On students' attitudes towards small group teaching in mathematics lessons

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Abstract

Research about students' attitudes is a current topic in understanding the processes and practices of teaching. In order to improve this process, it is useful to know attitudes of students towards its various aspects. The teaching method used is an important factor influencing the quality of teaching. The article explores students' attitudes towards one of these methods, namely small group teaching. For this purpose, a quantitative research survey was designed. The aim of this research was to determine students' attitudes towards this teaching method in mathematics lessons and investigate the influence of grade and gender on attitudes. The research method used was semantic differential for a sample of 364 primary and lower secondary school students. The research results indicated that the participants generally have a relatively neutral attitude towards the implementation of small group teaching into their mathematics lessons with the average score close to the positive perception. A further objective of the research was to find out the influence of gender and grade on the students' attitudes towards small group teaching. The average score showed that boys' perceptions of group teaching are slightly more positive than girls. The total average score by grade showed the most positive attitude in the case of 7th grade and the most negative attitude in the 8th grade with a statistically significant difference. Although the research results corresponded to neutral students' attitudes, the average scores close to the positive perception justify implementation of small group teaching into education.

Moreover, the article provides instruction for work with semantic differentials representing a relatively rarely used research method.

Key words: small group teaching, students' attitude, semantic differential.

O postojích studentů ke skupinovému vyučování v hodinách matematiky

Abstrakt

Zkoumání postojů studentů patří k aktuálním tématům týkajícím se vyučovacího procesu. Pro zkvalitnění tohoto procesu je užitečné znát postoje studentů k jeho různým aspektům. Důležitým faktorem ovlivňujícím kvalitu vyučování jsou použité vyučovací metody. Článek se zabývá postoji studentů vzhledem k jedné z těchto metod, totiž ke skupinovému vyučování. Pro tento účel byl realizován kvantitativní výzkum. Cílem tohoto výzkumu bylo určit postoje studentů k implementaci této vyučovací metody do hodin matematiky a zkoumat vliv věku a pohlaví studentů na tyto postoje. Výzkumnou metodou byl sémantický diferenciál použitý na vzorek 364 studentů základních a středních škol. Výsledky výzkumu ukázaly relativně neutrální postoj účastníků vzhledem k využívání skupinového vyučování v rámci výuky matematiky s průměrnám skóre blízkým pozitivnímu vnímání. Dalším cílem výzkumu bylo určit vliv pohlaví a věku studentů na jejich postoj ke skupinovému vyučování. Průměrné skóre ukázalo, že postoj chlapců je mírně pozitivnější než postoj dívek. Celkové průměrné skóre vztahující se k věku studentů ukázalo, že nejvíce pozitivní postoj měli studenti 7. ročníku, zatímco nejvíce negativní postoj byl zjištěn u student 8. ročníku se statisticky významným rozdílem mezi oběma ročníky. Ačkoliv výsledky výzkumu odpovídají neutrálnímu postoji studentů, průměrné skóre blízké pozitivnímu vnímání skupinového vyučování svědčí ve prospěch uplatňování této metody ve výuce. Navíc článek poskytuje návod pro práci se sémantickým diferenciálem, který představuje relativně málo využívanou výzkumnou metodu.

Klíčová slova: skupinové vyučování, postoje studentů, sémantický diferenciál.

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Introduction

A good deal of research exists on effective teaching methods from the perspectives of teachers and researchers, but there are few studies on how much students know about those teaching methods and on students' attitudes towards them. However, the knowledge of students' attitudes towards the teaching methods used in their lessons is very important for students' motivation and their success in the subject. The research described below focused on students' attitudes towards small group teaching, which represents one of the most frequently used non-traditional teaching methods.

In general, small group teaching usually means teaching in a group organizational form. A class is divided into smaller groups (3–5 members) who are assigned the same or different tasks. The groups can be homogenous (students with similar learning abilities) or heterogeneous (students with different learning abilities). One can find several definitions of e small group teaching but according to Fisher and Ellis (1990) most of the definitions indicate the sharing element among members of the group as the key factor of the group work. The sharing can involve sharing perceptions, motivation or objectives, as well as tasks or a scenario group session. These elements of cooperation can be greatly influenced by the group dynamic or climate of the group. The structure of the group is crucial for its success, that is the roles and relationships that influence the behaviour of group members and tie them to the collaborating team. Small group work (also known as cooperative or collaborative learning or peer learning) involves a high degree of interaction. The effectiveness of small group teaching is determined by the extent to which the interaction contributes to members' better understanding, building upon each other's help, finding out meanings, asking and answering questions. Studies showed that small group teaching has a positive impact on the ability to apply knowledge and solve problems, long term knowledge and skill retention, critical thinking and to the development of positive attitudes (McKeachie & Kulik, 1975, McKeachie, 1994). Student-centred approaches such as small group teaching are particularly useful in teaching mathematics. They improve mathematics achievement and attitudes towards mathematics among students (Zakaria, Lu Chung Chin, & Daud, 2010). The findings of much of the previous research indicate that small group interactions can give rise to learning opportunities that do not typically arise in traditional classroom interactions (Barnes & Todd, 1977; Davidson, 1985; Good, Mulryan, & McCaslin, 1992; Shimizu, 1993). Therefore, teachers need to be aware of the benefits and importance of small group teaching and thus change their practices from teacher-centred teaching methods to student-centred teaching methods. Teachers need to master the mathematical content to be delivered and plan how to implement small group teaching better. The results of many studies showed that small group teaching could have a positive effect on the formation of a more positive attitude towards mathematics amongst students. However, how is small group teaching perceived by students themselves? What attitudes

do students have for this teaching method? The aim of the research described below was to find out this fact.

The concept of attitude comes from psychology and several definitions exist among social psychologists as well as in other scientific disciplines. The concept has been explored in the research awareness by the work of Thomas and Znaniecki (1918), who understood attitudes as processes of individual consciousness which determine both the actual and the potential reactions of people to the environment. According to the authors, attitude is always associated with a relationship to a value. However, in professional studies it is possible to find out that the concept of attitude began to be used in the 18th century, and in psychology it has been used since 1860, when it was defined by Spencer and Bain as an internal state of readiness for a particular form (Cacioppo et al., 1994). The definition of attitude depends on its intention. Attitude can be considered as the "sum total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats, and convictions about any specific topic" (Thurstone, 1928, p. 532). Attitudes are an integral component of human character, including the inclinations and predispositions that direct an individuals' behaviour (Rubinstein, 1986). Attitudes can change and develop over time (Rubinstein, 1986) and can be measured as positive or negative (Fishbein & Ajzen, 1975). Attitude can be also defined as "a settled way of thinking or feeling about something" (*Oxford Dictionary*, 2016). Attitudes are not directly measurable but can be derived from observable and evaluative responses expressed as consent or disagreement, access or avoidance and attraction or aversion (Eagly & Chaiken, 1998). Obviously, the literature refers to attitude as a learned predisposition or tendency of an individual to respond positively or negatively to some concept, object, situation, or another person. This positive or negative feeling is of moderate intensity and reasonable stability; sometimes it is especially resistant to change.

Research suggests that there are three different components of attitude. These are the cognitive component, the affective component, and the behavioural component (Eagly & Chaiken, 1993; Maio & Haddock, 2010). The cognitive component contains opinions, views and knowledge about the attitude object. It also includes opinions or ideas about the ways of acting in connection with the attitude object. The affective (emotional) component concerns emotions experienced in relation to the attitude object. The object may have a pleasant or unpleasant impression, it may be preferred or non-preferred. The behavioural component contains promptness to act which is connected to attitude. Students' attitudes towards a lesson or towards a teaching method may be negative or positive. Positive or negative attitudes are constant and unchangeable beliefs acquired due to students' experiences. Most studies consistently showed that active, learner-centred approaches prove to be effective. According to Ajzen and Fishbein's (1980) theory of reasoned action, "attitudes are a function of beliefs". According to this theory, believing that performing a task will lead to positive outcomes resulting in a favourable attitude towards the task. On the other hand, lack of belief in

the success of performing a task will result in an adverse attitude. Therefore, if students believe that for example, cooperative methods will have a significant effect on their mathematics achievement, then this method will be to their benefit. Once formed attitudes can influence the way students understand, think, feel, and behave. The research of students' attitudes may provide new insights into the way these attitudes may obstruct or simplify learning. In the case of a positive attitude, an individual is more likely to be engaged in favour of this certain object and vice versa. Analogically, it is also true for negative attitudes. Students' attitudes towards their behavioural tendencies formed in social conditions during an individual's life, seem to be an important indicator of behaviour and experience. So far there has not been a unified definition of the attitude concept. The variability in this area is determined by the different foundations of the individual authors, but also due to various methodological approaches.

Measuring attitudes provides benefits such as determining attitudes towards the situations students face, changing their attitudes or creating new ones. As attitude is a hypothetical construct to represent certain underlying response tendencies (Arul & Misra, 1977), it cannot be measured directly, but by inference. Data on which this inference is based are collected by various methods. There are many mentioned in literature by means of which we can measure existence and quality of the attitude (Janoušek, 1986; Svoboda, 1992). Frequently used methods in quantitative research are represented in attitudinal scales. There are three different types of the scales: Likert ordinal scale (Likert 1931), Thurstone interval scale (Thurstone, 1928) and Guttman ratio scale (Guttman, 1944). The Semantic differential method is relatively rarely used (Osgood, 1952). According to some studies (Výrost & Slaměník, 1997), one can only measure the attitudes based on conclusions derived from the individuals' reactions to the object – from his obvious acting and verbal statements about opinions, feelings and dispositions to acting in relation to the object.

The Semantic differential method, created by American scientist Ch. Osgood in the 1950s, allows measure of the individual, psychological meanings of the words or attitudes towards something (Kerlinger, 1972, Janoušek, 1986, Výrost & Slaměník, 1997). Osgood's research has shown that people understand or give meaning to words or concepts along three dominant dimensions – the evaluative dimension (good – bad), the potency dimension (strong – weak), and the activity dimension (active – passive). Subjective ratings are captured by respondents on special scales arranged as opposite or bipolar adjective pairs. This simple tool is particularly useful for measuring emotional and behavioural aspects of attitude (Hewstone & Stroebe, 2006). The relatively easy administration and quick evaluation can be considered as great benefit of the method. The tool has been created for research of the connotative meaning of concepts, each of which can be expressed as a point in so-called semantic space. The basic dimensions of the space were determined by means of the factor analysis as well as the three most important factors (evaluative, potency and activity factors). Each scale is significantly

saturated with only one factor. Extraction of three factors leads to a relatively uncertain measurement when one scale measures different factors at different terms. The semantic differential is mainly suitable for investigation of the cognitive and emotional component of the attitudes (Výrost & Slaměník, 1997), especially the evaluation factor. As stated in the literature, the reliability and the validity of the method are relatively high (Svoboda, 1992).

1 Research Methodology

1.2 Research Questions

As is evident from the theoretical background of the study, knowledge of students' attitudes towards implementation of teaching methods is of key importance for successful pedagogical work. The quantitative survey research described below has focused on students' attitudes towards a particular teaching method, namely small group teaching. The study aimed to answer the following questions:

1. What are students' attitudes towards the implementation of small group teaching into their lessons?
2. Is there any difference between girls' and boys' attitudes towards small group teaching?
3. Is there any difference between students' in different grades in the attitudes towards small group teaching?

1.2 Research Sample

The research sample consisted of 364 primary and lower secondary school students aged 12–16 years attending five different Czech schools. 84 participants were from the 7th grade, 96 from the 8th grade, 103 from the 9th grade of primary school and 81 were from the 1st grade of secondary school. There were 230 girls (approximately 63%) and 135 boys (37%) in the sample. The semantic differential questionnaire was administered during the period November–December 2018.

1.3 Instrument and Procedures

For the purpose of research, the standardized questionnaire for semantic differential created by C. F. Bauer (Bauer, 2008) was used. However, it had to be slightly modified as the checking factor analysis showed that some scales do not have an exact factor structure. The questionnaire consisted of 15 bipolar adjective pairs arranged as seven

points scales (Table 1). The data obtained from the completed questionnaires were recoded into a numerical form so that the score scale 7 corresponds to the positive values and the scale 1 to the negative values. Students' attitudes towards small group work in mathematics can be determined according to the average scores. If the average values are in range <3.5; 4.5>, it can be considered as neutral perceptions, values higher than 4.5 correspond to a positive attitude and the score below 3.5 indicates a negative attitude towards the small group work. Subsequently, the reliability of the research tool was determined using the value of Cronbach's alpha. For the whole questionnaire, the value is $\alpha = .87$, the values for the particular factors are as follows: interest – $\alpha = .82$, fear – $\alpha = .79$, difficulty – $\alpha = .70$ and emotional satisfaction – $\alpha = .70$. All these values indicated effective reliability of the research tool.

Table 1
Bipolar adjective pairs

	1	2	3	4	5	6	7	
Easy								Difficult
Useful								Insignificant
Exciting								Boring
Simple								Complicated
Confusing								Clear
Good								Bad
Causing pleasure								Horrifying horror
Friendly								Unfriendly
Comfortable								Inconvenient
Valuable								Unnecessary
Laborious								Funny
Chaotic								Organized
Harmless								Dangerous
Risky								Safe
Understandable								Inconceivable

1.4 Data Analysis

After data recoding into numerical form, a factor analysis with Varimax rotation was performed which in addition to the division of items into dimensions, also serves to guarantee construct validity. Before the factor analysis was conducted, two tests of "factorability" of the actual data were done. Bartlett's test of sphericity was statistically significant ($\chi^2 = 974.44$, $p < .001$) and result of Kaiser-Meyer-Olkin (KMO) test was .85. The values of both tests allowed the use of factor analysis.

Based on factor analysis, the adjectives were divided into 4 groups (factors) (Table 2), similar to those of the original author: 1. Interest factor (4 items), 2. Fear factor (5 items), 3. Difficulty factor (3 items), 4. Emotional satisfaction factor (3 items). The factor score limit was .40. Data processing was done using the software Statistica, version 13.4.0.14.

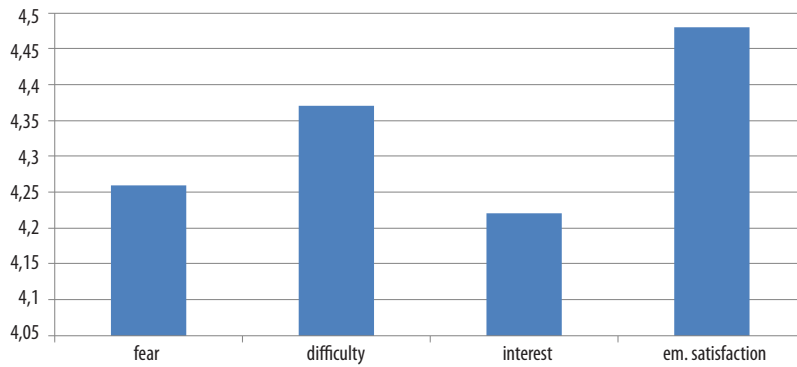
Table 2
Results of factor analysis

		α	1.	2.	3.	4.
1 Fear		**.79**				
Causing pleasure	Horrifying or horror Dangerous		**.51**	.30	.28	.29
Harmless	Risky		**.78**	.05	.12	.05
Safe	Inconceivable		**.80**	–.03	.09	.09
Understandable	Chaotic		**.62**	.37	.26	.24
Organized			**.60**	.10	–.03	.34
2 Difficulty		**.70**				
Easy	Difficult		–.18	**.78**	.10	.29
Simple	Complicated		.11	**.78**	.09	.19
Clear	Confusing		.38	**.70**	.15	–.06
3 Interest		**.82**				
Useful	Insignificant		.05	.03	**.86**	.05
Exciting	Boring		.17	.28	**.68**	.05
Good	Bad		.22	.23	**.69**	.21
Valuable	Unnecessary		.23	–.07	**.79**	.28
4 Emotional Satisfaction		**.70**				
Friendly	Unfriendly		.17	.18	.37	**.65**
Comfortable	Inconvenient		.08	.32	.38	**.64**
Funny	Laborious		.29	.03	.18	**.76**
Eigenvalues of factors			5.56	1.64	1.51	0.98
Percentage of variance			37.1	10.9	10.1	6.5

2 Research Results

The total average score obtained from the data was *M* = 4.32 (*SD* = 1.76), indicating a relatively neutral perception of group teaching which is close to the positive perception. When looking at the particular dimensions, students reached the highest score within a dimension called "emotional satisfaction" (*M* = 4.48, *SD* = 1.70), the lowest score was reached within the dimension "interest" (*M* = 4.22, *SD* = 1.73). The distribution of the scores was consistent with the overall score, and in addition, the overall score and the score of the particular dimensions could be considered as neutral perceptions, with the emotional satisfaction score being almost at the limit of positive perception. The distribution of scores for each dimension is shown in Figure 1.

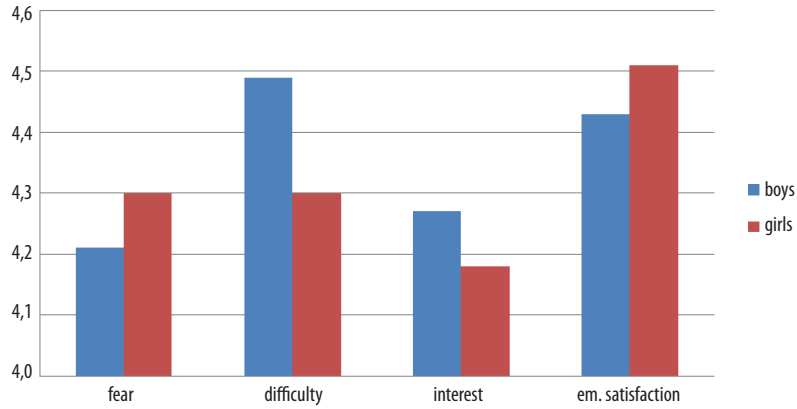
Figure 1
Average Scores of Dimensions



Using statistical *t*-test a statistically significant difference between boys' (*M* = 4.33, *SD* = 1.87) and girls' (*M* = 4.31, *SD* = 1.69) total average score was not found. The boys' perception of group teaching was therefore slightly more positive than the girls' one, but in both cases the perception can be considered as a neutral, close to positive. When evaluating scores for dimensions by gender, one can see statistically insignificant differences ($p > .05$) in all cases. Within the interest dimension, the boys achieved a score of *M* = 4.27 (*SD* = 1.85) and girls *M* = 4.18 (*SD* = 1.66), which means boys have slightly more positive perceptions. For the item called fear, the boys achieved score *M* = 4.21 (*SD* = 2.01) and girls *M* = 4.30 (*SD* = 1.84), indicating slightly greater fear in the case of boys. In the assessment of the difficulty dimension, the values *M* = 4.49 (*SD* = 1.69) for the boys and *M* = 4.30 (*SD* = 1.53) for the girls were found. For the emotional satisfaction

dimension, for boys it was $M = 4.43$ ($SD = 1.81$) and for girls $M = 4.51$ ($SD = 1.63$). In this case, the girls have a positive attitude towards group teaching.

Figure 2
Average Scores of Dimensions Based on Gender



With reference to the total average score, depending on the grade, the value for 7th grade comes out $M = 4.60$ ($SD = 0.09$), indicating a positive attitude of this age category to group teaching. There is only a very small difference between the 9th grade primary ($M = 4.35$, $SD = 0.07$) and 1st grade secondary school students ($M = 4.37$, $SD = 0.07$). A less positive score of $M = 4.09$, $SD = 0.06$ corresponds to students of the 8th grade. The one-way analysis of variance (ANOVA) confirmed the existence of statistically significant differences between the average scores of the age categories ($p = .00004$). The subsequent Tukey post-hoc test showed statistically significant differences between the 8th grade and the 9th grade ($p = .032$), between the 8th grade of primary school and the 1st grade of the secondary school ($p = .013$) and between the 8th grade and the 7th grade ($p = .00003$). When evaluating the score for each dimension with respect to the attended grade, within the interest dimension the students of the 7th grade achieved the score $M = 4.50$; $SD = 1.55$, for students of the 8th grade $M = 3.92$; $SD = 1.82$; for students of the 9th grade $M = 4.35$; $SD = 1.84$ and for the 1st grade of the secondary school $M = 4.26$; $SD = 1.59$.

Using ANOVA, the existence of a statistically significant difference was found out ($p = .021$) and Tukey post-hoc test confirmed a statistically significant difference between the 7th grade and the 8th grade ($p = .031$). Regarding the dimension of "emotional satisfaction", the following values were obtained: 7th grade – $M = 4.68$; $SD = 1.60$,

8th grade – $M = 4.28$; $SD = 1.71$; 9th grade – $M = 4.66$; $SD = 1.62$; 1st grade – $M = 4.42$; $SD = 1.79$. There wereno significant differences for this dimension (p-value of ANOVA was .196). Recorded values for the dimension „difficulty": 7th grade – $M = 5.09$; $SD = 1.52$; 8th grade – $M = 4.25$; $SD = 1.61$; 9th grade – $M = 4.09$; $SD = 1.60$; 1st grade – $M = 4.38$; $SD = 1.51$. The ANOVA discovered statistically significant differences ($p = .00012$) and Tukey post-hoc test showed the differences between the 7th grade and the 8th grade ($p < .001$), between the 7th grade and the 9th grade ($p < .001$), between the 7th grade of primary school and the 1st grade of secondary school ($p = .009$). Within the dimension "fear", the ANOVA showed insignificant differences between the age categories ($p = .12$): 7th grade – $M = 4.32$; $SD = 1.92$; 8th grade – $M = 4.03$; $SD = 1.85$; 9th grade – $M = 4.32$; $SD = 2.02$; 1st grade – $M = 4.42$; $SD = 1.81$.

Figure 3
Average Scores with Respect to Grades

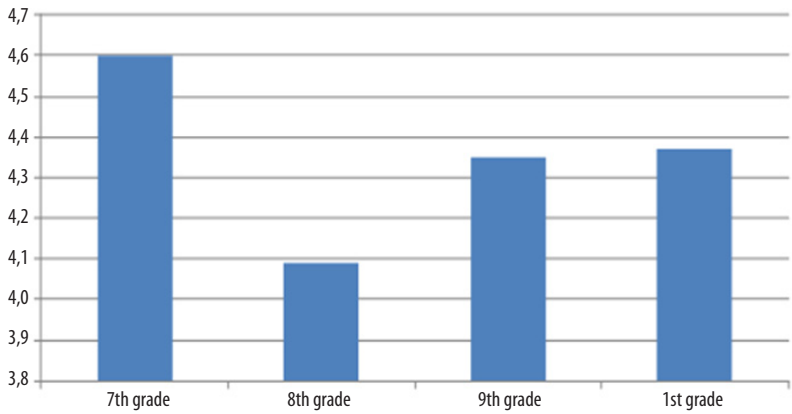
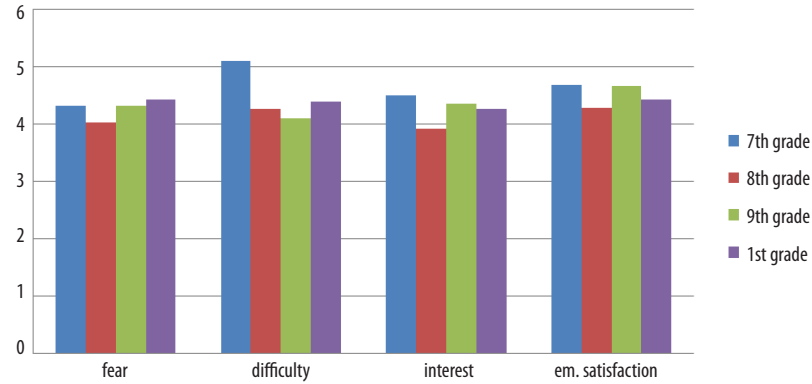


Figure 4
Average Scores of Dimensions with Respect to Grades



3 Discussion

The research results indicate that the participants generally hold a relatively neutral attitude towards the implementation of small group teaching into mathematics lessons with the average score being close to the positive perception. This assessment may result from the overall dislike of the subject and perhaps from the lack of application of small group teaching method. The investigated attitudes can be significantly influenced by the teacher's ability to utilise the advantage of the cooperative approach and properly motivate pupils. Working in groups, motivated pupils should feel that they can depend on others for help and this gives them the confidence to solve problems and enjoy learning. Positive attitude towards cooperative approaches may indirectly change the learners' attitude towards learning and encourage their interest in the subject. The research results are broadly consistent with the results of other similar studies. Y. Steinert's (2004) study was focused on students' perceptions of effective small group teaching during preclinical training in a medical school. The research has shown students' impressions of effective small group teaching, their emphasis on group atmosphere and their comments on the effectiveness of this method. According to the study of Latif and Miles (2013), students perceived the most important learning practice to be responding to practical questions and the least important to be the traditional lecture-focused format of teaching. Similarly, the findings of Cochran and Hodgin (2001) have shown that students considered careful preparation, fair grading, and clarity in communication

as important factors in the success of their study. The research results also support the finding of Sander et al. (2001) that students do not prefer traditional teaching methods.

The secondary goal of the research was to find out the influence of gender and grade on students' attitudes towards small group teaching. The average score has shown that boys' perception of group teaching is slightly more positive than that of girls, but the results for some dimensions (fear, emotional satisfaction) have indicated the opposite situation. This difference could be caused by the boys' greater interest in the subject. The total average score depending on the grade has shown the most positive attitude in the case of 7th grade and the most negative attitude for 8th grade with statistically significant difference. This state can be related to the different difficulty of the subject for the particular grades.

The research also showed that the method of semantic differential can be very useful for measuring the attitudes provided its checking factor analysis is done before any application in a different target group than that for which this instrument was created and standardized. In the above-mentioned research was used the already standardized questionnaire created by C. F. Bauer (Bauer, 2008), however, it had to be slightly modified as the checking factor analysis showed that some scales do not have an exact factor structure. The method of semantic differential was used, for example, to study students' attitudes towards a subject (Kubiatko, 2016), for the investigation of students' attitudes towards online learning (Knowles & Kerkman, 2007), in identifying the opinions of university students on education realized through e-learning (Klement, Chráska & Chrásková, 2015), for the investigation of changes in semantic space of students (Chráska, 1995), and for school self-evaluation (Vašťatková & Chvál, 2010), etc.

Conclusion

The aim of this research was to identify students' attitude towards small group teaching, especially in mathematics lessons. Although many studies have shown the usefulness of small group teaching, the research results corresponded to neutral students' attitudes towards this method. However, the average score close to the positive perception justify implementing small group teaching into the lessons. It would seem appropriate to further this research with a qualitative one that would show closer the benefits of the small group teaching for students.

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