type	differentiated			standard			Effect (d)
	Mean	Median	SD	Mean	Median	SD	
<b>Primary Intelligence</b>							-
<b>INTRApersonal</b>	2,37	2,00	1,244933	2,33	2,00	0,970143	0,0323691
<b>INTERpersonal</b>	2,96	3,00	1,34765	2,90	3,00	0,994814	0,0455462
<b>Bodily-Kinaesthetic</b>	3,39	4,00	1,206887	2,96	3,00	0,968061	0,3816761
<b>Naturalistic-Ecological</b>	3,78	4,00	0,942809	3,42	3,50	0,668558	0,4269760
<b>Verbal-Linguistic</b>	3,70	4,00	1,131505	3,09	3,00	1,269011	0,5101976
<b>Logical-Mathematical</b>	3,44	4,00	1,041618	2,83	2,50	1,029857	0,5892991
<b>Musical</b>	3,75	4,00	1,105183	3,08	3,00	1,059806	0,6130748
<b>Spatial</b>	4,00	4,00	1,309307	2,40	2,00	0,516398	1,4934199
						<b>Total d</b>	0.3880

*Table 7 - Interest Results and Effect Sizes for All Primary Intelligences*

With the addition of the gender dimension, Figure 11 reveals another interesting discrepancy. The difference in means for differentiated and standard tasks is much smaller for female than male, with calculated d being only 0.1367. With this division, the effect size for male suddenly falls into the moderate effect category with d = 0.5638.

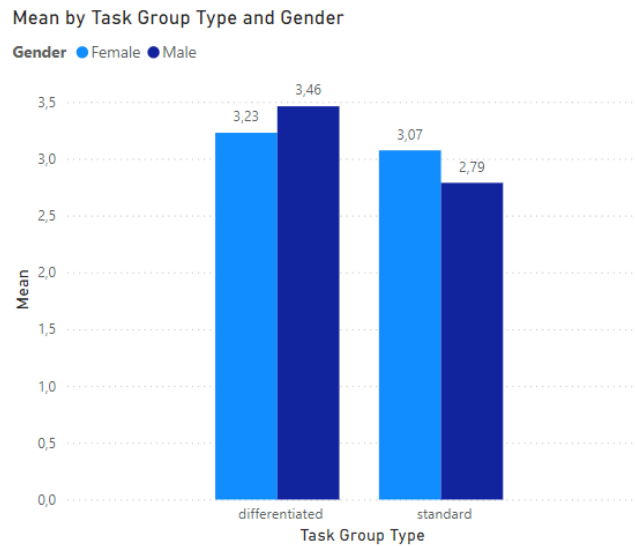


Figure 11 - Interest Scores by Gender

Correspondingly, the ISCED dimension uncovered a similar anomaly, as the lower-secondary students only showed a weak positive response to the differentiated tasks.

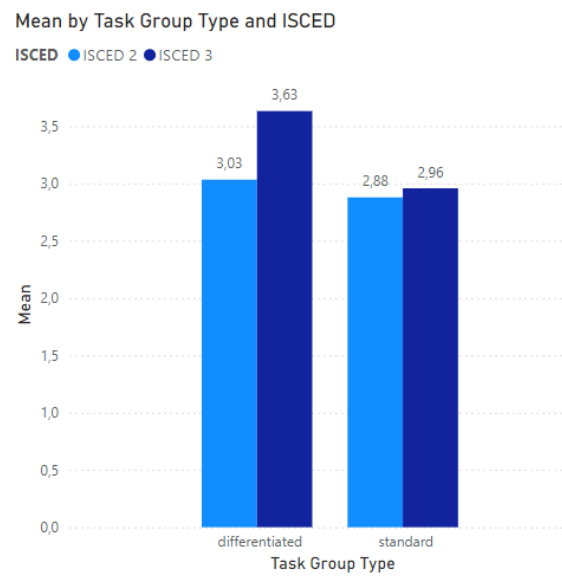


Figure 12 - Interest by ISCED Level

If we combine both of the previous dimensions, we observe a negative effect of differentiation on interest for the first time in this study, specifically for the combination of female and ISCED 2. The Other gender was excluded from Figure 11, as there was only one respondent in this category.

Gender	ISCED	Cohen's D
Female	ISCED 2	-0,1167
Female	ISCED 3	0,4839
Male	ISCED 2	0,4390
Male	ISCED 3	0,6464

Table 8 - The Effect Size of Differentiated Tasks on Interest by Gender and ISCED

Lastly, with the help of Figure 13, the study did not identify any major differences between the effect sizes for homogeneous and heterogeneous English classes ( $d_{\text{hom}} = 0,3922$ ,  $d_{\text{het}} = 0,3785$ ).

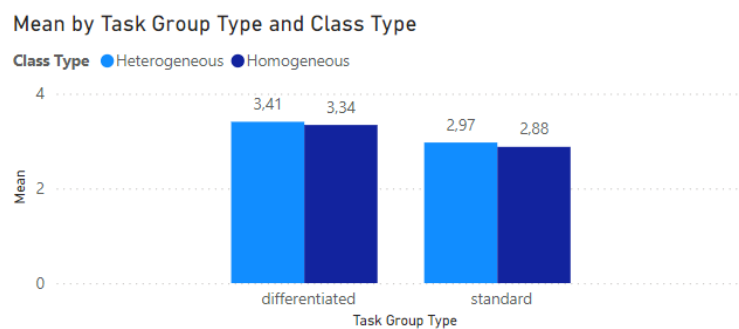


Figure 13 - Interest by Class Type

Although further combination of ISCED level, gender, class type and primary intelligence is possible, the subsequent discussion of the individual results would be too extensive. Moreover, these detailed categories only include a small number of respondents, thus the probability of the results being biased becomes much more plausible. For detailed results see Appendix 5.

### 3.3.1.1.1 Interest - Discussion

Differentiated tasks always reported a positive effect on the tasks' interest value with the exception of the assessments made by female students studying at a lower-secondary school and some very specific combinations of other dimensions. We can only speculate why this student category did not respond to differentiation in the same manner as the other ones, but one hypothesis is that these particular students could have been so used to the structure and nature of the textbook tasks that the sudden introduction of an alternative approach induced a negative response. Such a result was actually predictable based on the after-survey

discussions with the classes. The researcher always asked a simple question whether some students would still choose the textbook exercises over the differentiated ones and amongst those who answered affirmatively were mostly women. The number of these respondents was initially perceived as low, however, the study shows that it was still significant.

Despite the largely positive outcome, the effect size for inter- and intrapersonal intelligences was extremely low (less than 0.05) and alongside several respondents from the bodily-kinaesthetic category, the students with the mentioned intelligences even evaluated some of the differentiated tasks with the interest value of 1. This could potentially signal the limited accuracy of the MI test which could have categorised some of these students improperly or that the researcher and AI failed to generate appropriate exercises for all possessors of these intelligences.

Nonetheless, the use of AI exhibited almost no negative impact on the tasks with regard to interest. Contrary to the expectations, the generated tasks rivalled the manually created set, and on top of that, if used in combination with a proper review from the side of a human teacher, the AI was able to markedly surpass the interest value of the TO tasks. As mentioned above, this dissimilarity was prevalently caused by low values for selected intelligences and only another round of testing could probably confirm if this gap could be eliminated.

For now, the collected data support the assumption that AI can be used as a viable solution for the creation of differentiated tasks, as from the point of view of this section, there are no visible advantages to doing it the traditional way.

#### *3.3.1.2 Comprehensibility*

In chapter 3.2.1.1, the thesis also proposed another condition the AI tasks needed to meet in order to be considered a suitable replacement for the manual process and the student's book

tasks. The generated instructions had to provide the same level of comprehensibility, or at least be very close to the other non-AI categories.

As expected, both standard tasks received high scores on the comprehensibility scale, which is reflected in their combined calculated mean of 4,50. The differentiated tasks are unfortunately slightly behind, meaning that the effect size of using DI was negative with the *d* of -0,2633. Even though such an effect would probably be considered small, the study aimed to reproduce the same comprehensibility standard which is offered by the textbook tasks.

Task Group Type	Mean	Median	SD
<b>differentiated</b>	4,27	5,00	0,866804
<b>standard</b>	4,50	5,00	0,775690

Table 9 - Overall Results for Comprehensibility

The situation gets even worse for the AI tasks with the evidence presented in Table 10. The TO tasks' high comprehensibility score managed to improve the overall rating for the entire differentiated group and without it, the mean of AI tasks drops to 4,17. The worst out of the three approaches was AO with a negative effect size of -0,4700.

Task Category	Mean	Median	SD	d vs. Both standard
<b>ai_only</b>	4,09	4,00	1,040547	-0,4700
<b>ai_with_teacher</b>	4,26	4,00	0,872927	-0,2985
<b>teacher_only</b>	4,46	5,00	0,853551	-0,0490
<b>textbook1</b>	4,48	5,00	0,827268	-
<b>textbook2</b>	4,52	5,00	0,724763	-

Table 10 - Comprehensibility Scores for Each Task Category

The other dimensions only reveal a few interesting findings this time. The only primary intelligence which reported a positive increase in comprehensibility for differentiated tasks was verbal-linguistic. Interestingly, the leading category for this intelligence was AO with a perfect mean of 5,00 while the TO tasks were found to be the least comprehensible (but still with an acceptable mean of 4,73).

Primary Intelligence	Cohen's D
Bodily-Kinaesthetic	-0,3936
INTERpersonal	-0,3738
INTRApersonal	-0,4259
Logical-Mathematical	-0,0653
Musical	-0,2423
Naturalistic-Ecological	0,0000
Spatial	-0,6275
Verbal-Linguistic	0,4038

Table 11 - The Effect Size of Differentiated Tasks on Comprehensibility for Each Intelligence

Task Category	n	Mean	Median	SD
textbook1	11	4,36	5,00	1,2060
teacher_only	11	4,73	5,00	0,4670
ai_with_teacher	11	4,82	5,00	0,4045
textbook2	11	4,82	5,00	0,4045
ai_only	11	5,00	5,00	0,0000

Table 12 - Comprehensibility Scores from Verbal-Linguistic Respondents

In Figure 14, we can identify an anomaly for male evaluations of AO tasks where the mean visibly differs from the mean of the female student group. The calculated effect of AO differentiation on comprehensibility for male actually falls below the threshold for moderate effect size ( $d = -0,6085$ ).

### Mean by Task Category and Gender

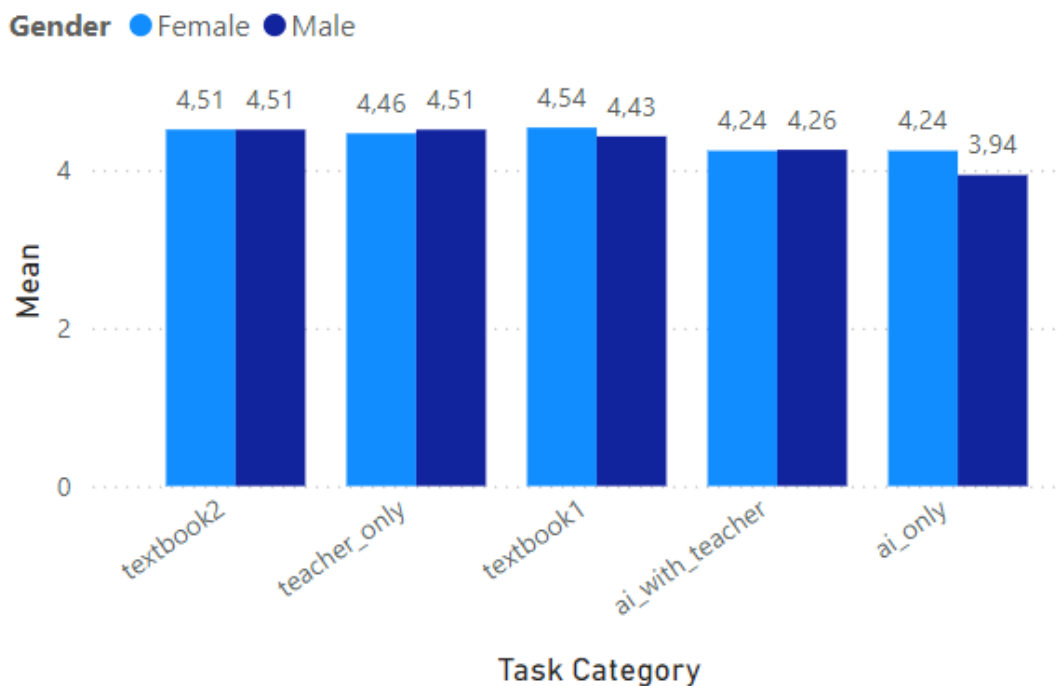


Figure 14 - Comprehensibility by Gender

Furthermore, comparison of the ISCED levels in Figure 15 tells us that upper-secondary students' reactions to AI-generated content, and human-made tasks as well, were not as negative as the reactions collected at ISCED 2.

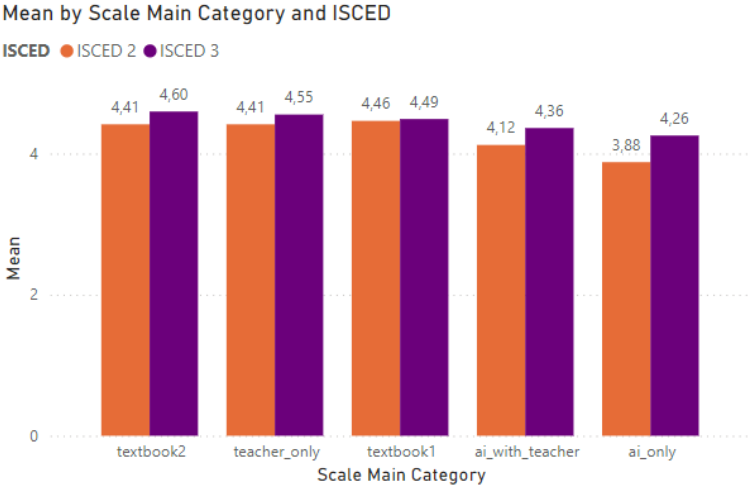


Figure 15 - Comprehensibility by ISCED Level

Finally, similarly to the results relating to interest, analysis by the type of the class did not seem to produce any significant differences with merely slightly better scores gathered for both task groups from homogeneous classes.

Class Type	Task Group Type	
	differentiated	standard
<b>Heterogeneous</b>	4,16	4,42
<b>Homogeneous</b>	4,33	4,54

Table 13 - Comprehensibility Scores by Class Type

For detailed results see Appendix 6.

3.3.1.2.1 Comprehensibility - Discussion

The results from the previous section do not entirely support the hypothesis H2. With an average mean of 4,17, the AI-generated tasks were unable to match the comprehensibility levels of the textbook tasks or the manually created differentiated exercises.

Yet, this outcome is not entirely unexpected. Both TB1 and TB2 have to comply with the highest standards of clarity, as they are included in students' books which often go through

multiple rounds of careful reviews done by renowned academics. For this reason, it was not surprising that the final rating for these categories was indeed high with regard to comprehensibility. The scores of the differentiated tasks also showed a degree of consistency. A trained teacher was predictably able to design clear instructions for the TO tasks, which reported almost identical comprehensibility as the standard group, and the low scores for the AO tasks can be attributed to the AI's acknowledged limitations. At the same time, the expectations for the AWT category were higher. The poor results of this category most likely imply that the researcher's review was not thorough enough and additional adjustments were required.

Returning to the AO tasks, a noticeable discrepancy was found with regard to gender. The feedback from male students was harsher than the one from female students. The explanation for this behaviour can possibly be inferred from the post-survey discussions where several male students admitted the recognition of AI language patterns in some of the phrases used in the texts. Such a claim supports the assumption that AI on its own cannot create appropriate differentiated instructions and that the human element cannot be excluded from this process.

Figure 15 also described the contrast between the two surveyed ISCED levels and found that the AI tasks performed better at upper-secondary schools. A probable reason is the older students' broader knowledge of English vocabulary and grammar, which supposedly made them less prone to the linguistic variation of the AI instructions. For the ISCED 2 students, we can assume that the AI tasks would necessitate either an improved ChatGPT prompt, which could better react to lower CEFR levels, or a much more rigorous human review.

With all this in mind, the results for the AWT category were not entirely terrible with an average rating of 4,26. Furthermore, a question can be raised whether the same tasks reviewed by a different academic could have produced superior results. For these reasons, the study



maintains the view that if the review process were to be slightly improved, this approach to differentiation could be a viable option. However, it is still up to the other teachers to decide whether this comprehensibility trade-off is justifiable in the light of AI's ability to greatly decrease the time needed to create differentiated tasks.

### *3.3.1.3 Perceived Difficulty and Time Complexity*

These other two scales were primarily included with the purpose of finding correlations between the cost of completing the task and the previously analysed interest and comprehensibility scales. As the correlations will be presented in another chapter, this section will only focus on a few general findings.

The presented data in Figure 16 show that the differentiated tasks were evaluated as more difficult and time consuming in comparison with the standard tasks.<sup>22</sup> With AO tasks being perceived as the most difficult with the mean of 2,84 and AWT tasks only 0,02 points behind, and while knowing that both categories struggled in terms of comprehensibility, we can make an assumption that there might actually be a correlation between comprehensibility and perceived difficulty. The difficulty of the standard tasks was assessed as low (TB1 mean = 1,53, TB2 = 1,73).

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<sup>22</sup> Both scales appear to show the same increase even in combination with other dimensions, so any further results for one scale will also be true for the other one as well.

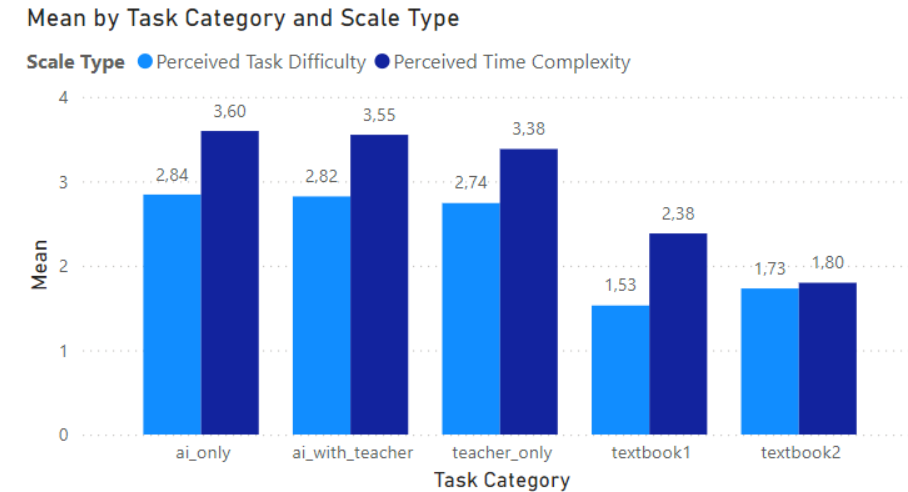


Figure 16 - Difficulty and Time Complexity by Task Category

The analysis of the results for the individual primary intelligences displayed no significant outliers, the same applies to the examination of the type of the class and even the gender dimension showed almost no variation. At least the division by ISCED level offered a visible discrepancy for differentiated tasks, where ISCED 2 level tasks reported a lower level of difficulty (ISCED 3 mean = 3,20, ISCED 2 mean = 2,33).

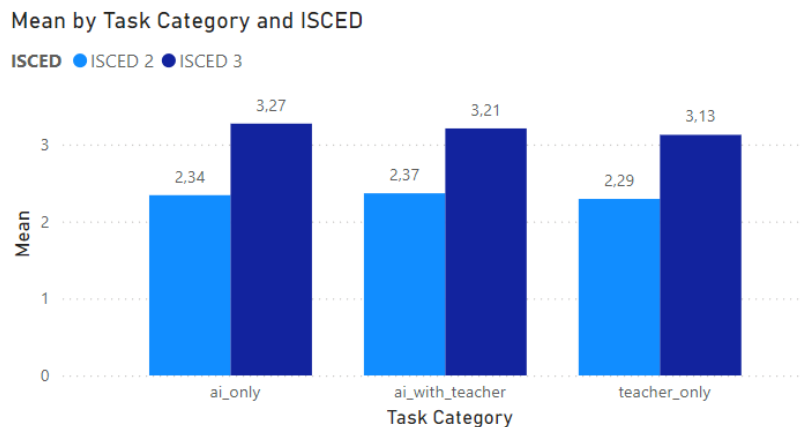


Figure 17 - Difficulty and Time Complexity of Differentiated Tasks by ISCED Level

For detailed results see Appendix 7 and Appendix 8.

### 3.3.1.3.1 Perceived Difficulty and Time Complexity - Discussion

There are several factors which could have influenced students' perception of differentiated tasks with regard to their difficulty. Firstly, the textbook tasks were complemented by images,

as they were simply extracted with a snipping tool from the student's book, and this managed to make the tasks seem easier. Secondly, the textbook tasks were more straightforward and offered only a limited freedom of choice. They either included a vocabulary list with words which the students were supposed to use, or sentence starters to guide the structure of the required output. This is a very likely reason, as the differentiated tasks did not provide this support and students were given the option to use almost anything they wanted. At first, this might sound as an advantage, but the additional requirement of selecting the linguistic elements could definitely increase cognitive load. Lastly, students might already be somewhat aware of how long it takes to complete a textbook task, but their estimates regarding the differentiated tasks could be inaccurate. Such an assumption could have been confirmed with practical testing of the tasks, or a post-task survey instead of a pre-task one.

On top of that, the described difference between the ISCED levels could simply indicate the discrepancy between the selected topics of modal verbs and superlatives/comparatives.

In conclusion, the AI content does not seem to have performed much differently from the TO tasks, so we can assume that the use of AI is not an issue in this case and that the increase in difficulty was probably caused by something else. Nevertheless, the higher difficulty does not necessarily have to be a negative trait, unless the upcoming chapter finds that it adversely affects results from the other scales.

#### *3.3.1.4 Correlations*

With all the scales analysed, we can now turn to the investigation of their relationships. To verify whether there really exists a correlation between the variables, the thesis will use another statistical tool - Pearson's  $r$ . The result of this calculation is a coefficient between -1 and 1, from which the study will be able to determine the strength and the direction of the correlation (Stewart).

In the previous section, an assumption was made that the results for perceived task difficulty can be applied to the perceived time complexity as well. With some exceptions, this is supported by the calculated  $r$  of 0,5615 between these two scales, which represents a moderate strength of correlation. Therefore, the assumption appears to be relatively correct and even if the study intended to divide the task complexity into two scales, students seem to generally associate difficulty with time complexity.

Based on Figure 16 and Table 10, the study predicted another correlation between comprehensibility and perceived difficulty. Again, Pearson's  $r$  of -0,3304 admits the presence of a connection between these variables and the interpretation of this result is that with decreased comprehension, the difficulty of the task increases. An existence of this relationship puts AI-generated tasks at a disadvantage, as their lower comprehensibility score unintentionally makes the tasks slightly more difficult. The calculated  $r$  of 0,2076 also shows a weak relationship between comprehensibility and interest. To conclude, both of these correlations highlight the importance of appropriate instructions and clearly reveal the area preventing the AI tasks from reaching their full potential.

The last task of this section was to test whether there was a link between interest and difficulty. This speculation was presented in chapter 3.2.1.1 with the proposition that relevant tasks of higher difficulty could increase students' interest and consequently stimulate their intrinsic motivation. In fact, the chart plotting both scales in Figure 18 revealed promising results, when all differentiated task categories appeared in the upper-right corner, but Pearson's coefficient with the value of 0,0711 demonstrates only a very small correlation between these variables.

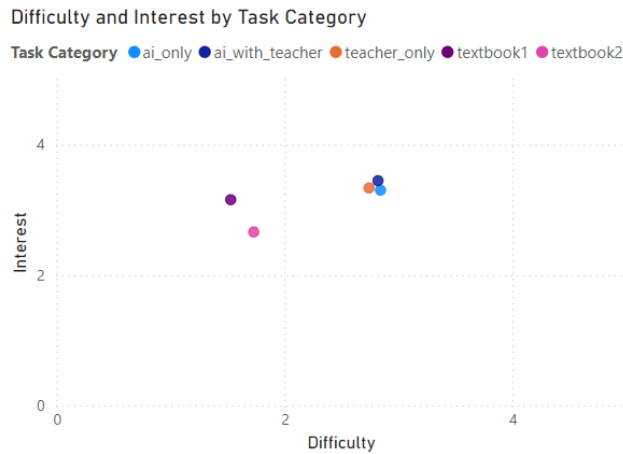


Figure 18 - Scatter Plot with Means for Interest and Difficulty by Task Category

With this result, the idea of leveraging intrinsic motivation seems to be refuted, but as unfortunate as the outcome of this last assumption might be, the positive revelation is that the increased difficulty did not make the tasks less interesting.

### 3.3.2 Survey Discussion

As all the survey data have now been discussed, there should be enough evidence for the study to make a decision whether the hypothesis H2 can be confirmed and whether AI can be used for the purposes of content differentiation with the goal of improving student motivation.

The study previously stated that average difficulty and time complexity mixed with high interest and comprehensibility should represent a well-designed and motivating task. All these variables were identified based on the theory of task-motivation and are thought to contribute to the overall motivational potential.

During the analysis of the interest parameter, the study found that the differentiated tasks are indeed the preferred choice for the majority of students. Moreover, the AI content was able to surpass not only the textbook tasks, but also the differentiated tasks manually created by the researcher.

In terms of comprehensibility, the AI still has a lot of room for improvement and even with a review from a teacher, the tasks could not fully rival the human-generated content. The negative effect of the AO tasks was quite significant, but despite having similar issues, AWT tasks' performance was visibly better. For the AWT content, it can be argued that the results might have improved had the check been done more carefully or by someone else. Additionally, the ChatGPT prompt could be also potentially modified to further reduce the overall number of inaccuracies the model produces. Regrettably, it cannot be clearly discerned from the results whether the issue was an overly advanced language, the lack of detailed instructions or a combination of both, as this particular scale was designed to cover both of these problems. The question of comprehensibility was later found to be even more critical with the discovered correlations with interest and difficulty.

In addition, the two other scales demonstrated that the use of differentiation made the tasks more challenging and time consuming, regardless of the chosen approach to content generation. In spite of this characteristic being often associated with decreased motivation, with almost no visible impact on the interest variable, the increase in difficulty should not be considered as entirely negative and might subtly imply that the increased relevance of the tasks could allow the use of more complex tasks in the classroom without any repercussions.

With all this being said, the study can now draw conclusions regarding H2.

H2: Differentiated tasks generated with the help of AI do have the potential to increase students' motivation, but their content should always be thoroughly reviewed.

The AWT tasks reported a moderate positive effect on the interest value of the tasks, the instructions were still comprehensible, although slightly less than the ones designed purely by a human, and their increased difficulty does not seem to indicate any negative effects. Furthermore, if the comprehensibility issues were to be solved, the effectiveness of AWT tasks

may considerably improve. In contrast, the tasks created solely by AI did not perform at an appropriate level of comprehensibility and with their use, teachers may cause undesirable misunderstandings.

Before the thesis moves on to the teacher interviews, one more detail should be mentioned. In the post-survey discussions, the vast majority of students reacted enthusiastically to the idea of having the chance to work with differentiated content which would be more relevant for them. Nonetheless, they mostly agreed that such an approach is very rare at their schools. Thus, even if the AI might not be the perfect solution, it might still represent a positive step towards more frequent and effective differentiation.

### 3.3.3 Findings from the Interviews

With the perspective of the students sufficiently explored, it is time for the thesis to focus on the second part of the research. In this part, the study aimed to reveal how teachers currently approach the concept of differentiation in their classes and whether they perceive this topic as problematic. Based on personal experience and the list provided by Tomlinson and Imbeau, the major assumption was that most teachers do not differentiate in their classes, or very rarely, due to the time complexity of task preparation (“Common Sticking Points” 19).

Considering this, the researcher wanted to show the teachers the alternative approach to differentiation using AI, find out if such an approach would be a viable solution to the identified issue and to see whether, in combination with the results from the survey, it would convince them to differentiate more frequently. This then formed the hypothesis H3, around which this whole section revolves.

The upcoming paragraphs will primarily focus on the responses from the individual teachers. After that, the last chapter will be dedicated to the identification of similarities (and differences) between the interviewees and the final discussion regarding the verity of H3.

### *3.3.3.1 Teacher 1*

Teacher 1 said in the interviews that he does not differentiate any content for individual students in his classes and that the only time he addresses his students' differences is during the evaluation of their work. Even though he is at the end of his pedagogical studies, he admits he has never been practically taught how to properly differentiate. Therefore, he feels unprepared and rather avoids it. Alongside this, teacher 1 feels that the primary issue is the time complexity of the concept, as the number of other duties associated with the profession of a teacher is already too high. In terms of AI, teacher 1 uses it approximately twice a week for the generation of lesson ideas and materials.

Having seen the AI differentiated tasks, the process of their creation and the responses from the students, he evaluated the proposed approach very positively. Teacher 1 acknowledged that it could indeed reduce the time complexity of differentiation and still offer relevant content to his students. Regardless of that, he agreed that the AO tasks were less appropriate and that the AWT category was his preferred choice. Moreover, teacher 1 was willing to try the approach in future and if the implementation were to be successful, he would definitely include differentiated tasks in his lessons more often. This being said, from the three demonstrated use cases (Gardner's MI, tiered tasks, differentiation based on interests), teacher 1 showed the highest interest in using the AI approach to create tiered tasks.

### *3.3.3.2 Teacher 2*

Despite being significantly more experienced than teacher 1, teacher 2 also differentiates very rarely. Her immediate response to the question why was that there is simply no time to prepare different materials for multiple students at once. She was also very sceptical towards the whole concept of differentiation in the light of the Maturita exam, which assesses everyone uniformly, but agreed that it could still prove to be beneficial for the students. The university where she studied did not provide any practical advice on how to differentiate, but the reason could be the



specific priorities of the educational institutions in the 1980s. With regard to AI, teacher 2 reported that she generally struggles with technology and due to this fact, she never tried any of the generative models. However, with proper guidance, she would be thrilled to try it.

The survey results and the practical demonstration then indeed convinced teacher 2 to consider the use of the AI approach, but still under the condition that the preparation would take less than 30-40 minutes. Later, she insisted on trying the online survey herself and responded very positively to all the differentiated tasks. She did not even find the AI only tasks to be inappropriate, just slightly more challenging. On the other hand, teacher 2 highlighted that she would still use the differentiated tasks only occasionally, approximately once per two weeks, just to break the classroom routine. With regard to the presented use cases, she said she had no preference and would switch between them according to her current needs.

#### *3.3.3.3 Teacher 3*

In contrast to the previous respondents, teacher 3 has ample experience with differentiation. Not only does her school divide students into homogeneous groups, but teacher 3 also actively differentiates internally within the classes. Nevertheless, she said she has never tried to make use of any formal frameworks and that her approach is based mostly on intuition and knowledge of her students. Her approach often involves the creation of alternative instructions, tasks and tests, and she already utilises various AI models during this process.

Similarly to teacher 1, she is also finishing the last year at the Faculty of Education and shares his opinions on the lack of practical training regarding differentiation. Additionally, as far as the time complexity is concerned, teacher 3 definitely agrees that the creation of differentiated tasks is more time-consuming than the use of standard tasks, however, she believes that it is an inherent part of the profession.

With teacher 3 actively differentiating with the help of AI, there was no need to convince her that this approach can work. According to her, the results from the survey and the generated MI tasks only provided additional evidence and inspiration. From the presented options, she selected the MI tasks as the one she would like to try in future.

#### *3.3.3.4 Teacher 4*

The topic of differentiation was not new for the last interviewed teacher either. Her approach largely resembles the one used by teacher 3, but without the employment of AI. Despite not having a primarily pedagogical education, teacher 4 is able to differentiate based on the knowledge of her students' abilities and tries to prepare extra materials and exercises as often as possible. Having said that, she admits she would love to differentiate more frequently, but claims that she does not have enough time to make it happen. Apart from the issue of time complexity, which was yet again mentioned as the main reason, teacher 4 is dissatisfied with the educational atmosphere in the Czech Republic, which highly encourages differentiation, but at the same time forces every student to pass a standardised test during the final Maturita exam.

As teacher 4 had never worked with AI before, she welcomed the opportunity to try it for the first time. Even though she had some objections regarding the completeness of the instructions, she confirmed that the tasks are a good starting point and that they would still speed up the whole process of preparation for a differentiated lesson. With such a tool in her inventory, teacher 4 would surely consider incorporating differentiated tasks into her lessons more often. From the available options, she would choose tiered tasks as they reflect the style of differentiation she currently practises.

### 3.3.4 Interviews - Discussion

From the responses of the four selected teachers, the study should be able to decide whether the last hypothesis H3 can be confirmed and whether the proposed approach to task differentiation would really motivate teachers to differentiate more frequently in English classes.

With only two teachers actively trying to differentiate, the goal was actually not only to show them the approach with which they could differentiate more often, but to make the other two reconsider their decision not to differentiate at all. To do so, the study tried to confirm that the obstacle standing in the way of effective and efficient differentiation is the time complexity of this process and that this thesis could offer an appropriate solution.

The initial interviews successfully endorsed this assumption with all teachers identifying time as the primary issue. Sequentially, the second most mentioned issue was the lack of practical training at pedagogical universities, followed by the perceived issues of national educational policies.

This finding allowed the study to continue with the prepared demonstration of the process of task generation via ChatGPT and the presentation of the results from the student survey. As suspected, both of these activities had a positive effect on the teachers' opinions regarding differentiation. The teachers who do not differentiate were suddenly willing to give it a try and the others thought that the alternative approach could make their current processes more efficient. Although, all teachers shared the same opinion about the necessity of reviewing the AI tasks, as they had some reservations regarding the sufficiency of the provided instructions.

Out of all the respondents, teacher 3 was the most important, because she already proved that the concept can be put into practice. Interestingly, she was the only teacher who actively uses AI for the purposes of differentiation and also the one teacher who did not perceive time to be

such a huge problem. We can only speculate whether these two characteristics are actually related.

Unfortunately, even when faced with the positive results from the survey built around the theory of MI, only two of the four teachers showed interest in the use of Gardner's framework. The other two were more inclined towards the creation of tiered tasks. A possible explanation for this could be that the employment of this framework requires additional collection of data about each student or that the teachers are more confident in using tiered tasks as it is something they have already encountered.

One more note before the thesis verifies the hypothesis H3. Differentiation seems to be more usual at the lower-secondary schools and this might provide another reason for the anomaly in Figure 12. The lower interest score of differentiated tasks reported by ISCED 2 students could perhaps indicate their familiarity with the concept and therefore these tasks did not manage to elicit the same strong reaction as in the case of ISCED 3 students.

Finally, the thesis returns to the hypothesis H3.

H3: Based on the responses from the teachers participating in the interviews, the alternative approach to differentiation with the help of AI can indeed reduce the time needed to create differentiated tasks, provide valuable support to teachers, motivate them to start differentiating in their English classes or help them differentiate more frequently.

## 4 Conclusion

This thesis set out to propose an alternative approach to differentiation which utilises the abilities of generative AI to design sets of tasks for differentiated English lessons. The suggested approach aims to address one of the major perceived drawbacks of this concept, namely its time complexity. The idea was to come up with a more efficient process of differentiation, to test its appropriateness and discuss it with teachers to see if they would choose to adopt it.

The researcher started with a theoretical overview of the chosen phenomena highlighting their importance in the educational process. The first chapters began with the description of differentiation and its positive implications, the second part was dedicated to digital technologies in general and their potential to transform the traditional ways of learning, and the last section dealt specifically with the topic of AI and its inevitable impact on modern education. The theoretical part served as a justification for the selection of the topic for this thesis.

The theory was then followed by an empirical part. To determine the viability of the AI approach, the researcher designed a study comprising three parts. The goal of each part was to verify one of the proposed hypotheses. In the first part, the study designed a ChatGPT prompt which successfully generated differentiated tasks based on Gardner's theory of MI, proving AI's ability to become a tool helping with differentiation.

To verify whether these tasks can be used in English classes and how they perform in comparison with human-generated content, they were evaluated in the next part by lower- and upper-secondary students in an online questionnaire. The primary observed variable was the motivational value of the tasks. We learned from the collected data that students would prefer to work with differentiated exercises regardless of the process behind their creation, and that even the AI tasks had the potential to positively influence student motivation. As the study also

revealed that the use of AI can slightly decrease the comprehensibility of the task instructions, we can safely assume that the human element still cannot be fully eliminated from the process. Furthermore, the suggested approach appears to be more effective at upper-secondary schools, as the ISCED 3 students seemed to be less sensitive to the aforementioned fluctuations in comprehensibility.

Lastly, the approach was shown to teachers. In the interviews, the research confirmed the assumption that teachers currently struggle with differentiation due to the issue of having limited time in their schedules. This being the case, the AI approach had a great potential to improve their situation. After the practical demonstration and the presentation of the survey results, teachers indeed admitted that this approach would motivate them to make use of differentiation more regularly, but despite the survey results, teachers would rather adopt the suggested approach to generate tiered tasks rather than to follow Gardner's framework of MI.

With these largely positive findings, the author of this thesis believes that the proposed alternative approach could be of benefit not only to teachers who are looking for ways how to effectively differentiate in their classes, but also to students who could consequently encounter content tailored to their needs and interests more frequently. The use of generative AI for this purpose might be considered controversial by some academics, but the potential of this technology to enhance various processes within the field of education should not be ignored.

## 5 Limitations of the Study and Future Research

The main limitation of the study is the lack of long-term practical testing of the generated tasks. However, the research was deliberately designed only to test the potential of AI and the appropriateness of its application, as the researcher did not want to waste students' and teachers' valuable time if it were to be revealed that the proposed approach could be ineffective or even have a detrimental impact on the learning process. Nevertheless, with the favourable outcome of the thesis, there is now an opportunity for further research which would field test the AI tasks and determine their actual performance.

Also, the teacher sample consisting of four respondents is indeed very small and even though their opinions regarding the use of AI for differentiation were similarly positive, any generalisations made based on the results from the interviews should be postponed until a larger number of teachers have had the chance to evaluate the process.

Additionally, the study is aware of the limited accuracy of the MI test which might have slightly affected the survey results. Despite that, no objections were raised by the surveyed students and the thesis believes that the increased accuracy would have likely influenced the results positively rather than negatively. Having said that, the thesis recommends to use the test only as a complementary tool to other methods helping with the recognition of student differences.

## 6 List of Used Abbreviations

DI – Differentiated Instructions

AI – Artificial Intelligence

MI – Multiple Intelligences

ICT – Information and Communication Technology

TEL – Technology-enhanced Learning

LLM – Large Language Model

AWT – Differentiated task created with the help of AI and reviewed by the researcher

AO – Differentiated task created only with the help of AI

TO – Manually created differentiated task by the researcher



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*Appendix 1 - Examples of Statements Used in the MI Test*

1) Myslím si, že mám širokou slovní zásobu. \*

0  1  2  3

2) Vždy si snadno poradím s matematickými úlohami. \*

0  1  2  3

3) Hudba je velmi významnou součástí mého každodenního života. \*

0  1  2  3

4) K lepšímu pochopení učiva/faktů potřebuji obrázky, čísla a diagramy. \*

0  1  2  3

5) Vynikám v jednom nebo více sportech. \*

0  1  2  3

6) Mám pocit, že jsem oblíbený a dobře vycházím s lidmi všech věkových kategorií. \*

0  1  2  3

7) Často v sobě hledám slabiny, které vidím u druhých. \*

0  1  2  3

8) Pobyt v přírodě mě dokáže uklidnit/nabít energií. \*

0  1  2  3

1.

c Talk to a partner. Compare the three things in each group using the **bold** adjective, e.g. for 1, decide which is the most dangerous, and then compare the other two. Say why.

- 1 **dangerous** cycling  
driving  
riding a motorbike
- 2 **easy** learning to drive  
learning to ride a bike  
learning to ride a horse
- 3 **relaxing** driving  
flying  
travelling by train
- 4 **difficult** sleeping on a coach  
sleeping on a plane  
sleeping on a train
- 5 **boring** being stuck in a traffic jam  
waiting at an airport  
waiting for a bus

*I think cycling is the most dangerous because sometimes drivers don't see cyclists. Riding a motorbike is more dangerous than driving.*

Úloha je zajímavá a bavila by mě. (Ia1) \*

1	2	3	4	5
Naprosto nesouhlasím			Naprosto souhlasím	

Z instrukcí je mi jasné, co mám dělat a co se po mně chce. (Ia1) \*

1	2	3	4	5
Naprosto nesouhlasím			Naprosto souhlasím	

Úloha se mi zdá náročná (do odpovědi nezahrnujte časovou náročnost) (Ia1) \*

1	2	3	4	5
Naprosto nesouhlasím			Naprosto souhlasím	

Zdá se mi, že je úloha ČASOVĚ náročná. (Ia1) \*

1	2	3	4	5
Naprosto nesouhlasím			Naprosto souhlasím	

Appendix 3 - Example of AWT Task Used in the Survey

**4. Task: Compare and contrast available data sets. Use the internet to find and analyze two sets of data (e.g., weather temperatures in different cities/countries or sports statistics) and describe each of them. Include sentences using comparative and superlative forms to describe trends and differences/similarities between the data sets. In your texts, use at least four comparatives and three superlatives.**

Úloha je zajímavá a bavila by mě. (M4) \*

1 2 3 4 5

Naprost  
nesouhlasím

Naprost  
souhlasím

Z instrukcí je mi jasné, co mám dělat a co se po mně chce. (M4) \*

1 2 3 4 5

Naprost  
nesouhlasím

Naprost  
souhlasím

Úloha se mi zdá náročná (do odpovědi nezahrnujte časovou náročnost) (M4) \*

1 2 3 4 5

Naprost  
nesouhlasím

Naprost  
souhlasím

Zdá se mi, že je úloha ČASOVĚ náročná. (M4) \*

1 2 3 4 5

Naprost  
nesouhlasím

Naprost  
souhlasím

**Pre-Survey part**

Jak dlouho učíte?

Setkal/a jste se s diferencovanou výukou již na vysoké škole?

Pokud ano, v jaké míře?

Snažíte se ve své třídě diferencovat výuku?

Jak?

Dělá vám problém diferencovat výuku/Případně proč nediferencujete? Jaké jsou hlavní důvody?

Jak případně vytváříte diferencované materiály/materiály obecně? Zkoušel/a jste na to někdy použít AI?

**Post-Survey part**

Využil/a byste tohoto způsobu tvorby diferencovaných materiálů pomocí AI?

Motivovalo by Vás to (začít/častěji) diferencovat výuku?

Který z použitých přístupů je podle Vás nejlepší a proč - Manuální, AI s úpravami od učitele, pouze AI?

Použil/a byste úlohy někdy jenom tak, jak by je AI vygenerovalo? Proč/Kdy?

Jaké má AI přístup podle vás výhody/nevýhody? Jaké v tom vidíte nedostatky/Kde je prostor pro zlepšení?

Pro který typ diferencovaných úloh byste AI hlavně využil/a - Multiple Intelligences, gradované úlohy, diferenciace na základě žákovských zájmů, kombinací? Proč?

Appendix 5 - Interest Results for All Combinations (Differentiated Group of Tasks vs. Standard Group)

Gender	ISCED	Class Type	Primary Intelligence	n	Differentiated Mean	Differentiated StDev	Standard Mean	Standard StDev	Cohen's D
Female	ISCED 3	Homogeneous	Spatial	1	5,00	0,00000	2,00	0,00000	Infinity
Other	ISCED 3	Homogeneous	Spatial	1	4,33	0,57735	2,00	0,00000	4,9497
Male	ISCED 2	Homogeneous	Verbal-Linguistic	1	4,33	0,57735	2,50	0,70711	2,9399
Male	ISCED 3	Heterogeneous	Musical	1	4,33	0,57735	3,00	0,00000	2,8284
Male	ISCED 3	Heterogeneous	Verbal-Linguistic	1	4,33	1,15470	2,00	1,41421	1,8708
Female	ISCED 3	Heterogeneous	Musical	3	4,33	0,50000	3,00	1,09545	1,6997
Male	ISCED 3	Homogeneous	Musical	2	4,00	1,09545	2,75	1,50000	0,9901
Male	ISCED 3	Homogeneous	Spatial	2	4,00	1,54919	2,75	0,50000	0,9901
Male	ISCED 3	Homogeneous	Bodily-Kinaesthetic	7	3,29	1,05560	2,36	0,84190	0,9504
Female	ISCED 3	Homogeneous	Naturalistic-Ecological	3	4,11	0,92796	3,33	0,81650	0,8771
Female	ISCED 2	Homogeneous	Musical	2	3,67	0,81650	3,00	0,81650	0,8165
Female	ISCED 2	Heterogeneous	Logical-Mathematical	1	3,33	1,15470	2,50	0,70711	0,8111
Male	ISCED 2	Homogeneous	Logical-Mathematical	1	3,33	1,15470	2,50	0,70711	0,8111
Male	ISCED 3	Heterogeneous	INTERpersonal	1	4,33	1,15470	3,50	0,70711	0,8111
Male	ISCED 3	Homogeneous	INTERpersonal	1	4,33	1,15470	3,50	0,70711	0,8111
Male	ISCED 3	Homogeneous	Logical-Mathematical	3	3,56	1,13039	2,67	1,21106	0,7649
Male	ISCED 3	Heterogeneous	Bodily-Kinaesthetic	5	4,00	1,00000	3,30	0,94868	0,7141
Male	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	3,83	1,19342	3,00	1,19523	0,6979
Female	ISCED 3	Heterogeneous	Verbal-Linguistic	2	3,00	1,26491	2,50	0,57735	0,4714
Male	ISCED 2	Heterogeneous	INTERpersonal	2	2,67	0,51640	2,25	1,50000	0,4145
Female	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,17	0,98319	3,75	1,25831	0,3807
Male	ISCED 2	Homogeneous	INTRApersonal	3	2,22	1,30171	1,83	0,75277	0,3464
Male	ISCED 2	Homogeneous	Bodily-Kinaesthetic	1	2,33	1,52753	2,00	0,00000	0,2673
Male	ISCED 2	Homogeneous	Naturalistic-Ecological	1	3,67	0,57735	3,50	0,70711	0,2673
Male	ISCED 3	Heterogeneous	INTRApersonal	1	1,00	0,00000	1,00	0,00000	NaN
Male	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,00	0,89443	3,75	1,50000	0,2157
Female	ISCED 2	Homogeneous	Spatial	1	2,67	1,15470	2,50	0,70711	0,1622
Male	ISCED 2	Homogeneous	INTERpersonal	4	3,33	1,43548	3,13	1,45774	0,1443
Female	ISCED 2	Heterogeneous	Naturalistic-Ecological	1	3,67	1,52753	3,50	0,70711	0,1270
Female	ISCED 2	Homogeneous	Verbal-Linguistic	3	3,22	1,20185	3,17	1,47196	0,0423
Female	ISCED 3	Heterogeneous	INTERpersonal	1	2,33	1,52753	2,50	0,70711	-0,1270
Male	ISCED 3	Homogeneous	INTRApersonal	3	3,00	1,22474	3,17	0,75277	-0,1560
Female	ISCED 2	Heterogeneous	INTRApersonal	2	2,33	1,03280	2,50	0,57735	-0,1873
Female	ISCED 2	Homogeneous	Bodily-Kinaesthetic	4	2,92	1,16450	3,13	0,64087	-0,2095
Female	ISCED 3	Homogeneous	Musical	4	3,08	1,37895	3,38	1,18773	-0,2230
Female	ISCED 2	Homogeneous	INTERpersonal	5	2,40	1,35225	2,80	0,42164	-0,3678
Female	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	3,08	1,37895	3,63	0,74402	-0,4615
Female	ISCED 2	Heterogeneous	INTERpersonal	1	2,67	0,57735	3,00	0,00000	-0,7071
Male	ISCED 3	Heterogeneous	Logical-Mathematical	1	3,33	1,15470	4,00	0,00000	-0,7071
Female	ISCED 3	Heterogeneous	Naturalistic-Ecological	1	3,00	0,00000	3,50	0,70711	-1,2247
<b>Total</b>				<b>89</b>	<b>3,36</b>	<b>1,25919</b>	<b>2,91</b>	<b>1,01559</b>	<b>0,3880</b>

*Appendix 6 - Comprehensibility Results for All Combinations (Differentiated Group of Tasks vs. Standard Group)*

Gender	ISCED	Class Type	Primary Intelligence	n	Differentiated Mean	Differentiated StDev	Standard Mean	Standard StDev	Cohen's D
Female	ISCED 2	Heterogeneous	INTERpersonal	1	5,00	0,00000	5,00	0,00000	NaN
Female	ISCED 2	Homogeneous	Verbal-Linguistic	3	5,00	0,00000	5,00	0,00000	NaN
Female	ISCED 3	Heterogeneous	Naturalistic-Ecological	1	4,67	0,57735	4,00	0,00000	1,4142
Male	ISCED 2	Homogeneous	Bodily-Kinaesthetic	1	5,00	0,00000	5,00	0,00000	NaN
Male	ISCED 3	Heterogeneous	Verbal-Linguistic	1	5,00	0,00000	2,50	2,12132	2,0412
Male	ISCED 3	Homogeneous	INTERpersonal	1	4,67	0,57735	4,00	0,00000	1,4142
Male	ISCED 2	Homogeneous	Logical-Mathematical	1	4,33	0,57735	3,50	0,70711	1,3363
Female	ISCED 2	Heterogeneous	Naturalistic-Ecological	1	5,00	0,00000	4,50	0,70711	1,2247
Male	ISCED 3	Homogeneous	Musical	2	5,00	0,00000	4,75	0,50000	0,8165
Female	ISCED 3	Homogeneous	Spatial	1	4,33	0,57735	4,00	0,00000	0,7071
Male	ISCED 3	Homogeneous	Logical-Mathematical	3	5,00	0,00000	4,83	0,40825	0,6583
Female	ISCED 2	Homogeneous	Bodily-Kinaesthetic	4	4,33	0,49237	4,00	1,41421	0,3464
Male	ISCED 2	Homogeneous	Verbal-Linguistic	1	4,67	0,57735	4,50	0,70711	0,2673
Male	ISCED 3	Heterogeneous	INTERpersonal	1	4,67	0,57735	4,50	0,70711	0,2673
Male	ISCED 3	Heterogeneous	Musical	1	4,67	0,57735	4,50	0,70711	0,2673
Female	ISCED 3	Heterogeneous	Verbal-Linguistic	2	4,83	0,40825	4,75	0,50000	0,1873
Male	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,83	0,40825	4,75	0,50000	0,1873
Female	ISCED 3	Heterogeneous	Musical	3	4,67	0,50000	4,67	0,51640	0,0000
Female	ISCED 2	Heterogeneous	INTRApersonal	2	4,67	0,51640	4,75	0,50000	-0,1633
Female	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,67	0,51640	4,75	0,50000	-0,1633
Male	ISCED 3	Homogeneous	Bodily-Kinaesthetic	7	4,00	0,83666	4,29	0,82542	-0,3433
Male	ISCED 2	Homogeneous	INTRApersonal	3	4,11	1,26930	4,50	0,54772	-0,3696
Female	ISCED 2	Homogeneous	INTERpersonal	5	4,27	1,16292	4,70	0,48305	-0,4531
Male	ISCED 2	Heterogeneous	INTERpersonal	2	3,17	0,40825	3,50	1,00000	-0,4815
Male	ISCED 3	Homogeneous	INTRApersonal	3	4,22	1,09291	4,67	0,51640	-0,4856
Female	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	3,33	1,43548	4,00	1,19523	-0,4949
Male	ISCED 2	Homogeneous	INTERpersonal	4	3,58	1,31137	4,25	1,03510	-0,5503
Female	ISCED 3	Homogeneous	Musical	4	4,50	0,79772	4,88	0,35355	-0,5669
Female	ISCED 3	Homogeneous	Naturalistic-Ecological	3	4,56	0,52705	4,83	0,40825	-0,5730
Female	ISCED 2	Homogeneous	Musical	2	4,33	0,81650	4,75	0,50000	-0,5832
Male	ISCED 2	Homogeneous	Naturalistic-Ecological	1	4,67	0,57735	5,00	0,00000	-0,7071
Other	ISCED 3	Homogeneous	Spatial	1	4,00	1,73205	5,00	0,00000	-0,7071
Female	ISCED 2	Homogeneous	Spatial	1	2,33	0,57735	3,50	2,12132	-0,8890
Male	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	4,42	0,79296	5,00	0,00000	-0,9410
Female	ISCED 2	Heterogeneous	Logical-Mathematical	1	3,00	1,00000	4,00	0,00000	-1,2247
Male	ISCED 3	Heterogeneous	Bodily-Kinaesthetic	5	4,20	0,67612	4,90	0,31623	-1,2425
Male	ISCED 3	Homogeneous	Spatial	2	3,83	0,40825	4,50	0,57735	-1,3926
Male	ISCED 3	Heterogeneous	INTRApersonal	1	3,33	0,57735	4,00	0,00000	-1,4142
Male	ISCED 3	Heterogeneous	Logical-Mathematical	1	3,33	0,57735	4,00	0,00000	-1,4142
Female	ISCED 3	Heterogeneous	INTERpersonal	1	3,00	0,00000	4,00	0,00000	-Infinity
<b>Total</b>				<b>89</b>	<b>4,27</b>	<b>0,93508</b>	<b>4,50</b>	<b>0,77569</b>	<b>-0,2633</b>



*Appendix 7 - Perceived Task Difficulty Results for All Combinations (Differentiated Group of Tasks vs. Standard Group)*

Gender	ISCED	Class Type	Primary Intelligence	n	Differentiated Mean	Differentiated StDev	Standard Mean	Standard StDev
Female	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	3,17	1,02986	2,00	0,92582
Female	ISCED 2	Homogeneous	Bodily-Kinaesthetic	4	2,92	0,90034	1,63	0,51755
Female	ISCED 2	Heterogeneous	INTERpersonal	1	1,00	0,00000	1,00	0,00000
Female	ISCED 2	Homogeneous	INTERpersonal	5	1,80	0,94112	1,20	0,42164
Female	ISCED 2	Heterogeneous	INTRApersonal	2	1,50	0,83666	1,25	0,50000
Female	ISCED 2	Homogeneous	Logical-Mathematical	1	2,00	0,00000	2,00	0,00000
Female	ISCED 2	Homogeneous	Musical	2	2,33	1,03280	1,75	0,95743
Female	ISCED 2	Heterogeneous	Naturalistic-Ecological	1	2,33	0,57735	1,50	0,70711
Female	ISCED 2	Homogeneous	Spatial	1	2,67	0,57735	2,50	2,12132
Female	ISCED 2	Homogeneous	Verbal-Linguistic	3	1,78	0,66667	1,17	0,40825
Female	ISCED 3	Heterogeneous	INTERpersonal	1	3,00	1,00000	2,50	0,70711
Female	ISCED 3	Heterogeneous	Musical	3	4,00	1,11803	1,33	0,51640
Female	ISCED 3	Homogeneous	Musical	4	3,08	1,50504	1,25	0,46291
Female	ISCED 3	Heterogeneous	Naturalistic-Ecological	1	3,67	0,57735	1,50	0,70711
Female	ISCED 3	Homogeneous	Naturalistic-Ecological	3	3,22	1,09291	1,33	0,51640
Female	ISCED 3	Homogeneous	Spatial	1	3,00	1,00000	1,50	0,70711
Female	ISCED 3	Heterogeneous	Verbal-Linguistic	2	3,17	0,75277	1,25	0,50000
Female	ISCED 3	Homogeneous	Verbal-Linguistic	2	2,83	1,47196	1,00	0,00000
Male	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	2,50	0,90453	2,00	1,06904
Male	ISCED 2	Homogeneous	Bodily-Kinaesthetic	1	2,00	1,00000	1,00	0,00000
Male	ISCED 2	Heterogeneous	INTERpersonal	2	3,00	0,63246	2,75	0,95743
Male	ISCED 2	Homogeneous	INTERpersonal	4	2,08	1,31137	1,75	0,70711
Male	ISCED 2	Homogeneous	INTRApersonal	3	2,78	0,83333	1,83	1,16905
Male	ISCED 2	Homogeneous	Logical-Mathematical	1	2,33	1,15470	2,00	0,00000
Male	ISCED 2	Homogeneous	Naturalistic-Ecological	1	2,33	0,57735	1,50	0,70711
Male	ISCED 2	Homogeneous	Verbal-Linguistic	1	2,00	0,00000	1,50	0,70711
Male	ISCED 3	Heterogeneous	Bodily-Kinaesthetic	5	3,13	1,18723	1,90	0,87560
Male	ISCED 3	Homogeneous	Bodily-Kinaesthetic	7	2,81	1,03049	1,71	0,72627
Male	ISCED 3	Heterogeneous	INTERpersonal	1	2,67	1,15470	2,00	1,41421
Male	ISCED 3	Homogeneous	INTERpersonal	1	2,67	1,15470	1,00	0,00000
Male	ISCED 3	Heterogeneous	INTRApersonal	1	4,33	1,15470	2,00	0,00000
Male	ISCED 3	Homogeneous	INTRApersonal	3	3,89	0,78174	1,83	0,40825
Male	ISCED 3	Heterogeneous	Logical-Mathematical	1	3,33	0,57735	2,00	0,00000
Male	ISCED 3	Homogeneous	Logical-Mathematical	3	3,67	0,70711	1,83	1,16905
Male	ISCED 3	Heterogeneous	Musical	1	2,67	0,57735	1,50	0,70711
Male	ISCED 3	Homogeneous	Musical	2	3,17	0,75277	1,50	0,57735
Male	ISCED 3	Homogeneous	Spatial	2	3,33	1,21106	1,75	0,95743
Male	ISCED 3	Heterogeneous	Verbal-Linguistic	1	3,33	0,57735	2,00	1,41421
Male	ISCED 3	Homogeneous	Verbal-Linguistic	2	2,83	0,40825	1,25	0,50000
Other	ISCED 3	Homogeneous	Spatial	1	2,33	1,52753	1,00	0,00000
<b>Total</b>				<b>89</b>	<b>2,80</b>	<b>1,12804</b>	<b>1,63</b>	<b>0,76479</b>

*Appendix 8 - Perceived Time Complexity Results for All Combinations (Differentiated Group of Tasks vs. Standard Group)*

Gender	ISCED	Class Type	Primary Intelligence	n	Differentiated Mean	Differentiated StDev	Standard Mean	Standard StDev
Female	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	3,50	1,24316	1,50	0,53452
Female	ISCED 2	Homogeneous	Bodily-Kinaesthetic	4	3,42	0,66856	2,50	0,92582
Female	ISCED 2	Heterogeneous	INTERpersonal	1	1,00	0,00000	1,00	0,00000
Female	ISCED 2	Homogeneous	INTERpersonal	5	2,13	1,12546	1,30	0,67495
Female	ISCED 2	Heterogeneous	INTRApersonal	2	2,17	1,16905	1,50	0,57735
Female	ISCED 2	Heterogeneous	Logical-Mathematical	1	4,33	0,57735	2,50	0,70711
Female	ISCED 2	Homogeneous	Musical	2	2,17	1,32916	1,50	0,57735
Female	ISCED 2	Heterogeneous	Naturalistic-Ecological	1	3,33	0,57735	2,00	1,41421
Female	ISCED 2	Homogeneous	Spatial	1	2,67	0,57735	3,00	2,82843
Female	ISCED 2	Homogeneous	Verbal-Linguistic	3	2,11	1,05409	1,17	0,40825
Female	ISCED 3	Heterogeneous	INTERpersonal	1	2,67	0,57735	2,00	0,00000
Female	ISCED 3	Heterogeneous	Musical	3	4,33	0,70711	2,67	1,63299
Female	ISCED 3	Homogeneous	Musical	4	4,33	0,65134	1,88	0,83452
Female	ISCED 3	Heterogeneous	Naturalistic-Ecological	1	4,33	1,15470	1,50	0,70711
Female	ISCED 3	Homogeneous	Naturalistic-Ecological	3	4,33	0,70711	3,00	1,09545
Female	ISCED 3	Homogeneous	Spatial	1	4,00	0,00000	2,50	2,12132
Female	ISCED 3	Heterogeneous	Verbal-Linguistic	2	4,17	0,40825	2,00	0,81650
Female	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,50	0,54772	2,75	0,95743
Male	ISCED 2	Heterogeneous	Bodily-Kinaesthetic	4	2,92	1,08362	2,13	1,24642
Male	ISCED 2	Homogeneous	Bodily-Kinaesthetic	1	2,67	0,57735	1,00	0,00000
Male	ISCED 2	Heterogeneous	INTERpersonal	2	2,83	0,40825	2,75	0,95743
Male	ISCED 2	Homogeneous	INTERpersonal	4	3,50	0,90453	1,88	1,35620
Male	ISCED 2	Homogeneous	INTRApersonal	3	3,78	0,83333	1,83	0,98319
Male	ISCED 2	Homogeneous	Logical-Mathematical	1	3,67	2,30940	4,00	0,00000
Male	ISCED 2	Homogeneous	Naturalistic-Ecological	1	4,00	0,00000	1,50	0,70711
Male	ISCED 2	Homogeneous	Verbal-Linguistic	1	4,00	0,00000	1,50	0,70711
Male	ISCED 3	Heterogeneous	Bodily-Kinaesthetic	5	2,93	1,16292	2,10	0,99443
Male	ISCED 3	Homogeneous	Bodily-Kinaesthetic	7	3,29	1,18924	2,21	1,25137
Male	ISCED 3	Heterogeneous	INTERpersonal	1	4,67	0,57735	3,50	0,70711
Male	ISCED 3	Homogeneous	INTERpersonal	1	3,33	0,57735	2,00	0,00000
Male	ISCED 3	Heterogeneous	INTRApersonal	1	5,00	0,00000	2,00	0,00000
Male	ISCED 3	Homogeneous	INTRApersonal	3	4,78	0,44096	2,33	1,21106
Male	ISCED 3	Heterogeneous	Logical-Mathematical	1	4,00	1,00000	2,50	0,70711
Male	ISCED 3	Homogeneous	Logical-Mathematical	3	4,11	0,78174	1,83	0,75277
Male	ISCED 3	Heterogeneous	Musical	1	4,67	0,57735	3,00	1,41421
Male	ISCED 3	Homogeneous	Musical	2	4,00	0,89443	2,00	1,15470
Male	ISCED 3	Homogeneous	Spatial	2	4,00	0,89443	3,00	1,15470
Male	ISCED 3	Heterogeneous	Verbal-Linguistic	1	4,00	1,00000	2,50	2,12132
Male	ISCED 3	Homogeneous	Verbal-Linguistic	2	4,33	0,51640	2,00	1,15470
Other	ISCED 3	Homogeneous	Spatial	1	4,33	1,15470	2,50	2,12132
<b>Total</b>				<b>89</b>	<b>3,51</b>	<b>1,19637</b>	<b>2,09</b>	<b>1,09586</b>