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Is students' teamwork a dreamwork? A new DCE-based multidimensional approach to preferences towards group work

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From the characteristics of the learning process, student satisfaction is important for learning effectiveness, motivation, and student well-being. However, student preferences toward learning are not well understood and rarely considered in practice. Thus, this study examines the preferences of lower secondary school students in Poland for different study modes and school subjects. It employs a discrete choice experiment to describe student preferences in light of the time devoted to studying. The study shows significant heterogeneity of student tastes for different study modes. Most students prefer studying in a group of peers, but there are important differences across students at different achievement levels and subjects. This study demonstrates how preferences toward learning can be properly measured using discrete choice experiments. Moreover, the results can inform policy and practice to satisfy student tastes and optimize learning incentives.

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Introduction

Besides cognitive skills, social and emotional skills, especially the ability to collaborate, are perceived as critical for professional success and income (Brackett et al., 2011; Evans, 2020; Leopold et al., 2018). The ability to work in a group is in high demand in a business environment (Rios et al., 2020); it significantly impacts the work performance of employees and increases productivity and creativity (Sanyal and Hisam, 2018). As work is becoming more interdisciplinary and tasks more complex and requiring extensive knowledge, people depend on others with complementary roles and competencies (Dutta and Rangnekar, 2022). The existing mediating effect of teamwork on the relationship between strategic orientation and the performance of organizations (Otache, 2019) provides companies with a competitive advantage.

Not everyone prefers and recognizes the benefits of group work, which may be due to a lack of experience and, therefore, also skills in this area. Experiences shape preferences (Crawley and Hagen-Zanker, 2019), and education and schooling may also play an important role in this case. Already early at the school level, the abilities and preference to work in a group can be shaped, in response to the study mode practiced at school. In the world of progressive digitization of education, the social needs of students should not be overlooked. Regardless of the form (traditional, remote), education should create conditions for building social skills by including collaborative learning activities while considering the students' preferences. Social interaction and group work were proven to positively impact the effectiveness of learning (Baber, 2021; Hammar Chiriac, 2014; Jeffery and Bauer, 2020), and the lack of it is one of the major challenges in remote education (Ferri et al., 2020).

Although it is known that students' preferences for class organization vary (Alkooheji and Al-Hattami, 2018) and depend on the context (Kanevsky et al., 2022), the existing educational data (including large-scale assessments such as PISA, TIMSS, and PIRLS) do not provide adequate ways of evaluating preferences towards study modes and groupwork and overlook their unobserved heterogeneity. Literature on preference towards groupwork suffers from several methodological challenges. Most research on group work uses Likert-scale questions (Forrester et al., 2016; Marks and O'Connor, 2013; Rosander et al., 2020), which pose problems of interpretation and give biased results (Kreitchmann et al., 2019). Rating scale questions do not involve trade-offs and do not make respondents choose between attributes (Wijnen et al., 2015). The questions assess preferences in isolation from other factors and do not allow to reflect the complexity of human opinions and importance level of attributes (Heo et al., 2022; Joshi et al., 2015).

Without knowing what the students actually consider when making the assessments, one risks making erroneous conclusions. The response to these problems is the stated preferences method. This type of analysis is based on an artificially created world described by selected characteristics. Given the possibility of controlling all aspects and circumstances of the decision process, researchers do not have to address the problem of omitted variables and biased estimates resulting from the retrospective nature of the information used.

This paper uses a Random Utility Model-based preference measurement approach that has foundations in economics. The method has gained increasing attention, especially in, but not limited to, the field of environmental evaluations and transportation and health literature (Goossens et al., 2014; Hernandez and da Costa, 2022; Hoyos, 2010; OECD, 2018; Rakotonarivo et al., 2016; Soekhai et al., 2019; Wang et al., 2021). It also finds application in analyzing educational preferences (Benning, 2022; Steimle et al., 2022). The paper shows that the discrete hypothetical choice method allows for an in-depth analysis of the heterogeneity of preferences toward a mode of learning and collaboration. Past studies (Whitty et al., 2014) also showed that respondents prefer the DCE (Discrete Choice Experiment) as it enables comparison of alternative full profiles.

The assessment was conducted in Poland where, according to the PISA 2015 results, fewer Polish 15-year-olds expressed a positive attitude toward working in a group relative to students from other OECD countries (Jakubowski, 2018). Although 85% of Polish students admitted that they enjoyed cooperating with peers, 74% preferred working as a team to working alone. However, the relatively low values of the collaborative work indices may not necessarily mean Polish students do not feel comfortable and avoid working in groups. It may be identified rather as the effect of the methodology. The paper investigates and discusses this phenomenon.

The study analyzed preferences for different study modes and school subjects in the context of achievement assessed using standardized tests linked to the international PISA scale. The focus is on the students' attitudes toward group work against other study modes, including self-study and tutoring. We show that preferences toward subjects depend on the learning environment—analyzing preferences for individual characteristics of schooling separately may yield erroneous conclusions. Investigation of heterogeneity of preferences in regard to the type of activity and subject allowed for understanding the context of math anxiety and fear of being graded. This study precisely measures variation in student preferences and explains it using achievement tests and students' characteristics. To our best knowledge, we are the first to use a framework of discrete choice experiment to analyze students' preferences simultaneously towards the mode of study and school subject while controlling student learning outcomes.

The remainder of this paper proceeds as follows. First, the literature review discusses the theoretical and empirical links between preferences, students' characteristics, and educational outcomes. The methods section discusses the methodology. Then the results of the empirical study conducted among Polish students are discussed, and recommendations are made for education policy and future research.

Literature review

The role of preferences toward group work. Groupwork, or more generally social and emotional skills, is a part of global competence (OECD, 2017b), a prerequisite for successful participation and performance in academic settings and the labor market. Both at work and school, group work involves cooperation with other people, often with diverse knowledge and skills, to achieve a common goal (Chan and Pheng, 2018). From the point of view of both staff and students, this way of working brings advantages and disadvantages (Nokes-Malach et al., 2015; Šerić and Garbin Praničević, 2018). The main concern is the responsibility of each member, and the evaluation of group performance (Rosander et al., 2020). This is due to different expectations regarding group work, e.g., the study by Cera Guy et al. (2019) shows that high-achievers see group work as collaborative learning and expect this mode of work less frequently, as they care about equal distribution of tasks, quality of work (Kanevsky et al., 2022) and appreciation of the individual contributions. In contrast, low-achieving students expected from group work less effort due to the division of tasks. These two different attitudes distinguish two group learning approaches, namely collaborative learning, and cooperative learning. The collaborative learning aims to create knowledge and students take substantive

responsibility for working together. In cooperative learning students work together on a collective task that has been clearly assigned. The activities are structured, and controlled by the teacher (Davidson and Major, 2014; Laal and Laal, 2012).

Studies show that generally active-learning approach involving interacting with others can deliver robust effects when it is correctly done, and schools and teachers play a significant role in setting up the conditions for collaboration. Collaborative learning stimulates students to exchange ideas (Winarti, 2019), cultivates metacognitive abilities (Dunlosky et al., 2013; Shin et al., 2018), and enhances critical thinking by engaging higher-order thinking skills (Baber, 2021; Jeffery and Bauer, 2020; Rodríguez-Sabiote et al., 2022). Interactive engagement may allow students to build their understanding beyond that of any individual because of the complementary knowledge of the members (Dutta and Rangnekar, 2022).

Although the potential benefits of group work are extensively documented—it supports learning and has an advantage over individual learning, this mode of study may not be equally effective for all students, likely given individual differences (Hsieh, 2011; Serić and Garbin Pranicevic, 2018) and preferences. Slavin (2014) associate the effectiveness of group work with motivational, social, and cognitive constructs. A positive attitude towards mode of work may facilitate learning (Nokes-Malach et al., 2015) and translate into higher academic outcomes (Gillies and Boyle, 2011; Hammar Chiriac, 2010; Johnson et al., 2022; Şener, 2021). The effectiveness of group work and students' content mastery depends on how comfortable they feel in a group. Feeling comfortable may enhance students' content mastery by 27.5% (Theobald et al., 2017).

Analogously, students may be unwilling to undertake a task when they do not expect to feel well during the performance process the anxiety or emotional distress may make them take avoidance coping strategies such as disengagement from the project (Hilliard et al., 2020). Similar situations may arise when students do not believe teamwork may positively impact learning and grades (Grzimek et al., 2020). In both cases, we are dealing with certain beliefs and preferences of students.

Preferences are the subjective comparative evaluations between the alternatives or importance people give to things or actions that are evident in decision-making (Dietrich and List, 2013; Hausman, 2011). Preferences allow to order options in terms of expected levels of utility or satisfaction (Arrow, 1958). Assuming that people are rational, they make optimal choices, i.e., those they believe are better than others. The compliance of the learning process characteristics with preferences may significantly affect the effort put into education and, thus, the educational process outcome, which results from the positive relationship between well-being and academic success (Clarke, 2020). From an economic perspective, the theoretical justification of the relationship between students' preferences and educational outcomes can be derived from the efficiency wage theory (Akerlof and Yellen, 1986). The theory assumes that the effort put into work (i.e., the effort students put into learning) increases along with wage increases (i.e., utility or satisfaction from education), directly affecting the increase in employee productivity (i.e., educational outcomes). Adopting efficiency wage theory in education means acknowledging that increasing students' satisfaction may evoke an increase in their effort and commitment, inducing an increase in the effectiveness of the learning process. Assuming that students maximize utility, stimulating their enjoyment and satisfaction in the educational process should further motivate their investment in task-directed effort (Dysvik and Kuvaas, 2013; Hopland and Nyhus, 2016; Meece, 2023; Vergara-Morales and Del Valle, 2021), ultimately translating into academic achievement (Doğan, 2015; Lee, 2014; Topçu and Leana-Taşcılar, 2018; Wentzel, 2020) and reinforcing motivation and self-efficacy affecting academic performance (Hayat et al., 2020). This is due to the reciprocal relationship between motivation and academic achievement (Liu and Hou, 2018; Vu et al., 2022).

Among the most critical attributes of education regarding students' preferences that affect satisfaction, motivation, and achievement is the compatibility of the field of study with interests (Grotkowska and Sztanderska, 2015) and students' attitudes toward subjects and education. Interest is an underlying disposition highlighting individuals' preferences for specific content (Harackiewicz and Priniski, 2018). It can be characterized by increased attention, effort, enjoyment, and excitement when participating in a subject, thereby directly promoting learning (Hidi and Renninger, 2006; Holmes, 2018; Song et al., 2019). According to PISA 2000 as well as the later studies (Nuutila et al., 2020), subject interest and performance may be mutually reinforcing. Pupils' performance hinges on self-efficacy and subject interest (Otunuku and Brown, 2007; Sejčová, 2006), and a positive attitude toward the subject improves educational results (Holúbková and Glasová, 2011). While positive attitude and assigning a high value to subjects induce attention, commitment, and better school performance (Geddes et al., 2010; Ismail, 2009; Schenkel, 2009; Verešová and Malá, 2016), the negative attitude induces fear of the subject and lower results, intensifying negative attitudes.

Depending on individuals' preferences heterogeneity, the effectiveness of methods influencing satisfaction (and, thus, motivation) can vary across populations.

Heterogeneity of preferences toward group work. The answer to the question whether students prefer group work over other modes of studies is not a clear-cut. The preferences towards learning mode vary between- and within- a student. Between-students tastes differ across performance levels depending on personality characteristics but may also vary by learning situations and subject (Kanevsky et al., 2022). Students assess work mode through their own experiences (Cera Guy et al., 2019; Neber et al., 2001). Their general preference may be strengthened or exacerbated by the social learning environment (French et al., 2011; Peterson and Miller, 2004; Walker and Shore, 2015). Negative past group work experiences may bias students to view future group work opportunities more negatively and opposite (Grzimek et al., 2020). For example, a student might have had negative experiences due to excessive workload, too much responsibility, or not being listened to while working in a group, and positive experiences related to the opportunity to work with a friend or share interests (Cera Guy et al., 2019).

Those who experience more positive student-student interaction report positive effects of group work more often (OECD, 2017b). Interestingly, although working with a friend is typically the best predictor of comfort, no impact on performance was revealed, consistent with Harlow et al. (2016): working in self-selected groups versus instructor-selected groups did not affect student performance. Moreover, by providing students with comfortable learning conditions, we may reduce their anxiety and fear of failure and eventually improve their emotional well-being. Good emotional well-being in childhood is responsible for cognitive functions, motivation, and emotional behavior (Davidson and McEwen, 2012). It contributes to future well-being, reduces the likelihood of mental health disorders, and engages in risky behaviors (Goldman-Mellor et al., 2014). It is also directly linked with self-esteem, satisfaction, and building social and emotional skills—features that shape the school climate and student attitudes.

Preference for working alone or with others may be related to students' sociological preferences (Felder, 1996). This social

aspect is usually associated with gender (not per se). Females tend to value relationships more, but males are significantly more likely to value teamwork. Even so, females outperform males in collaborative problem-solving (OECD, 2017b), likely because of their more cooperative behavior, which might give them an advantage when interacting with other people (Large et al., 2002). Students with introverted personalities, less participating, and experiencing isolation in the group typically prefer to work individually (Chamorro-Premuzic et al., 2007). The lack of students' commitment does not necessarily result from their passivity but the dominance of other members, which disrupts robust interactive engagement. For example, shy or low-status students are likely to be excluded from discussions in groups larger than seven (Lyons et al., 2003). Students displaying extraverted tendencies often opt for more cooperative learning experiences and may dominate the group to the former's detriment.

High-achieving students, who want to have control over the work structure (Williams et al., 2019) and are focused on their success are less likely to prefer working as part of a team to working alone (OECD, 2017b). Moreover, the advantaged students less often see the positive value of teamwork and prefer working as part of a team less often than their disadvantaged peers. The most talented students prefer performing exciting and challenging work more strongly than those with lower results (Trank et al., 2002). Moreover, students achieving the highest scores largely appreciate the high load of training and the possibility of rapid promotion; group awards and interdisciplinary career paths are less important for them; they prefer demanding, focused, and individual careers. Lower-achieving students highlight that teams make better decisions than individuals, especially when paired with peers of higher abilities (Moshman and Geil, 1998; OECD, 2017b; Samaha and De Lisi, 2000). However, several studies show contradictory results (Walker and Shore, 2015). Chang and Brickman (2018) found that students with high test scores are more likely to recognize the benefits of group work than their lower-scoring colleagues, who perceive this work mode as time-consuming with little cognitive benefit. Other studies underline that gifted students are willing to work in a group but only provided they are not stalled and are grouped with peers who share the same learning goals and work distribution is fair (Guy et al., 2019; Kanevsky, 2011; Williams et al., 2019). Although both high- and low-scoring groups complain about unequal contributions in group work, high-achieving students are more willing to work with others provided there is work distribution fairness and group members give equal amounts of time and effort. French et al. (2011) explain that gifted students prefer working alone more because they are accustomed to independent learning activities and perceive them as more comfortable.

Work mode preferences change with students' age, grade and experience as well as students' perception of group work. Leman (2015) found that younger students viewed group work as the opportunity to receive information, older students viewed it as a constructive process which success depends on group cohesiveness.

One of the factors changing the attitude toward group work is the acquisition the ability to work in this form. As Cooley et al. (2016) shown, university students who were skeptical of group work changed their attitudes after taking a course in group work and reported a strong intention to continue to use this work mode in the traditional university settings. We see the group work must be practiced first to induce desired results. Once teamwork procedures are mastered, members focus on tasks and may perform even better than those working alone.

Preferences may also change in favor of working alone or appear and increase with age or grade (Dunn et al., 1981; Dunn and Price, 1980; Rayneri et al., 2006). In French et al. (2011), gifted junior high school girls preferred to work alone relative to those in elementary school. Such a pattern may reflect students' increasing understanding that their performance and abilities will be judged at the university or after a job application.

Summarizing, preferences depend on beliefs, habits, social norms, emotions, moral principles, and personality measures (Becker et al., 2012; Gervais and Fessler, 2017; Hausman, 2011; Kimbrough and Vostroknutov, 2016; McBride and Ridinger, 2021). Satisfying individual preferences contributes to people's well-being (Luper and Balotskiy, 2014; Benjamin et al., 2014), thus adjusting the teaching mode or other learning process characteristics corresponding to students' needs can affect educational results. Combining approaches that rely on cognitive limitations, prior knowledge, and achievement with recognition of student preferences is essential to establishing an effective design for a mix of learning methods or supporting effective collaborative learning strategies.

The literature on learning mode preferences is extensive; however, the conclusions are often contradictory (regarding efficiency and preferences toward study mode). Exploring preferences without considering context is an oversimplification (French et al., 2011; Neber et al., 2001). The approaches and methodologies used in presented studies are often biased. For example, Walker and Shore (2015) revealed that the preference to work alone was less pronounced when explored through open-ended or suggested-choice questions than when students had lists of options. The question arises to what extent we can believe and how to interpret the results of studies such as PISA or TIMSS, shaping educational policy in many countries.

This study approach provides a helpful lens to understand learning preferences considering what is unobservable and beyond capture by other methods. Contrary to existing studies on general preferences, we go beyond a simple dichotomy between working alone or with others and verify whether the preferences are stable across subjects. Since the preferences for working in a group may depend on self-efficacy, bearing in mind that students may perform differently in various subjects, they may also have different preferences for the mode of study in the subjects. Similarly, widespread gender differences in self-concept in mathematics and science (Mejía-Rodríguez et al., 2021) may entail differences in preferences toward the studying modes in these fields between females and males.

Methods

Novelty of the approach. Most existing studies on preferences toward collaborative learning are based on large-scale surveys. The sampling strategy and representativeness are undoubtable, but the instrument is usually based on one-dimensional Likert-type scales. This approach suffers from several weaknesses outlined below.

PISA 2015 data for Polish students indicates that in three out of four Likert-type questions used to reflect the value of teamwork, Polish students were below the OECD average, which placed them among the countries with the lowest value of the index of valuing teamwork. A similar pattern can be observed in the index of valuing relationships (OECD, 2017b). Although informative, these results should be treated with caution given the potential response bias, reference-group bias, social desirability (OECD, 2017a), or other latent constructs. Unveiling preferences and comparing them between countries is challenging with traditional Likert-type questions, as the reference point is unclear (Bishop and Herron, 2015). Moreover, Likert-type responses are not directly related to study-mode preferences. For example, when asking students to "rate different options for learning

mathematics," it is unclear whether students are rating study modes, their attitude toward learning mathematics, or their satisfaction with a particular teacher or school. In addition, we do not find out how the approach to a specific mode of work is assessed in relation to the other modes.

PISA also omits another aspect. PISA data is subject to cultural biases and based on different student experiences. Students' value of teamwork and relations may depend on the prevalence of such activities. Students who learn mainly through collaborative projects or small group work and those who learn mostly or entirely in a traditional model of individual work in a class directed by a teacher will probably generate different responses. Students who participate in teamwork activities are more likely to value it; thus, the reluctance of students to cooperate in groups may be related to the limited number of such activities in schools.

The empirical component of this study is based on a large assessment survey (i.e., Competences survey) performed online yearly by the Evidence Institute Foundation in Poland. In 2018, the Evidence Institute conducted "Competences 2018," covering more than 34,560 students of the final grades in lower secondary school and primary school, aged 14 and 15, respectively. The study was aimed at Polish schools. Most schools that participated in the assessment conducted a survey during regular school classes under the teacher's supervision. The sample was not random, as the school decided whether to take the assessment. However, a comparison of the average examination scores of participating schools shows that the average achievements of students eligible (age criteria) for the assessment were similar to the results of the entire population (on the PISA scale for Poland). 63% of the respondents were primary school students, the remaining respondents were lower secondary school students. The share of boys and girls was balanced, girls constituted slightly more than 50% of the sample.

The study consisted of three parts: the analysis of preferences, assessment of competences in mathematics, reading comprehension and foreign language, and a questionnaire. Given the limitations of previous research about student preferences towards the mode of study, we used hypothetical choices (DCE) to measure the preferences and psychometric techniques to assess achievement. Apart from the preference assessment covering attitudes toward school grades, school subjects, teaching modes and methods, reading activity, further education career, and future professional path, the study included online assessments for schools in mathematics, reading comprehension, and foreign language, which results were linked to the PISA scale using common test items and the questions to obtain demographic data. In contrast to the questionnaire and the DCE, the part devoted to the analysis of competencies had a strict time limit. Competences 2018 was the first study to merge achievement assessment using IRT-standardized tests with a measurement of preferences using the DCE method.

DCE approach. DCE allows for modeling an individual student's decision and extracting information about preferences (individual utility function parameters) and the valuation of learning process characteristics. The DCE approach is based on three theories. According to the economic theory of consumers, people are rational and make choices according to their preferences striving to maximize the utility (a measure of satisfaction a person experiences). Characteristics theory of demand (Lancaster, 1966) states that the consumer views a purchased good as a bundle of characteristics and derives utility not from the actual good but its characteristics or attributes. Finally, DCE is the only data collection method based on the random utility model (RUM) (Ben-Akiva et al., 1985; Domencich and McFadden, 1975) that asserts that respondents select an alternative, providing them with the highest utility when facing a choice.

To discover preferences, respondents are presented with a hypothetical situation described by a set of features (attributes) and asked to indicate preferred alternatives in successively presented choice sets. In the stated preferences methodology, we control for a set of features that respondents consider when making choices, thus revealing their preferences. Relative to traditional methods of preference study, DCE provides trade-off information, eliminates the personal scales problem and including the continuous attribute allows us to present the results in an objective measure (i.e., the value of one attribute can be expressed in another attribute, that is, we can estimate Marginal Rate of Substitution (MRS)).

In this study, to reveal preferences towards working mode and subject, the respondents were presented with the hypothetical situation and alternatives concerning school projects to be delivered weekly, described by time to be spent on it, working mode (individual, in a group of five, with a parent or tutor), and subject (mathematics, Polish [Native], English, and geography). Including the continuous variable—time to be spent on a project—allows us to determine the value of the other attributes students are willing to devote to learning a specific subject or in a specific mode. The respondents were asked to select a preferred alternative in six subsequent choice tasks with three alternatives each (no opt-out option). Figure 1 gives an example. The instruction was as follows:

"In a moment, we will ask you to select a better or preferred way of working on the project. Suppose you have to do a project in one of the following subjects: mathematics, geography, English, or Polish. Projects can be performed in several schemes (independently, in a group of five colleagues, or with a tutor or parent). Each project requires a different workload (the number of hours required to complete the project).

ATTENTION! There are no right or wrong answers here. Provide the answer under your preferences by comparing the available alternatives. Mark the one that seems the best to you, then click next."

	Option 1	Option 2	Option 3
Attribute			
Subject	Mathematics	Polish	Geography
Form of work	Group work	Group work	Independently
Work time	10 hours	5 hours	10 hours
Your choice	○	◉	○

Fig. 1 An example of the discrete choice experiment choice set item. Source: Competences 2018 survey.

For this part of the survey, we obtained answers from 21,381 respondents (different DCE modules were randomly assigned to the sample). Excluding non-participants and incomplete questionnaires yielded a final sample of 20,942 respondents, of which nearly 50% were females. Thus, the database covered 125,652 individual choices to estimate student preferences.

Strategy for modeling preferences. The DCE approach is based on the assumption that the selected option (the most preferred) is the one that provides us with the highest utility. When estimating the parameters of the utility function (U) for a given good, we use multinomial logistic (MNL) regression and random parameters logistic regression (RPL). MNL relies on the assumption of independence of irrelevant alternatives (IIA) and fixed coefficients; thus, the preferences are homogeneous (all respondents have the same preferences). RPL relaxes the IIA assumption and accounts for heterogeneity by allowing the coefficients for each attribute level to vary randomly across individuals, following a defined continuous distribution. The RPL model returns mean coefficient values, interpreted in the same way as the MNL results and standard deviation, indicating variability in preferences (unlike standard errors indicating estimate uncertainty). A standard deviation significantly different from zero indicates existing heterogeneity.

Both model results can be used to calculate marginal rates of substitution (MRS) between the attribute levels, which is a de facto willingness to pay (WTP) for a given level (characteristics of the education process in this study). The MRS between the attribute levels shows how much of an attribute (i.e., time) is worth the given level for the consumer (Train and Weeks, 2005).

The utility of an individual i resulting from choosing an alternative j in the situation t can be expressed as

$$U_{njt} = \alpha\left(p_{njt} + \boldsymbol{Y}_{njt}\boldsymbol{b}\right) + e_{njt} = \alpha\left(p_{njt} + \boldsymbol{Y}_{njt}\beta\right) + e_{njt}$$

where e_{ijt} is the stochastic component, p is the time attribute, and the vector of parameters $\beta = b/\alpha$ is a vector of implicit prices (marginal WTP) for the non-monetary attributes Y_{njt}. Thus, the probability of choosing *alternative j* by individual i is equal to

$$p_{ji} = \frac{e\left(\alpha\left(p_{njt} + Y_{njt}\beta\right)\right)}{\sum_{l=1}^{J} e\left(\alpha\left(p_{njt} + Y_{njt}\beta\right)\right)}$$

The analysis starts by estimating a simple MNL model drawn from utility theory and WTP. To explain stated choices, we assume the students' utility resulting from choosing an alternative (studying mode and subject) takes the following form:

$$\begin{aligned} \mathrm{U_{ij}} = {} & \beta_1 \mathrm{Subject\_Maths_i} + \beta_2 \mathrm{Subject\_Eng_j} \\ & + \beta_3 \mathrm{Subject\_Geo_j} + \beta_4 \mathrm{Mode\_Tutor_j} \\ & + \beta_5 \mathrm{Mode\_Independent_j} + \beta_6 \mathrm{Mode\_Parents_j} \\ & + \beta_7 \mathrm{Mode\_Group} + \beta_8 \mathrm{Time_j} + \varepsilon_{ij} \end{aligned}$$

The coefficient values do not have an absolute interpretation; however, based on their signs and relative values, we can explore how different factors influence respondents' choices and which attributes are the most important. For the categorical response variables, we consider the result at the bas level in the Polish language and studying independently. To assess heterogeneity, we introduced interactions to the model, and finally, we calculated individual-level parameters following Revelt and Train's (2000) approach.

To measure students' achievement, we employ the item response theory (IRT) (Hambleton et al., 1991). The item response function gives the probability that a person with a given ability level correctly answers the questions. The probability of a correct response to an item is a mathematical function of person and item characteristics. For individuals, it is usually the expected level of competencies, IQ score, or ability measure. Item parameters include difficulty, discrimination (expressed by the slope or correlation of how steeply the success rate of individuals varies with their ability), and a guessing parameter (how much individuals with the lowest ability levels will score by guessing). The imputed individual-level parameters and IRT-scaled achievement measures were used to assess the mutual relationship between preferences and educational outcomes.

Results

As a starting point for analysis, the Multinomial Logit Model was estimated. All variables were statistically significant at the 5% level. A positive sign implies the attribute positively impacts the probability of choosing an alternative relative to the reference level; that is, studying in a group of five and Polish for the study mode and subject, respectively. The negative sign indicates that utility negatively depends on the variable.

Further, to explore possible heterogeneity in the studied sample, we estimated the random parameter logistic regression (RPL) in the second step, which addresses certain MNL weaknesses. We set all attributes as random parameters following a normal distribution and applied 500 replications using the Stata mixlogit command. Table 1 shows the mean and standard deviation of the parameter distribution for RPL that can be used to determine the preferences' distribution. All parameters were significant at the 5% level. The same dependence direction with differences in parameter sizes, as in MNL, indicates consistent conclusions for both models. However, the statistical significance of the estimated standard deviation parameters indicates that students have heterogeneous preferences for all attributes. Thus, the MNL assumption of fixed coefficients is inappropriate. Given a normal distribution for random parameters, we can calculate the student proportion for whom an attribute has a positive or negative (per the β sign) effect on studying scenario preference.

The analysis of parameters confirms that time devoted to studying lowers students' utility (they prefer to spend time differently). Second, group work is a study mode generally preferred by students, followed by independent work. Studying with individual tutors and parents is the least liked by students relative to group work, the reference level here. The parameters are the lowest in both MNL and RPL. This may be related to the fact that individual studying with parents or tutors requires much effort and may stress students. The RPL model parameter coefficient for studying with a tutor has an estimated mean of nearly −0.60 and a standard deviation of 1.30. Thus, a standard deviation over the mean reveals students with positive preferences for this study mode, confirming heterogeneous preference for the attribute level. Over 32% of students had positive preferences for studying with a tutor, which was a negative factor for the remaining two-thirds. Similarly, we have heterogeneous preferences for the remaining levels of the study mode: nearly 32% of students have a positive preference for studying with parents, and 44% for studying independently. Relative to studying in a group, other modes are less often preferred.

Among the subjects included in the survey, relative to Polish, English was the most preferable, as it has the highest parameter and utility, followed by mathematics. Nearly 71% of students have a positive preference for English classes and 70% for mathematics. The latter result may be slightly surprising, given the well-documented reluctance to mathematics in the Polish educational system—according to TIMSS 2019 data, 31% of Grade 4 polish students do not like learning mathematics (Mullis et al., 2020).

The WTP calculated as the ratio of the attribute's coefficient to the price (i.e., time) coefficient provides a common metric for

Table 1 Estimated coefficients for multinomial logistic regression and random parameter logistic regression.

	MNL	RPL	RPL	RPL
	Coef.	Mean	SD[a]	% Pos[b].
Studying time	−0.148*** (0.001)	−0.257*** (0.003)	0.258*** (0.003)	
Study mode	Reference level: studying in a group of five			
With tutor	−0.349*** (0.009)	−0.597*** (0.016)	1.299*** (0.021)	32.29%
Independent	−0.033*** (0.010)	−0.181*** (0.016)	1.258*** (0.024)	44.28%
With parents	−0.251*** (0.010)	−0.437*** (0.014)	0.931*** (0.022)	31.92%
Subject	Reference level: Polish language (Native)			
Mathematics	0.175*** (0.010)	0.245*** (0.015)	0.885*** (0.023)	60.90%
English language	0.356*** (0.009)	0.515*** (0.015)	0.952*** (0.021)	70.57%
Geography	−0.118*** (0.010)	−0.170*** (0.014)	0.765*** (0.025)	41.21%
Number of choice sets	125,652	125,652		
Number of observations	376,956	376,956		
Log likelihood	−127,324.65	−121,599.2		

Standard errors in parentheses.
WTP willingness to pay, *MNL* multinomial logistic regression, *RPL* parameters logistic regression.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.
[a]The sign of the estimated standard deviations is irrelevant: interpret them as being positive.
[b]The proportion of the respondent population that has a positive preference for an attribute.
Source: Authors' own calculations.

Table 2 Willingness to pay calculated based on multinomial logistic regression estimates and mixed logit model in willingness to pay space.

	MNL	RPL	
	WTP	Mean	SD
Study mode:	Reference level: studying in a group of five		
With tutor	−2.340*** (0.066)	−2.440*** (0.066)	4.390*** (0.095)
Independent	−0.220*** (0.067)	−0.612*** (0.064)	4.060*** (0.098)
With parents	−1.690*** (0.064)	−1.623*** (0.054)	2.900*** (0.097)
Subject:	Reference level: Polish language (Native)		
Mathematics	1.183*** (0.068)	0.684*** (0.055)	2.04*** (0.151)
English language	2.399*** (0.065)	1.957*** (0.613)	2.97*** (0.115)
Geography	−0.792*** (0.068)	−0.528 (−1.628)	1.98*** (0.096)

Standard errors in parentheses.
WTP willingness to pay, *MNL* multinomial logistic regression, *RPL* parameters logistic regression, *SD* standard deviation.
***$p < 0.01$.
Source: Authors' own calculations.

comparing attributes. In random coefficient models, the ratio of two randomly distributed parameters may heavily skew a WTP distribution that may not have defined moments (Daly et al., 2012). A standard solution specifies the price (time) coefficient to be fixed; however, it implies that all students have the same preference for time, which is unreasonable. The second approach is to specify the price coefficient as log-normally distributed; here, there is a risk of unrealistic estimates of the WTP means and standard deviations (Hole and Kolstad, 2012; Meijer and Rouwendal, 2006). This study estimates the mixed logit model in WTP space using the Stata mixlogitwtp command, wherein the variable whose coefficient is the denominator in the WTP expression (i.e., time) is assumed to be log-normally distributed. Notably, the means and standard deviations in the WTP space can differ from the estimates received in the preference space. As in the WTP space, time is assumed to have a log-normal (normal) distribution (in preference space). Table 2 presents the WTP calculated per MNL estimates and the mixed logit model in the WTP space. The WTP values of the two models are consistent, and the WTP estimates in the MNL model are close to the mean estimates of the RPL model. The relatively high value of the standard deviation estimates indicates a high differentiation of preferences.

The results show that students are willing to sacrifice more than two hours of leisure time (−2.34; MNL model) to change the mode from work with a tutor to group work and nearly two hours (−1.69) to be in a group rather than work with parents. For working alone, they were willing to spend 13 min more (nearly 37 min per the RPL model) to avoid this study mode and work in a group. However, these preferences are heterogeneous across populations. Having identified the heterogeneity in preferences for the study modes and subjects, we can calculate individual-level parameters (using the mixlbeta Stata command) and the average WTP for those with and without positive preferences (Table 3).

As suggested in the literature, differences in preferences may result from addressing the free-rider problem in weak students' preference for group work, given the belief that they will benefit from others' work without consequences (free-riding). To verify this notion, Table 4 presents the WTP estimates based on the MNL model for high- and low-performing students. The favorable preference for working in the group was stronger among the highest-performing students than the lowest. For each study mode, they were ready to sacrifice more time to replace them with group work.

For the highest- and lowest-performing students, the learning modes with a tutor and parents are the least preferable. However, the highest-performing students are willing to devote more of their free time to avoid such modes than the low-performing

Table 3 Average willingness to pay for the study mode and subject attributes for students with positive and negative preferences.

	Positive coefficient estimate	Negative coefficient estimate
Study mode	**Reference level: studying in a group of five**	
With tutor	1.42	−3.00
Independent	1.42	−1.68
With parents	0.65	−1.87
Subject	Reference level: Polish language (Native)	
Mathematics	0.86	−0.44
English language	2.06	−0.69
Geography	0.39	−0.75

Source: Authors' own calculations.

Table 4 Willingness to pay calculated based on multinomial logistic regression for 20% highest- and lowest-performing students in mathematics.

	20% top-performing students		20% low-performing students	
	Coef	**St. err**	**Coef**	**St. err**
Study mode	Reference level: studying in a group of five			
With tutor	−3.129***	0.131	−1.959***	0.18
Independent	−0.072***	0.128	0.398***	0.191
With parents	−2.226***	0.124	−0.979***	0.184
Subject	Reference level: Polish language (Native)			
Mathematics	2.350***	0.134	0.208***	0.191
English language	2.631***	0.128	2.116***	0.182
Geography	0.274***	0.130	−2.356***	0.201

***$p < 0.01$.
Source: Authors' own calculations.

students. The best students are ready to sacrifice, on average, over three (two) hours to work in a group rather than with a tutor (parent). In contrast, the lowest-performing students would, on average, devote nearly two hours and one hour, respectively. Contrary to common belief, the highest-performing students value group work more than independent work and are ready to spend four additional minutes working in a group. Interestingly, weaker students are more reluctant to engage in group work than work independently. On average, they would devote 24 min of leisure time to change the study mode from group to independent work. As per the literature, these students may lack a sense of self-development, thus feeling unwelcomed in groups or dominated by better students. Therefore, except for the lowest-performing students working independently, group work is preferred by the best and weakest. The DCE results contradict the PISA 2015 conclusions that Polish students do not like group work. Rather, group work is generally preferred by the weakest and the highest-performing students, with some predominance by the latter.

To assess the extent to which the preference variation could be explained by the student's individual characteristics (i.e., gender) and how it influences the WTP (Table 5), we compare the WTP for analyzed attributes for male and female students.

Females and males preferred group work to working with a tutor or parents. However, males feel much more dissatisfied with studying with a tutor and are willing to devote three additional hours to working in a group, whereas females, to a slightly greater extent than males, value group work to working with parents. Males value working independently more than group work and

Table 5 Willingness to pay (in hours) for males and females.

	Females		Males	
	Coef	**St. err**	**Coef**	**St. err**
Study mode:	Reference level: studying in a group of five			
With tutor	−1.661***	0.095	−3.007***	0.092
Independent	−0.802***	0.100	0.304***	0.091
With parents	−1.831***	0.096	−1.551***	0.087
Subject:	Reference level: Polish language (Native)			
Mathematics	0.620***	0.100	1.704***	0.093
English language	2.216***	0.096	2.581***	0.089
Geography	−1.408***	0.102	−0.219**	0.092

Reference levels: working in a group of five for study mode attribute and Polish language (Native) for subject attribute.
***$p < 0.01$.
Source: Authors' own calculations.

are ready to spend 18 extra minutes in this mode than in a group. The situation is the opposite for females, who strongly prefer group work to individual work. They are willing to spend almost an hour more to avoid working individually, which is inconsistent with the PISA 2015 results, where the index of valuing teamwork clearly showed that males were more likely to appreciate group work. Additional WTP analysis based on the MNL model by gender and achievement level (Table 6) reveal that low-performing males prefer independent work and are ready to sacrifice more than an hour (1.35) to avoid group work.

Top-performing females and males value group work more than studying with a tutor or parents than their lower-performing peers. Considering subjects, contrary to the highest-performing males, who would sacrifice over 40 min (0.685) on geography projects to avoid working on Polish, their low-performing colleagues would instead devote more than one hour to work on Polish.

Including the interaction between the mode of learning and school subjects in the MNL model allows for investigating whether preferences are stable across subjects. The reference level is studying Polish in a group of five. Table 7 reveals that most of the interacted variables are statistically significant. Thus, the preferences of the study mode are dependent on the school subject, probably related to the content of the field and self-efficacy in a specific subject. Notably, students prefer studying mathematics with a tutor or parents than a Native language (Polish) in a group. When comparing self-study mathematics with learning Polish in a group, students show a preference for the latter, justified by the fact that mathematics is a more demanding subject, the learning of which, without the support of a teacher, may be more challenging. Regardless of the study mode, students prefer English to Polish in the group, and classes with a tutor are more preferred than studying Polish in a group. When studying geography, students do not like to be directly supervised by a tutor or parent; rather, they prefer studying Polish in a group.

Finally, a multilevel analysis was conducted using individual parameter coefficients from the RPL model, assuming a normal distribution for the analyzed variables. The empty multilevel model with a random intercept and no explanatory variables decomposed the variance into student and school levels (Table 8). The interclass correlation coefficient and likelihood ratio test indicate that we address the clusters. For the school- and student-level study mode, the largest variation of preferences (regarding the reference level and group learning) concerns studying with a tutor. For subject preferences (i.e., the Polish language) at the student level, the results show a much larger variation for English classes (33 and 115% larger than for mathematics and geography, respectively). When the school level is considered, the variance for the three subjects is similar. Hence, though schools shape

Table 6 Willingness to Pay (in hours) by the students' gender and achievement level. Reference levels: working in a group of five for study mode attribute and Polish language (Native) for subject attribute.

	20% top performing		20% low performing	
	females	males	females	males
	Coef.	Coef.	Coef.	Coef.
Study mode:	Reference level: studying in a group of five			
With tutor	−2.718*** (0.191)	−3.533*** (0.180)	−1.316*** (0.274)	−2.442*** (0.256)
Independent	−0.448** (0.192)	0.232 (0.172)	−0.793*** (0.287)	1.348*** (0.259)
With parents	−2.442*** (0.188)	−2.083*** (0.165)	−1.163*** (0.275)	−0.816*** (0.247)
Subject:	Reference level: Polish language (Native)			
Mathematics	1.774*** (0.198)	2.921*** (0.185)	−0.090 (0.282)	0.494* (0.259)
English language	2.723*** (0.192)	2.644*** (0.173)	1.888*** (0.270)	2.267*** (0.247)
Geography	−0.002 (0.194)	0.685*** (0.176)	−3.503*** (0.314)	−1.384*** (0.264)

Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Authors' own calculations.

Table 7 Estimated coefficients for multinomial logistic regression with the interaction between study mode and subject attributes.

	Coef.	Std. err.
Studying time	−0.153***	0.0013
Study mode	Reference level: studying in a group of 5	
With tutor	−0.497**	0.018
Independent	−0.041***	0.021
With parents	−0.356***	0.021
Subject	Reference level: Polish language (Native)	
Mathematics	0.081***	0.019
English language	0.151***	0.017
Geography	−0.074***	0.018
Interactions	Reference level: Polish language project in a group of five	
Mathematics with tutor	0.300***	0.028
Mathematics independently	−0.106***	0.030
Mathematics with parents	0.213***	0.031
English language with tutor	0.397***	0.028
English language independently	0.219***	0.028
English language with parents	0.239***	0.029
Geography with tutor	−0.132***	0.030
Geography independently	0.003	0.031
Geography with parents	−0.098***	0.032
Number of choice sets	125,652	
Number of observations	376,956	
Log likelihood	−126,938.54	

**$p < 0.05$, ***$p < 0.01$.
Source: Authors' own calculations.

student preferences of the study mode and subject (regarding their reference levels), they are responsible only for the below or slightly above 1% of variance.

Polish 14- and 15-year-old students are not reluctant to group work, contrary to the literature. Moreover, gender preferences do not accord with prior studies, which may primarily stem from a Likert-scale approach prone to multiple biases. The study also indicated heterogeneity in preferences per gender and subject.

Discussion

Groupwork ability is appreciated by employers, regardless of the industry. Understanding students' preferences is the first step to spreading skills and willingness to work in a group. This study focuses on students' preferences for learning modes and subjects. The DCE approach allowed for conclusions related to educational policy and methodology.

Contrary to existing research (Jakubowski, 2018; OECD, 2017b), our study indicated that Polish students enjoy group work, however, these preferences depend heavily on the work features and alternative options. Group work is the most preferred form of learning relative to working with a parent or a tutor. Students were willing to spend at least an hour longer working on a project with peers than to work with support from an adult.

The results revealed strong heterogeneity in youths' preferences —the learning mode preferences are sensitive to personal characteristics and achievement. Males show a particular reluctance to work under the supervision of an adult. Students who like and do well in the given subject showed a greater willingness to work in a group. Among the best students (yielding 20% of the highest mathematics results), the reluctance to work under supervision is the strongest.

Preferences towards group work depend on the learning field; thus, it is the wrong strategy to investigate them separately from the context using an abstract instrument (as it was done in the previous studies using Likert-type items). The study shows that students declared the greatest desire to pursue projects in English and mathematics, inconsistent with the prior notion of students' aversion to mathematics. At the same time, students are more averse to groupwork in Geography and the Native language (Polish).

The results also contradict the common belief that males show a greater preference for group work. Indeed, males were more willing to work independently than their female counterparts. The lowest-achieving students showed the highest preference for collaborative learning.

Importantly, the future studies devoted to the analysis o preferences should take into account the broader context of the learning process. Such a possibility is provided by the DCE approach, which, by taking into account various attributes, allows to control all aspects and circumstances of the decision process. Common scales usually do not allow comparison of preferences, which DCE allows for the ability to represent preferences using WTP.

Implications. This study had two policy-relevant implications. First, contrary to the common views about aversion to mathematics, students can enjoy learning maths if comfortable study

Table 8 Multilevel regression decomposing variance.

	Mode of study			Subject			Time
	With tutor	Independent	With parents	Mathematics	English	Geography	
Coefficients							
Constant	−0.597***(0.007)	−0.178***(0.006)	−0.443***(0.004)	0.243***(0.004)	0.515***(0.004)	−0.170***(0.003)	−0.256***(0.002)
Variance components							
Variance at the school level	0.005 (0.001)	0.002 (0.001)	0.002 (0.000)	0.001 (0.000)	0.001 (0.000)	0.001 (0.000)	0.000 (0.000)
Variance at the student's level	0.634 (0.006)	0.518 (0.005)	0.212 (0.002)	0.173 (0.002)	0.230 (0.002)	0.107 (0.001)	0.032 (0.000)
Share of school level variance in total variance (ICC)	0.78%	0.43%	0.87%	0.55%	0.49%	0.92%	1.46%
Number of observations	20,942						
Number of groups	327						
LR test vs. linear model	30.76	11.88	42.13	17.99	14.30	37.42	90.78

Standard errors in parentheses.
ICC Interclass correlation coefficient, *LR* likelihood ratio.
***p* < 0.01.
Source: Authors' own calculation.

modes are used. The obtained results may contribute to the literature focusing on math anxiety. Apparently, this is not the mathematics itself that fears students; instead, the instructional grading and assessment, fear of failure should be blamed. Education would be more effective and satisfying if only learning in the desired mode were based on evidence-based techniques (Rosenshine, 2012).

However, stakeholders need to exercise care when implementing recommendations for adjustment of modes of learning. Given the desire for group work, designing an effective implementation way to maximize knowledge transfer is essential. A well-organized groupwork needs to focus on well-balanced activities, engaging all students (otherwise, disadvantaged students do not benefit from group work and stay passive). Clear preferences for group work and the importance of the ability to cooperate in today's world are also important from the point of view of digital education, where the social aspect usually plays less important role, not allowing for the full development of teamwork skills. Given that, an educational policy may adjust the instruction to student preferences, increasing their academic motivation and effectiveness. Preferences towards group work depend on the context and subject, which teachers should take into account when implementing this type of work during classes, and not forget that education should, apart from ensuring well-being, be effective.

Although it is important to understand students' perceptions of group learning in classrooms, a student's low preference for this mode of work does not necessarily mean the complete exclusion of this method of work. If the negative attitude comes from bad experiences. Teachers should try to create good experiences or discuss with students the concerns they have about working in a group and, above all, teach students how to work in a group, as they also influence the work and preferences of others.

Second, this study showed that DCE offers an appropriate tool for investigating students' tastes for subjects, study modes, and other activities and confirmed that the attribute importance resulting from DCE and Likert-type questions might differ and provide various conclusions, as per prior studies (Wijnen et al., 2015). This study's approach is free from constraints and bias in studies using common rating scale exercises. However, mode of learning is just one of many examples of non-cognitive scales assessed using a defective instrument. Instead, DCE may be applied in many other educational contexts, reflected in the recent growing interest in well-being in education.

Limitations. Although the results obtained are satisfactory, some limitations of the study are worth mentioning. First, the study was conducted in Poland, in specific socio-cultural and educational context; to generalize findings it would be recommended to replicate the study in other environments and grades.

Second, the study did not control for students experience with group work and frequency of practicing it, which may be crucial, bearing in mind that preferences are shaped on the basis of past experience. While it is unlikely that the students did not have experience with group work, we do not know how their previous work in this mode looked like and whether they identify it with collaborative or cooperative learning. We are also unable to distinguish preferences from expectations and examine what students expect from group work. Moreover, in this study, we did not differentiate the group work into its varieties.

Third, the study did not include information on the size of group in which students would work, and which also affects the preferences for this form of work (Lyons et al., 2003).

Future research. The identified existing methodological gap and results of this study show how important is to use state-of-the-art

methods of preference investigation in educational studies. The popular Likert-based methods used in research on well-being and preferences could be replaced by DCEs based on hypothetical scenarios. This would allow for bringing new quality of evidence on non-cognitive measures in education. With agile tools as DCE, this can be done on the national level but also even a school level, providing reliable data on students need to policy makers, principals and teachers.

These studies could investigate deeper different approaches of group work that are becoming more and more common. Future research should also examine students' learning habits as well as past experiences and expectations to different modes of work.

Future studies on learning conditions may include additional attributes relating to other modes of delivery, but also to learning strategies. A particularly important attribute that may determine the choice of work in a group is the grade in the subject. Taking this attribute into account would make it possible to analyze students' motivation and striving for educational success. Similarly, it would also be reasonable to consider the frequency of operation in different modes. To the best of our knowledge, nobody has explicitly studied these learning characteristics with the use of Discrete Choice Experiment.

In addition, bearing in mind that students of different ages see different benefits from working in a group (Leman, 2015), and therefore their preferences for different modes of work may also differ, future research should include students of different grades and backgrounds.

Data availability

The datasets generated and analyzed in the current study will be available upon a request.

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Ethical approval

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