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USING DIFFERENTIATION STRATEGIES FOR GIFTED PUPILS IN PRIMARY SCHOOL SCIENCE CLASSES

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Abstract/Izvleček The aim of this study was to determine the extent to which gifted pupils receive differentiated instruction in primary school science classes, which of the differentiated instruction strategies are used by teachers and how often. The survey sample included 134 primary school teachers. The results show that teachers frequently use questioning and thinking activities but make only minor modifications in the regular curriculum to meet the needs of gifted pupils. Gifted pupils rarely engage in activities such as providing challenges and choices, differentiated reading and writing assignments, individually set work, activities involving curriculum modification, and enrichment centres.

Uporaba strategij diferenciacije za nadarjene učence pri začetnem poučevanju naravoslovja

Namen raziskave je bil ugotoviti, v kolikšni meri so nadarjeni učenci vključeni v procese diferenciacije v začetnem poučevanju naravoslovja, katere strategije diferenciranega poučevanja učitelji izvajajo in kako pogosto. V raziskavo je bil vključen vzorec 134 učiteljev v osnovni šoli. Rezultati raziskave kažejo, da učitelji najpogosteje uporabljajo zasliševalne postopke za razvijanje študentskega mišljenja, vendar v redni učni načrt vnesejo le manjše spremembe, da bi zadovoljili potrebe znanstveno nadarjenih študentov. Nadarjeni učenci so redko vključeni v dejavnosti, kot so zagotavljanje izzivov in izbire, uporaba različnih bralnih in pisnih nalog, individualno delo, dejavnosti v katerih so vključene spremembe učnega načrta in dejavnosti v obogatitvenih centrov.

Keywords:
gifted pupils, differentiation, primary school science class, development of pupils' competences

Ključne besede:
nadarjeni učenci, diferenciacija, začetno poučevanje naravoslovja, razvoj študentskih kompetenc

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Introduction

Differentiated instruction is a process in which a teacher, having analysed the specific needs of each pupil within a heterogeneous classroom, adapts the curriculum and activities to their individual needs (Tomlinson, 2001). This process involves allowing pupils to learn in several different ways in accordance with their abilities (Munro, 2012). Such an approach to instruction contrasts with traditional teaching methods, in which all activities are adapted to the "average and medium pupil", while ignoring pupils' individual characteristics (Table 1).

Table 1. Comparing traditional and differentiated classrooms

	Traditional classroom	Differentiated classroom
Teaching and learning strategies	Dominance of whole-class instruction.	Multiple teaching and learning strategies are used. Flexible grouping and regrouping of pupils according to instructional objectives and in response to pupils' needs (Munro, 2012).
Learning focus	Learning focus is on mastery of facts and skills out-of-context.	Emphasis on understanding key concepts and application of essential skills in the real-life context (Huebner, 2010).
Learning assignments	Emphasis on using single option assignments.	Emphasis on using multi option assignments. The contrast is in the depth and complexity of tasks (Munro, 2012).
Pupils' interests	Interests are less frequently assessed. Instruction is driven by the curriculum content coverage.	Incorporate pupils' interests to increase their motivation for learning and to maximize individual potential (Tomlinson, 2001).
Assessment and evaluation	Assessment usually takes place at the end of learning to see the results.	Implement multifaceted, continual assessment to guide instructional decisions and focus pupils' learning goals. Provide a variety of opportunities for the pupil to demonstrate knowledge and skills (Hall, Strangman and Mayer, 2007).
Questions	Dominance of convergent questions and development of convergent thinking.	Dominance of open-ended questions and encouragement of divergent thinking (Munro, 2012).
Learning centres	Learning centres are not typically used.	Forming learning centres and multiple activities to learn similar material in a variety of ways (Huebner, 2010).
Gifted pupils	Pupils who have already mastered the learning content wait until the rest of the class catches up.	Pupils who have already mastered the learning content work on "challenge assignments" in order to deepen their understanding (Kim, 2016).

Conversely, differentiated instruction attempts to bring the learning and teaching process closer to pupils with different learning abilities who belong to a single class. The main purpose of this process is to enhance the productivity of each pupil and foster their development and individual success (Hall, Strangman, and Mayer, 2007). Previous research studies have shown that differentiated instruction is usually achieved by adapting both the teaching content and the learning process, as well as the final product, i.e., the manner in which pupils demonstrate the competences they have acquired during the learning process (Huebner, 2010; Tomlinson and Strickland, 2005; Munro, 2012). In the teaching process, differentiated instruction begins with identifying individual differences among pupils. Differentiated instruction also includes focusing on basic knowledge and skills related to the currently taught content; identifying pupils' various learning styles, differences in their prior knowledge, levels of interest, degree of activity, and participation in the teaching process; flexible grouping of pupils according to their interests, topic at hand and possibilities; and continuous monitoring of pupils' progress, as well as adjusting the teaching content, learning and teaching process and learning product to the needs of pupils. It also involves recognizing pupils who are capable of going above and beyond the intended teaching content by means of enrichment activities, i.e., identifying gifted pupils who need an appropriate level of challenge and support to develop their full potential (Wallace, Bernardelli, and Molyneux, 2012).

There is no single definition that can precisely describe giftedness. Different researchers have developed specific definitions of giftedness that include thinking, learning styles and function of the brain, giftedness as a genetic trait, giftedness as the result of creativity, and intrapersonal attributes such as identity development and self-awareness. These definitions try to move away from the traditional definition of giftedness as high intelligence defined by IQ tests, an approach that has been criticized as static. Other definitions are built on a multidimensional understanding of giftedness. Renzulli's (2012) three-ring conception of giftedness postulates three clusters of characteristics in gifted children: above-average ability, creativity, and task commitment. Gagne (2004) distinguishes between gifts (aptitude) and talent (performance), encompassing a wide range of possible areas in which children can demonstrate capability and emphasizing the transition between gifts and talent and environmental influences. Mönks (1992) describes giftedness as a combination of inherent potential and environmental factors.

Schmitt and Goebel explain that the term gifted and talented students, means "those students who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services or activities not ordinarily provided by the school in order to fully develop those capabilities" (Schmitt and Goebel, 2015, p. 429). These students are characterized by quicker and more efficient learning and thinking at a higher level than other kids of their age. Morelock (1996) defines giftedness as a form of development and talent – a "multi-level potential for domain-specific creative productivity which can be fostered through appropriate identification and environmental support". Children with exceptional achievement or potential in one or more areas are considered gifted. Gifted pupils "achieve exceptionally high levels of attainment in all or some aspects of the curriculum demands in school science or undertake some science-related tasks at a level of demand well above that required at their current curricular stage" (Taber, 2010, p. 9). They show strong curiosity about things and phenomena around them, and often ask many questions. They are able to handle abstract concepts, enjoy challenging problems and have creative and investigative ideas. They demonstrate high interest in investigating scientific phenomena and show ability to make connections between scientific concepts and observed phenomena. The concepts of gifted and talented are commonly used together, but some definitions show that there is a subtle difference between giftedness and talent, as giftedness talks about potential abilities whereas talent talks about present abilities that can be demonstrated or performed (Da Costa and Lubart, 2016).

The main methods that foster the development of gifted pupils in general include differentiation, extra-curricular amplification - i.e., curriculum enrichment, acceleration, and grouping of gifted pupils. Each of these methods specifically contributes to meeting the needs of gifted pupils and developing their abilities.

Extracurricular amplification and curriculum enrichment refer to an intervention in both the learning content and the learning process which aims to enhance the competences of gifted pupils within regular classes and allow maximum development of their abilities (Southem and Jones, 2004).

Acceleration is most commonly described as an educational intervention model in which pupils progress rapidly through educational programmes at a younger age than usual.

It can be partial, i.e., used for specific subjects only, or complete, which involves an accelerated progression through the educational system based on pupils' specific abilities (Southem and Jones, 2004). The advantages of this approach are that it improves gifted pupils' personal motivation, academic performance and mental habits, and helps meet their emotional needs and reduce their sense of isolation, while the disadvantages include social and emotional difficulties and possible occurrence of gaps in pupils' knowledge and skills (Petrovich, 2005; Rogers, 2002). Despite the observed disadvantages, acceleration is considered the most efficient strategy for enhancing the achievements of gifted pupils and improving their motivation (Colangelo, Assouline and Gross, 2004). Therefore, it is recommended that it be combined with other methods that foster the development of gifted pupils (Davis and Rimm, 2004).

Grouping of pupils according to their specific abilities contributes to academic performance, development of critical thinking and creativity in gifted pupils (Rogers and Span, 1993). One of the advantages of grouping pupils by ability is that it allows teachers to focus on meeting the needs of gifted pupils and on tailoring activities to suit their specific abilities. A possible disadvantage of this method is the emergence of elitism and negative attitudes among other pupils towards such grouping, as well as a loss of self-esteem among pupils who have not been identified as gifted.

Based on all the above, it can be concluded that none of the existing strategies aimed at meeting the needs of gifted pupils is ideal, which is why it is recommended to combine several different methods when working with gifted pupils. Moreover, it is worth mentioning that curriculum enrichment and differentiation are generally considered the most acceptable strategies for fostering the development of gifted pupils, given that both methods can have a positive impact on the development of competences among both gifted pupils and all other pupils in an education system.

Tomlinson and McTighe (2006) emphasize that gifted pupils require alternative forms of work that allow them to develop their knowledge and skills and perform at a higher, more challenging level. Especially convenient for this purpose are tasks that can be solved in several different ways (Tomlinson and Imbeau, 2010), thus supporting different learning styles. High-quality differentiated instruction will allow pupils to showcase their comprehension of the acquired knowledge and abilities that they have developed in different ways during the teaching process.

In terms of the assessment process, this means that the mark a pupil receives should reflect what the pupil knows, understands and is able to do, instead of what he/she is like in comparison with his/her peers.

Research conducted so far has shown that teachers lack sufficient knowledge about gifted pupils (Chan and Yuen, 2015; Cheung and Hui, 2011), and that they usually do not implement differentiated instruction to meet the needs of different pupils (Yuen, Westwood, and Wong, 2005; Wan, 2015). Such results are devastating, considering that a meta-analysis of research dealing with the effects of differentiated instruction in the teaching process has shown that differentiated instruction has a positive impact on academic achievement by talented pupils and on their socio-emotional development (Kim, 2016). Furthermore, research by Stavroula, Leonidas and Mary (2011) shows that pupils who are exposed to differentiated instruction achieve better results than those who learn in traditional classrooms.

Despite that, teachers often resist differentiated instruction because they lack the competences to implement it (Tomlinson, Callahan, Tomchin, Eiss, Imbeau and Landrum, 1997). Sometimes even the content of in-service teacher training programs is deficient in the area of education for gifted and talented pupils (Kukanja Gabrijelčič, 2014).

Although more recent study programmes at teacher education faculties emphasize the need to implement differentiated instruction, they often fail to teach prospective teachers how it should be done. The lack of competences among future teachers to conduct this extremely important process is correlated with practical implementation of differentiated instruction. An analysis of future teachers' lesson plans in the study conducted by Skribe Dimec (2013) showed insufficient presence of elements of differentiated instruction in primary science education, as well as a lack of differentiation elements in the majority of teaching materials for primary-level science.

Although many teachers emphasize the importance of differentiated instruction and advocate the need to implement it, their teaching methods do not coincide with their beliefs. Another problem is that differentiated instruction requires much longer preparation for the teaching process. There is also the misconception that differentiated instruction cannot be implemented because of the traditional methods used to assess pupils' achievements. The biggest challenge for the implementation of differentiated instruction is the teachers' lack of confidence in their own ability to implement it properly (Hawkins, 2009).

Moreover, teachers often raise concerns that differentiated instruction would benefit only some pupils. However, this concern is unjustified, as research shows that properly implemented differentiated instruction benefits all pupils (McQuarrie, McRae and Stack-Cutler, 2008).

There are, however, certain disadvantages to differentiated instruction. The main weakness is the lack of unique guidelines for its implementation (Huebner, 2010), which stems from the differences in structure of each individual school class. Furthermore, differentiated instruction involves additional pressure on teachers to provide support for pupils with special needs, which is usually only provided by experts. In addition, the process cannot take place only once, but needs to be repeated continuously over a lengthy period of time, which requires patience and persistence from teachers (Tomlinson, 2001). Furthermore, some pupils might need much more support than a competent teacher is able to provide during the differentiated instruction process (Tomlinson et al. 1997).

When implementing differentiated instruction for gifted pupils, teachers will develop more complex learning activities for such pupils (Huebner, 2010). The emphasis is placed on inquiry-based learning, during which a pupil can experience the joys and frustrations of creative productivity. Through appropriate differentiated instruction methods, gifted pupils are presented with additional challenges to help maintain their interest and attention, and appropriately develop their abilities. Only by being presented with such challenges can gifted pupils develop persistence, curiosity and intellectual risk taking (Tomlinson, 2001).

When working with gifted pupils in primary school science classes, the goal is to support the development of an advanced level of understanding and knowledge, the development of self-regulated learning, commitment to the task, self-esteem and the sense of creative accomplishment in such children. During the differentiated instruction process, teachers will help pupils understand their abilities, interests and learning styles.

Maker's model (1982) suggests that a curriculum which best supports gifted learners' skills should be differentiated in the key areas of content, process, product and learning environment (Figure 1).

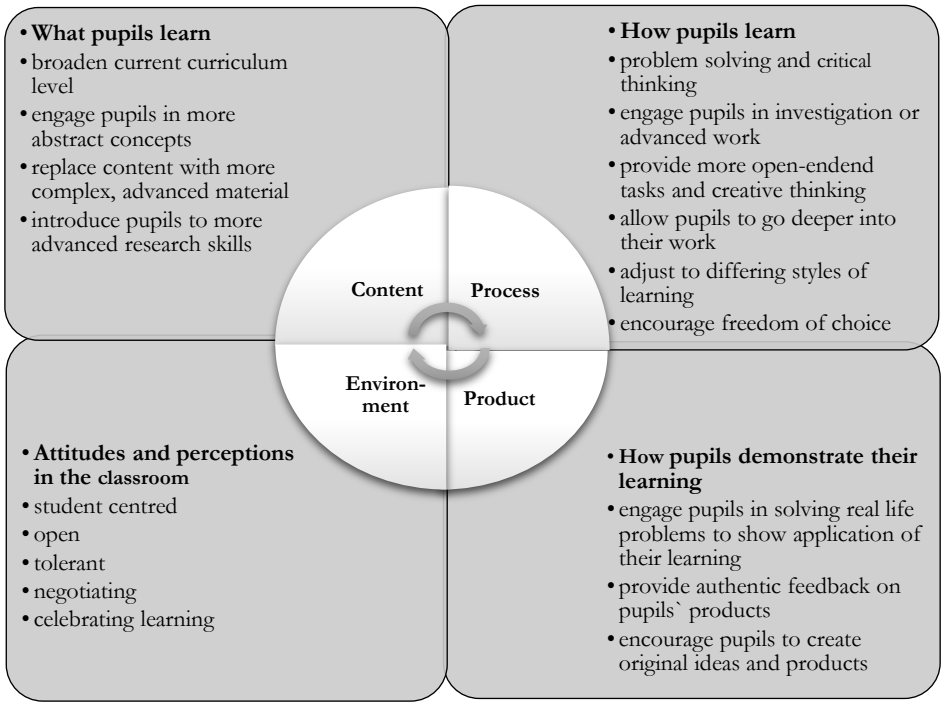

Figure 1. Maker`s (1982) model of the differentiated curriculum for highly able pupils

Research methodology

Research objective

This paper presents the results of a study to determine whether teachers in the first four grades of elementary school implement differentiated instruction for gifted pupils in primary school science classes, which of those differentiated instruction techniques they implement and how frequently.

Hypotheses

H(1) Teachers frequently (once a week) implement all differentiated instruction techniques for pupils who are gifted at natural sciences in primary school science classes.

H(2) Teachers use differentiated instruction techniques more frequently when working with gifted pupils than with other pupils in primary school science classes.

H(3) There is no statistically significant difference in the frequency of implementation of specific differentiated instruction techniques in primary school science classes.

Research instruments, variables and data processing

For the purpose of this research, a questionnaire was developed that was modelled on a similar questionnaire by Archambault et. al. (1993). The statements from this questionnaire were partially modified and adapted to the peculiarities of teaching science in primary school. Before using the instrument, a pilot study was conducted on a smaller, targeted sample for the purpose of testing it. After that, any ambiguities within the instrument were removed, allowing it to be used in research on a larger sample.

The questionnaire consists of three sections. The purpose of the first section was to collect demographic data on respondents and to establish whether they had participated in any courses or professional training during their teaching career that dealt with the topic of working with gifted pupils.

The second part of the questionnaire was aimed at determining how often the respondents implement differentiated instruction when working with gifted pupils and with other pupils in primary school science classes. This section of the questionnaire comprised a scale consisting of 38 items (statements) divided into six subscales related to several different groups of differentiated instruction techniques used to encourage the development of gifted pupils: (1) Asking questions and developing higher-order thinking; (2) Offering challenges and choices; (3) Differentiated tasks, which include reading and writing; (4) Changes in the curriculum; (5) Learning Enrichment Centres; (6) Individual work in pupils' work stations. Teachers provided their own assessments of the frequency of implementation of these techniques using a six-point Likert scale (1=never, 2=very rarely (once or twice a semester), 3=rarely (once a month), 4=occasionally (2 or 3 times a month), 5=often (once a week), 6=always (in every class)). The dependent research variable is the frequency of implementation of differentiated instruction techniques for gifted pupils in primary school science classes. Independent variables are a program concept and the context of learning (lower grades of primary education and primary science classes).

The following statistical measurements and data processing procedures were used: descriptive statistics to determine basic statistical indicators in interpreting research results, a t-test to compare the mean of a continuous variable in two different groups and ANOVA for comparison of mean values of the variable in more than three groups.

Respondents

The study was conducted by means of a survey, and the sample included teachers of lower (first to fourth) grades of elementary school (N=134). The sample predominantly included female respondents (97%), whereas in terms of qualification level there was an equal representation of respondents with graduate level qualifications (56%) and undergraduate level qualifications (44%). In terms of years of service, the respondents were divided into six groups. The first group comprised respondents with 0 to 5 years of service (20.9%); the second group comprised those with 6 to 10 years of service (14.9%); the third group comprised those with 11 to 15 years of service (23.1%); the following group were teachers with 16 to 20 years of service (9.7%), then those with 21 to 25 years of service (19.4%), and finally those with 25 or more years of service (11.9%). For the question whether teachers had participated in any professional development course or training dealing with the topic of instruction for gifted pupils during their teaching career, the respondents were divided into those whose answer to that question was affirmative (30.6%) and those whose answer was negative (69.4%).

Results and discussion

The differentiated instruction methods most frequently used by teachers when working with gifted pupils in primary school science classes, in the group of techniques based on asking questions and developing higher-order thinking, are shown in Table 2.

Table 2. Techniques based on asking questions and developing higher-order thinking

Items	*M*	*SD*
I achieve the educational outcomes related to thinking skills which are defined by the curriculum.	**4.51**	1.68
I encourage critical thinking and creative problem solving in science classes.	**4.47**	1.59
I encourage pupils to ask more complex questions in science classes.	**4.01**	1.62
I encourage pupils to discuss the given issue among themselves.	**4.01**	1.45
Total	**4.28**	1.41

The total arithmetic mean of teachers' answers to this group of questions is M=4.28; SD=1.41, which indicates that these differentiated instruction techniques are implemented occasionally (2 or 3 times a month) in science classes. Higher-order questions develop pupils' critical thinking skills and help pupils to apply, analyse, synthesise and evaluate information, instead of simply reproducing facts. Taylor et al. (2003) emphasize that pupils whose teachers use questions at a higher cognitive level reach higher levels of knowledge, while Hus and Legvart claim (2016) that questions and cognition development are strongly connected. Therefore, it is very important to incorporate these instruction techniques into everyday teaching practice, instead of using them only a few times a month.

Educational equality requires providing each pupil with challenges that meet their abilities (Davidson, Davidson, and Vanderkam, 2004). The highest and the lowest arithmetic mean values in the group of differentiated instruction techniques based on offering challenges and choices to gifted pupils are shown in Table 3.

Table 3. Techniques based on offering challenges and choices

Items	*M*	*SD*
I prepare pupils for participation in natural science competitions.	1.82	1.48
I suggest additional sources of knowledge to pupils during science class (journals, encyclopaedias, children's books etc.).	**3.29**	1.34
I suggest that the pupil attend science class in a higher grade.	**1.44**	1.20
I bring additional sources of knowledge (journals, encyclopaedias, children's books etc.) to science class and encourage pupils to use these in their work.	3.37	1.48
Total	**2.68**	**1.04**

The total arithmetic mean of teachers' answers to this group of questions is M=2.68; SD=1.41, which indicates that these differentiated instruction techniques are rarely implemented in science classes. Gifted pupils in primary science are more engaged and can fulfil their potential when teachers set high expectations, along with assignments and activities that challenge them appropriately (Council of Curriculum, Examinations and Assessment [CCEA], 2006). Challenging problems help gifted pupils to "cultivate their high-level thinking skills, while also providing opportunities to advance their metacognitive skills, feelings of ownership, motivation, and engagement levels" (Matsko and Thomas, 2014, p. 160)). Absence of these instruction techniques can have a negative influence on gifted pupils' motivation for learning, which is why they need to be implemented more frequently in practice.
The highest and the lowest arithmetic mean value in the group of differentiated instruction techniques based on task assignments that involve reading and writing are shown in Table 4.

Table 4. Techniques based on task assignments that involve reading and writing

Items	***M***	***SD***
I use more complex texts about certain topics which require higher-order thinking in science classes.	2.90	1.45
I require pupils to write a report on a given topic in science classes.	3.04	1.32
In science classes I give pupils the task of writing a presentation about a book they have read.	1.82	1.02
In science classes the pupil is given the task of writing an essay on a topic assigned by the teacher, in which the pupil needs to present or explain the given topic in a creative manner.	1.94	1.00
Total	**2.44**	**1.02**

The total arithmetic mean of teachers' responses to this group of questions is M=2.44; SD=1.02, which indicates that these differentiated instruction techniques are very rarely implemented in science classes (1 or 2 times a year). Independent reading and writing assignments offer opportunities for developing fluency as well as practice with comprehension strategies and decoding skills (Clay, 1991). At the same time, there should be some opportunity for pupil choice, since pupils can often read materials above their instructional reading level if they are interested in and excited about a specific topic (Ancrum and Bean, 2008).

This is a demanding procedure that requires good reading skills and orientation in written texts, which is not yet fully developed in pupils aged 7 to 10. This is probably why teachers only rarely apply this differentiation technique in their teaching practice.

The highest and lowest arithmetic mean values in the group of differentiated instruction techniques based on changes to the curriculum are shown in Table 5.

Table 5. Techniques based on changes to the curriculum

Items	***M***	***SD***
I use pre-tests to assess pupils' prior knowledge of a specific teaching unit or teaching content and change the curriculum accordingly.	2.31	1.62
I eliminate and do not use the curriculum content that pupils have already mastered well.	1.87	1.09
In science classes we analyse and study teaching content that is more complex and more demanding for pupils.	3.66	1.09
In science classes I use different teaching methods for pupils who are able to learn the teaching content more quickly.	3.47	1.42
Total	**2.84**	**1.06**

The total arithmetic mean of teachers' responses to this group of questions is M=2.84; SD=1.06, which indicates that these differentiated instruction techniques are rarely implemented (once a month) in science classes. An effective curriculum for pupils who are gifted is essentially a basic curriculum that has been modified to meet their needs. It can be modified in content, process, product expectations or learning environment. Both content and learning experiences can be modified through acceleration, compacting, variety, reorganization, flexible pacing, and the use of more advanced or complex concepts and abstractions. On the other hand, modification of the process can include restructured activities, more intellectually demanding for highly able pupils. They need to be challenged by questions that require a higher level of response and stimulate inquiry, active exploration, and discovery. Activities should meet pupils' interests and encourage pupils' self-directed learning. Also, the learning environment should encourage pupils' creativity, inquiry and independence, and needs to be pupil-centred and receptive.

The total arithmetic mean of teachers' responses in this group of differentiation techniques is not satisfactory and shows that the respondents' teaching practice does not meet the needs of gifted pupils in primary school science classes.
The highest and the lowest arithmetic mean values in the group of differentiated instruction techniques based on enrichment centres are shown in Table 6.

Table 6. Techniques based on enrichment centres

Items	M	SD
In science classes I allow pupils a certain amount of time to pursue their own particular interests in the field of natural sciences.	3.31	1.32
During science classes I organize workstations in the classroom and encourage pupils to use these and perform various activities.	3.03	1.54
I sometimes work on science curriculum content with pupils even after class.	2.05	1.25
I include pupils in extracurricular activities related to natural sciences.	2.15	1.32
Total	**2.73**	**1.06**

The total arithmetic mean of teachers' answers to this group of questions is M=2.73; SD=1.06, which indicates that these differentiated instruction techniques are rarely implemented (once a month) in science classes. Enrichment centres enhance a pupil's educational experience and allow participants to meet their interests. Pupils are working on subject matter in more depth or breadth. This technique can be easily implemented in the classroom by grouping pupils with similar abilities to complete activities at their learning levels or be organized as an extra-curricular activity for gifted pupils. The main purpose is highlighting the talents of gifted pupils and investing in their abilities to motivate their creativity.
The highest and the lowest arithmetic mean values in the group of differentiated instruction techniques based on individual work of gifted pupils at their workstations are shown in Table 7.

Table 7. Techniques based on individual work of gifted pupils at their work stations

Items	***M***	***SD***
In science classes I use worksheets to help develop pupils' basic skills.	3.47	1.31
In science classes I use worksheets enriched with additional material for the development of pupils' specific skills.	2.91	1.24
I instruct pupils to use computers in science classes.	3.47	1.55
Total	**3.30**	**1.05**

The total arithmetic mean of teachers' answers to this group of questions is M=3.30; SD=1.05, which indicates that these differentiated instruction techniques are rarely implemented in science classes, with a mild tendency towards occasional implementation. Individual work forms an important part of effective provision for gifted and talented pupils. Individualized learning offers the pupil the possibility of working on his/her own research topics, encourages him/her to make decisions about the domains of learning, supports him/her in working efficiently in a manner best suited to his/her needs and motivates him/her for self-regulating learning (Kelemen, 2010). It is relatively easy to apply in everyday teaching practice, so the frequency of its use is slightly higher compared to other differentiation techniques.
By comparing the arithmetic mean values of respondents' answers regarding the frequency of implementation of various differentiated instruction techniques in science classes, in some subscales we can establish that most differentiated instruction techniques are rarely implemented, which is why the first hypothesis (H1), which posited that teachers frequently implement all differentiated instruction techniques for gifted pupils, is rejected.

Table 8 shows the results of testing the statistical significance of differences in the frequency of implementation of specific groups of differentiated instruction techniques for gifted and other pupils in science classes in mixed-ability classes.

Table 8. Statistical significance of differences in the frequency of implementation of specific groups of differentiated instruction techniques for gifted and other pupils in science classes

	Pupils	***M***	***SD***	***t-test***	***p***
Asking questions and developing higher-order thinking	gifted	4.28	1.41	-1.19	0.24
	others	4.45	0.96		
Offering challenges and choices	gifted	2.68	1,04	0.46	0.64
	others	2.62	0.81		
Task assignments that involve reading and writing	gifted	2.44	1.02	1.14	0.25
	others	2.31	0.84		
Changes to the curriculum	gifted	2.84	1.06	-0.21	0.83
	others	2.86	0.85		
Enrichment centres	gifted	2.73	1.06	0.45	0.65
	others	2.68	0.88		
Individual work	gifted	3.30	1.05	-1.06	0.29
	others	3.41	0.70		

According to the data shown in Table 8, it can be concluded that there is no statistically significant difference in the implementation of differentiated instruction techniques for gifted and other pupils in a mixed-ability class, i.e., that the differentiated instruction techniques are equally frequently implemented for both groups of pupils. Hence, the second hypothesis (H2), which posited that teachers implement differentiated instruction techniques more frequently when working with gifted pupils than with other pupils in science classes, is also rejected. This finding is satisfactory because differentiated instruction in a heterogeneous school class should be available to all pupils, since it encourages them to be as successful as possible in the educational process. The problem, however, is that the identified frequency of implementation of various differentiated instruction techniques is relatively low, which is why the lack of a significant difference in the frequency of implementation is not particularly noteworthy.

In order to determine the difference in the frequency of implementation of specific differentiated instruction techniques among gifted pupils, we conducted the ANOVA test (Table 9).

Table 9. The difference in the frequency of implementation of specific differentiated instruction techniques among gifted pupils

	Sum of squares	**df**	**Mean square**	**F**	**p**
Between groups	297.49	5	59.49	47.80	0.00
Within groups	993.29	798	1.25		
Total	1290.79	803			

According to the data shown in Table 9, we notice that the significance level is p=0.00 with regard to testing the difference in the frequency of implementation of specific differentiated instruction techniques when dealing with gifted pupils, which is why we can establish that there is a statistically significant difference in the frequency of their implementation. By means of a post hoc Tukey test, we have established that there are significant differences between most differentiated instruction techniques. Thus, in science classes, the frequency of using questioning techniques to develop pupils' thinking skills is statistically more significant than the frequency of using all other differentiated instruction techniques. Moreover, the frequency of having pupils do individual work at workstations is statistically more significant than the frequency of implementing the methods of offering challenges and choices, assigning differentiated tasks that involve reading and writing, changing the curriculum and Learning Enrichment Centres. Therefore, the third hypothesis (H3), which posited that there is no statistically significant difference in the frequency of implementation of specific differentiated instruction techniques in science classes, is also rejected.

Conclusion

Based on the results of this research, it can be concluded that the majority of teachers rarely (once a month) implement most of these differentiated instruction techniques in primary school science classes. The only technique that is more frequently implemented is the technique of asking questions, whose aim is to develop pupils' thinking skills. Such findings confirm the results of earlier studies (e.g., Yuen et al., 2016; Wan, 2015). This situation in the teaching practice is particularly concerning because it means that in elementary education, there is no adequate support for the development of pupils gifted at natural sciences.

This is particularly unfavourable because gifted pupils need to be identified as early as possible in the course of their education so that their potential can be developed as soon as possible. Here, however, we should also emphasise some limitations of the research. Namely, some education experts (Stevenson and Stigler, 1992) believe that teaching practice needs to be directly observed in order to be assessed more precisely. They also emphasise that the research questions in the questionnaire can only partially clarify teacher behaviour, while direct observation of their teaching could help determine the difference between efficient and inefficient practice. This is further supported by research conducted by Burstein, McDonnell, Van Winkle, Ormseth, Mirocha and Guiton (1995), according to which the coincidence between teachers' self-assessment of their practice and their actual practice is only 40-60%. That is why the findings of this study will be tested in a future research study based on observation of teachers' teaching practice and methods in primary school science classes. Moreover, the results of this study raise the question why differentiated instruction techniques are not implemented frequently enough in actual teaching practice. One reason for this might be insufficient development of teachers' competences to implement differentiated instruction. Therefore, it is important to include training in practical implementation of differentiated instruction strategies in formal initial teacher training programmes, which would allow teachers to acquire the appropriate competences and implement them in their teaching practice with more confidence, more efficiently and more frequently. It would also be necessary to organize various forms of high-quality professional development courses for teachers who already work in the education system, to allow them to understand the importance and function of differentiated instruction, and to use these strategies more frequently, thus promoting the appropriate development of gifted pupils. Differentiation should become a constant and systematic practice in classrooms, not an occasional event.

Because only a few research studies dealing with the use of differentiation have been conducted in Croatia, and there is a lack of appropriate guidelines for implementing this method in teaching practice, the research findings presented in this paper help identify current educational practices and suggest that there is a need to improve those aspects of teaching practice related to the development of gifted pupils. Moreover, the theoretical overview, which emphasizes the importance of differentiation, can contribute to its popularization and lead to more frequent implementation of this method in teaching practice. The findings of this study

should encourage teachers to use appropriate differentiation methods more frequently to facilitate the development of gifted pupils' potential.

This study could also serve as an incentive towards further studies of the efficiency of differentiation for the development of competences among gifted pupils, as well as those that will determine how teacher training programmes can affect the development of teacher competences that are necessary for the implementation of differentiation methods in primary school science classes.

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