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Teacher Support Adaptivity in Physics Classroom for Gifted Students

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Abstract

Gifted students have varying learning characteristics and learning needs. In this respect, adapted support to their skills and learning characteristics during academic activities plays a key role in engaging in learning activities and achieving learning goals. Accordingly, this study focuses on teachers' support of adaptivity competencies during microteaching from the perspective of both gifted and nongifted students. To this end, a descriptive comparative method was adopted, and gifted (n=124) and non-gifted (n=205) students joined the study. An adapted version of the Questionnaire on Teachers’ Support Adaptivity was employed for collecting data. Data were quantitatively analysed including MANOVA and ANOVA. The results revealed that both groups perceived the support they received from teachers as slightly above and below average, meaning that teachers were not competent. In deep analysis, results indicated a significant difference between the two groups, but no difference between girls and boys. That is, gifted students are more disadvantaged than nongifted students since their teachers lack strategies in adapting their support to meet the different academic needs of their students. This study recommends that teachers need pre-service or in-service training to offer quality and appropriate support for gifted students, which is crucial in achieving learning goals.

Keywords: gifted education, gifted students, support adaptivity, science teacher competency, physics education

INTRODUCTION

Gifted students are exceptional learners with unique learning styles and specialized educational needs. Research indicates that when gifted students receive differentiated and adapted learning experiences, they demonstrate improvements in academic achievement, school attitudes, and engagement (Muammar, 2023; Brigandi, Gilson, & Miller, 2019; Aljughaiman & Ayoub, 2012). Since gifted learners are not a homogeneous group, their cognitive, affective, and socio-emotional skills should be considered when designing effective instructional strategies. In this regard, Hebert (2022) emphasizes that gifted education should incorporate differentiation, enrichment, and acceleration to align with students’ skills, nurture creativity and critical thinking, and prevent disengagement. Differentiated teaching strategies actively challenge students intellectually while providing opportunities for social and academic collaboration with like-minded peers (Hebert, 2022)

The predominant approach in gifted education research focuses on evaluating macro-level teaching strategies, such as curriculum models (e.g., parallel curriculum, integrated curriculum) or long-term instructional approaches (e.g., project- and problem-based learning) (Knopik & Oszwa, 2022; Jovanovic & Vukić, 2019). Kim (2016) reported that these enrichment programs positively influence both cognitive and non-cognitive development in gifted students. However, the role of teachers' scaffolding at a micro-level—within lesson activities and learning tasks—is equally critical (Van de Pol, Volman, & Beishuizen, 2010). Teacher-student interactions during learning activities significantly impact student outcomes (Weyns, Preckel, & Verschueren, 2021), making it imperative to examine the quality of teacher support at a micro-level in the classroom.

While many studies emphasize the role of challenge in differentiated instruction, effective support for gifted students extends beyond providing rigorous academic tasks (Eysink et al., 2020). Challenge, broadly defined as increasing task complexity, is essential but insufficient on its own. Teachers must also consider students' diverse learning characteristics, readiness levels, and motivational factors when providing support (Tomlinson, 2017). Van de Pol, de Vries, Poorthuis, & Mainhard (2022) highlight that effective teacher support must be responsive to individual learner needs, as gifted students vary in their cognitive abilities, prior knowledge, and socio-emotional attributes. Similarly, Sayı and Yurtseven (2022) argue that gifted learners form a heterogeneous group, necessitating personalized academic support strategies. Despite the wealth of research on curriculum differentiation, limited studies have examined how teachers adapt their support within daily learning activities in general classrooms and how competent they are in addressing gifted students' individual learning needs.

Teacher Support in Physics Education for Gifted Students

Physics classrooms present unique challenges and opportunities for supporting gifted learners. For example, the Schoolwide Cluster Grouping Model fosters collaboration among gifted students, encouraging in-depth inquiry and engagement in physics concepts (Gentry & MacDougall, 2023). Specialized physics courses have been shown to enhance gifted students' problem-solving abilities (Djordjevic & Pavlovic-Babic, 2010). Additionally, peer interactions are critical in maintaining motivation and fostering academic growth among gifted students (Kirsi et al.,2013; Fredricks et al., 2010). However, teachers should actively guide these interactions to maximize effectiveness (Makkonen, Lavonen, & Tirri, 2022).

Another essential component of physics education for gifted learners is cultivating a growth mindset. Makkonen et al. (2023) suggest that emphasizing effort, teaching effective learning strategies, and framing academic challenges as opportunities for development can enhance students' engagement. Given the cognitive complexity of physics, teachers must provide tailored instructional support that aligns with students' abilities, ensuring both challenge and accessibility in the learning process. Physics education inherently involves abstract concepts and complex problem-solving, requiring teachers to adopt innovative approaches such as inquiry-based learning, interdisciplinary integration, and technology-enhanced instruction to accommodate the needs of gifted learners (Garcia, Lane, & Rincón, 2021).

Theoretical Framework: *Teacher Support at Different Pedagogical Levels*

Gifted students require support at various pedagogical levels, ranging from curriculum-level modifications to activity-level scaffolding within the classroom. Christie's (1993) Curriculum Genre Theory provides a valuable framework for examining the structure and organization of learning in gifted education. According to Christie (2002), pedagogic discourse consists of curriculum macrogenres (broad curricular structures) and microgenres (lesson-level instructional activities). The macro-level encompasses gifted education models such as Science and Arts Centers, children's universities, and specialized enrichment programs. In contrast, the micro-level includes teacher-led instructional scaffolding within classroom activities.

O'Halloran (2004) expanded Christie's framework by identifying Lesson Microgenres, which categorize the instructional approaches used in classroom activities. These microgenres provide insight into how teachers scaffold learning through various strategies, ranging from open-ended questioning to direct instruction. van de Pol et al. (2022) emphasize that effective scaffolding requires contingency (adapting support to student needs), fading (gradually withdrawing support as students gain independence), and transfer of responsibility (encouraging student autonomy). These principles align with Vygotsky's (1978) Zone of Proximal Development, highlighting the importance of adjusting support based on learners' developmental readiness.

Adaptive Teacher Support for Gifted Students

Research highlights the essential role of adaptive teacher support in gifted education, emphasizing that effective scaffolding strategies are critical for enhancing learning outcomes among gifted students (Murphy & Messer, 2000; van de Pol et al., 2022; van de Pol et al., 2010). The concept of scaffolding, rooted in Vygotsky's Zone of Proximal Development (1978), posits that students can reach higher levels of understanding when supported by a more knowledgeable individual. In this context, scaffolding refers to teachers' tailored instructional support to accommodate students' diverse learning needs. This ensures that students are neither under-challenged nor overwhelmed by the instructional content.

Wood and Middleton (1976) argue that effective scaffolding involves continuously adjusting instructional support to match students' evolving abilities and comprehension levels. Van de Pol et al. (2022) expand on this idea by introducing the concept of Support Adaptivity, which refers to how teachers modify their instructional strategies in response to students' readiness and cognitive capabilities. Adaptive support ensures that students receive the appropriate level of guidance, facilitating both skill development and intellectual autonomy. This adaptivity can be classified into four key categories (See Table 1).

A+ (Adapted High Regulation): Increased teacher guidance for students with low understanding or skill. This support is necessary when students struggle with new or complex material, requiring step-by-step guidance, explicit instruction, and structured prompts to facilitate comprehension and engagement. A+ support might include breaking tasks into smaller steps, providing models or worked examples, and using questioning techniques to scaffold understanding effectively.

A- (Adapted Low Regulation): Decreased teacher guidance for students with high understanding or skill. When students demonstrate proficiency, teachers should gradually reduce their level of intervention, allowing students to engage in independent inquiry and problem-solving. This might involve encouraging self-directed learning, promoting metacognitive strategies, and facilitating peer collaboration to reinforce higher-order thinking skills. A- Support is crucial for fostering autonomy and deep engagement in the learning process.

NA+ (Unadapted High Regulation): Excessive teacher guidance for students with high understanding or skill. In this scenario, teachers may continue to provide unnecessary support despite students' readiness to work independently. Over-scaffolding can hinder students' ability to develop self-regulation and critical thinking skills, leading to dependency on teacher instruction rather than cultivating independent problem-solving abilities.

NA- (Unadapted Low Regulation): Insufficient teacher guidance for students with low understanding or skill. This occurs when teachers fail to provide the necessary support for students struggling with complex concepts, potentially leading to frustration, disengagement, and underachievement. NA- support reflects a mismatch between the instructional approach and students' learning needs, highlighting the importance of ongoing assessment and differentiation in teaching practices.

This framework objectively assesses the quality of support provided to gifted students within classroom activities. By identifying whether teachers provide appropriate adaptive support, educators can refine their instructional strategies to optimize learning experiences. Moreover, adaptive support is not a static process; it requires continuous monitoring and adjustment based on students' responses, progress, and evolving skill levels. Effective scaffolding is a dynamic and interactive process in which teachers must be attentive to students' verbal and non-verbal cues, modifying their guidance accordingly.

Aim of the Study and Research Questions

This study aims to investigate how teachers in regular classrooms adapt their instructional support to meet the academic needs of gifted students during learning activities. Since student perceptions provide valuable insights into instructional effectiveness (van de Pol et al., 2022), this study explores gifted and non-gifted students' views on their teachers' competencies in adapting support within physics classrooms. The following research questions guide this investigation:

1. To what extent are middle school physics teachers competent in adapting their instructional support to address the diverse academic needs of their students?
2. How do gifted and non-gifted students perceive teachers' support adaptivity during physics classroom instruction?
3. How do male and female students perceive teachers' support adaptivity during physics classroom instruction?

By addressing these questions, this study seeks to contribute to the broader discussion on effective and adaptive teaching strategies for gifted learners and provide actionable insights for educators and policymakers in gifted education. Examining how teachers provide support at both macro and micro levels will shed light on how instructional adaptation can enhance the learning experiences of gifted students in physics education and beyond.

METHOD

Participants and Procedure

A total of 329 (152 male and 177 female) students from Grades 5 to 7 (125, 5th; 109, 6th; 92, 7th) participated in this study. The participants are both gifted students (n= 124; 60 male and 64 female) and non-gifted students (n= 205; 92 male and 113 female). Their ages ranged between 11 and 14 (Mage 12,5, SD = 1.12) years. Data for gifted students were randomly collected from Science and Art Centers (SACs), and data for non-gifted students were collected from public schools in northern Turkiye. In the context of Türkiye, physics is taught as part of the general science curriculum in middle schools. During the period in which physics topics are covered, the average grade of gifted students is 87 out of 100, whereas the average grade of typically developing students is 56. The gifted population is identified as those who attend the Science and Arts Center (SAC) pull-out enrichment schools for gifted students. Students of SACs also attend mainstream schools.

Table 1. Facets of teacher support and adaptivity

Student's level of understanding	Teacher's Response	Adaptivity Facet	Explanation
Low	Much regulation	A+	Adaptive support by providing much regulation upon low student understanding
	Little regulation	NA- Challenge	Non-adaptive support by providing many challenges to low student understanding
		NA- No support	Non-adaptive support by providing little regulation, by not helping when students have a low understanding
High	Little regulation	A- Challenge	Adaptive support by providing many challenges upon high student understanding
		A- No support	Adaptive support by providing little regulation, by not helping when students understand
	Much regulation	NA+	Non-adaptive support by providing much regulation upon high student understanding

SACs are public institutions spread over all cities in Turkey for the supplementary education of gifted students. Students of SACs are selected in three stages. Students who are eligible to receive education in SACs are selected in three stages: (1) teacher nomination, (2) group intelligence testing, (3) individual intelligence testing, and then committee judging according to talent area (intellectual ability, painting, and music) (MEB, 2016). The current intelligence test is the Anadolu-Sak Intelligence Scale (ASIS) developed by Sak et al. Students who pass the screening exam and get scores of 130 and above from the ASIS test for each grade level and talent area are enrolled in the Science and Art Center. The non-gifted population comprised students who failed at any stage of the three-stage identification process and were not selected for SACs (See Figure 1).

Researchers decided on the schools according to the above criteria, and data were collected in the general public schools. Science teachers in the classrooms were asked whether they had gifted students in their classrooms. Data was collected with the help and consent of the teachers, who had professional experience ranging from 3 years to 15 years. As mentioned above, gifted students attending SACs study in public schools and study with nongifted students. The data collection tool used demographic data that asked, "Are you attending SACs?". This way, participants were coded as gifted and nongifted during data analysis. Therefore, gifted and non-gifted students evaluated the support adaptivity competency of the same teacher in the classroom. Before data collection, the participants were informed about the research, ethical considerations, and freedom to leave the research at any stage. Data was collected by the researchers in collaboration with school administrators.

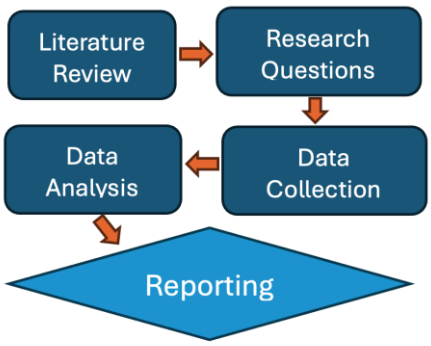

Figure 1. Research Process

Instrument

A demographic form. The form aims to collect information on gender, age, and whether or not they are enrolled in SACs.

The QTSA. The Questionnaire on Teacher Support Adaptivity (van de Pol, de Vries, et al., 2022) is a recently developed scale measuring students' perceptions of teacher support adaptivity. According to (van de Pol, de Vries, et al., 2022), support adaptivity is a complex construct in which a teacher determines the degree to which he or she adapts the organization or guidance of the student's learning process to the student's current level of understanding/skill and thus takes into account two situational factors (i.e., teacher regulation and student understanding). In other words, it emphasizes the effectiveness of teachers in adapting their lessons to the comprehension level of the whole class while at the same time offering individual help to students who have different understanding levels. In this way, the QTSA can enable both class- and individual-level feedback for teachers and help them gain more insight into their instructional process.

The QTSA has four facets and 21 items. The first factor is adaptive support with much teacher regulation upon low student understanding (A+; α = .98). A sample item in this facet includes "When I do not know how to continue, this teacher helps me to find the correct answer". The second factor is little teacher regulation upon high student understanding (A-; α = .97). A sample item includes "When I understand something well, this teacher makes it a little bit harder for me". The third factor is non-adaptive support with much teacher regulation upon high student understanding (NA+; α = .80). A sample item includes "This teacher helps me with things that I already understand". The last is little teacher regulation upon low student understanding (NA-; α = .95). A sample item includes "When I find an exercise difficult, this teacher barely explains it to me". (See Table 2).

Table 2. Instrument information

Section	*Question Type*	*Number of Items*	*Skills Assessed*	*Points*
A+	Likert	1-5	Provided many regulations to low student understanding	Min: 5 Max: 25
NA-		10-13	Provided little regulation to low student understanding	Min: 4 Max: 20
A-		6-9	Provided little regulation to high student understanding	Min: 4 Max: 20
NA+		14-17	Provided many regulations to high student understanding	Min: 4 Max: 20

The adapted version (in Turkish) of the scale also has the same four facets but consists of 17 items (Gül & Ayık, 2023). The A+ factor includes five items (α = .87), the A- factor involves four items (α = .80), the NA+ factor encompasses four items (α = .80), and the NA- factor includes four items (α = .78). As a result of CFA, the fit indices were found as follows: RMSEA = 0.06, AGFI = 0.87, NFI = 0.91, IFI = 0.93, GFI = 0.91, CFI = 0.93, TLI = 0.91. These values show that the model has good fit indices. In addition, item analysis and the difference between the means of the lower 27% and upper 27% groups were analyzed to determine item discrimination. As a result of the analysis, it was found that the t values were appropriate and the p values were significant (p<.01), that is, the discrimination of the items was at a reasonable level. Responses were given on 5 5-point Likert-type scale from 1 (not true) to 5 (true). In order to obtain a separate score for A+, A-, NA+, and NA- for a given student, the mean of the items for each dimension is calculated.

RESULTS AND DISCUSSION

For addressing the first research question, the mean and standard deviation values of the scores given by the students in both groups to their teachers regarding the adaptivity process were found through descriptive analysis (see Table 2). When the scores of both groups are evaluated, it can be stated that their teachers are not competent in adaptivity. In the dimensions of low level of student understanding and much regulation (A+) and high level of understanding and little regulation (A-), gifted students gave lower scores to their teachers than non-gifted students. On the contrary, in the dimensions of high levels of understanding and much regulation (NA+) and low levels of understanding and little regulation (NA-), nongifted students gave lower points than gifted students. Furthermore, it can be concluded that the teachers of both groups were not competent in adapting the teaching process to their learning level and that gifted students found their teachers less competent than typically developing students.

The situation may arise from multiple factors, as outlined below. First, teacher-related factors, such as beliefs, experience, knowledge, and cognitive processes regarding adaptivity, may play a significant role (Parsons et al., 2018; Egloff & Souvignier, 2020). These factors encompass essential aspects of the teaching profession, including epistemological beliefs, self-efficacy, and pedagogical approaches. Moreover, the developmental differences among students, whether lower or higher, are closely linked to teachers' pedagogical adaptivity (König et al., 2020). A complex and integrated understanding of teaching and student learning enables teachers to construct innovative instructional approaches from multiple perspectives, fostering adaptivity (Bohle Carbonell et al., 2016). A second contributing factor may be the lack of curricular flexibility and rigid institutional standards, which can hinder adaptive teaching practices (Pak et al., 2020; Parsons et al., 2018). The flexibility of the curriculum, in conjunction with opportunities provided by the socio-cultural environment, can facilitate the development of teachers' adaptive skills. These skills encompass behavioral adaptation, cognitive adaptation, and cognitive readiness for adaptation (Hu, 2024).

Gifted students vary according to their cognitive, affective, and socio-emotional characteristics and show different learning styles. Besides, they may have different readiness levels, motivation, understanding, or skills in learning activities. Given these facts, they need exceptional support in learning experiences, and the quality of support is crucial for reaching learning goals. Teachers are expected to adapt, provide contingent support, fade the support over time, and transfer responsibility to facilitate quality support.

To address the second and third research questions, the independent sample t-test was employed to examine whether there is a significant difference between the two groups according to gender. Then, MANOVA was employed to explore whether there were significant effects of giftedness and sex on the QTSA factors. Finally, several one-way analyses of variance (ANOVAs) were performed.

When we examine the mean adaptability scores, it becomes evident that both groups were exposed to a comparable level of adaptability. It was also found that the mean values in each dimension were almost equal between male and female participants in the two groups. At the same time, independent sample t-tests were conducted to determine whether there was a significant difference between the two groups regarding gender; no differences were found regarding gender across all factors within the groups. More specifically, there were no significant differences about A+ [$t(124) = -.387$, $p > 0{,}05$], A- [$t(124) = -.735$, $p > 0{,}05$], NA+ [$t(124) = -.962$, $p > 0{,}05$], and [$t(124) = -.504$, $p > 0{,}05$]. Similar results were also found for non-gifted students for each factor: A+

[t(205) = .000, p > 0,05], A- [t(205) = .401, p > 0,05], NA+ [t(205) = -.653, p > 0,05], and NA- [t(205) = -1.993, p > 0,05] (See Table 3).

Table 3. Descriptive data

	Gifted				Non-gifted			
	M (SD)				*M (SD)*			
Adaptivity scores	Male (*n=60*)	Female (*n=64*)	t	p	Male (*n=92*)	Female (n=113)	T	P
A+	2.70 (.41)	2.72 (.31)	-.387	.699	3.32 (.31)	3.35 (.33)	.000	1.000
A-	2.42 (.45)	2.48 (.51)	-.735	.464	3.27 (.47)	3.24 (.45)	.401	.689
NA+	3.50 (.51)	3.59 (.49)	-.962	.338	2.73(.39)	2.77 (.35)	-.653	.515
NA-	3.50 (.29)	3.54 (.46)	-.504	.615	2.71 (.43)	2.83 (.37)	-1.993	.048

When we examine in general terms, within and between both groups, it is seen that the students received an average level of support on the subjects they understood easily or had difficulty with during the learning process. However, they did not receive a high level of adaptation. Specifically, for the first dimension (high teacher regulation relative to low level of understanding), the gifted group received less support from their teachers on proceeding to the next step than the typically developing group. For the second dimension (low teacher regulation relative to the high level of understanding), the gifted group scored below average, while the non-gifted group scored above average. In other words, gifted students reported that the topics they understood well were not made more difficult later on, while non-gifted students reported that they were more difficult.

To explore whether there were significant effects of giftedness and sex on the QTSA factors, a 2 x 2 (giftedness by sex) MANOVA was conducted on the four dimensions of the scale. The findings indicated a significant impact of the giftedness factor, but not of the sex factor. Specifically main effect was found for giftedness [Wilk's Lambda = .25, F (4, 322) = 236.81, p < .001, E2partial = .75], and there is no impact regarding sex [Wilk's Lambda = .99, F (4, 322) = .84, p > .001, E2partial = .01]. Therefore, follow-up ANOVAs were conducted to determine whether there were significant main differences between gifted and nongifted students on the four dimensions of the QTSA.

For the third dimension (too much teacher regulation on high student understanding), gifted students gave above-average scores for teachers who still emphasized what they already understood. Non-gifted students complain less about this, but still do not receive full support. For the fourth dimension (too little instructional organization on low student understanding), the gifted group reported that the teacher could not explain their difficult understanding better (above average score). In contrast, the non-gifted group scored close to the average. The MANOVA results barely show that the gifted group is indeed more disadvantaged than the typically developing group in terms of the adaptation of the support they receive in these four dimensions, that is, in the areas that are easy or difficult for them to understand (significant difference). This shows that teachers of gifted students do not employ a variety of facet types of support in responding to diverse academic needs during learning activities.

Several one-way analyses of variance (ANOVAs) were performed to determine whether gifted and nongifted students' scores differed in terms of A+, A-, NA+, and NA-. Benforini correction was also used to control for type I error, so each ANOVA was tested with an alpha level of .01 (.05/4).

Gifted versus nongifted comparison

Results revealed significant differences between gifted and nongifted students in the four dependent variables (Table 3). More specifically, nongifted students got higher points than gifted students in A+ [F (1, 327) = 259.24, p < .01, η2 = .188] and A- [F (1, 327) = 231.60, p < .01, η2 = .323] dimensions in the QTSA. However, gifted students outperformed nongifted students in NA+ [F (1, 327) = 271.41, p < .01, η2 = .312] and NA- [F (1, 327) = 274.76, p < .01, η2 = .275] factors (See Table 4).

Although Kim (2016) demonstrated that gifted students are effectively provided with adapted support in differentiated programs such as curriculum compacting or enrichment, this study showed that gifted students are not given effective adapted support in general classrooms. Teachers are viewed as having insufficient facets of support for their students. The possible reasons teachers lack effective strategies for adapting their support for gifted students at a disadvantaged position in the classroom may be the following. First, as Barbier et al. (2022) noticed, teachers may lack knowledge about giftedness, which is called "frame of reference" by Barbier et al. (2022), and they may not believe that gifted students need support in learning activities as they can already master. Secondly, in line with (VanTassel-Baska & Stambaugh, 2005), teachers may lack appropriate strategies in their teaching repertoire for differentiating their instructional practices for gifted students. This shortage may cause the absence of effective support for the diverse learning needs of gifted students in general classrooms. Finally, Weyns et al. (2021) pointed out that teachers may have negative dispositions and biases that negatively affect the relationship between teachers and students. Such a conflict can prevent constructive classroom interactions between teachers and gifted students.

Overall, the findings indicated a significant impact on the giftedness factor, but not the sex factor. This means that teachers' competency generally falls short of addressing the specific learning needs of gifted students at an individual level, and appropriate types and facets of scaffolding are rare. The revealed situation has an enormous potential for a decrease in the engagement and success of gifted students in learning tasks.

DISCUSSION

This study examined the extent to which physics teachers adapt their support to meet the academic needs of gifted gifted students and make a comparison with the non-gifted students in physics classrooms. The findings revealed that both groups of students perceive teacher support adaptivity as moderate; however, gifted students reported lower levels of perceived adaptivity than their non-gifted peers. This suggests that teachers may struggle to adequately differentiate their instructional support to meet gifted students' unique learning needs.

One key finding of this study is that teachers tend to provide excessive regulation even when students demonstrate a high level of understanding (NA+), which can limit the intellectual autonomy of gifted learners. Conversely, when students struggle with understanding (NA-), teachers may not provide sufficient support, leaving students without the necessary scaffolding to progress effectively. This lack of balance in instructional support highlights a gap in teachers' ability to appropriately adjust their teaching strategies based on student readiness and comprehension levels.

Table 4. The comparison of facets of support adaptivity between the gifted and non-gifted groups

	Gifted		Nongifted					
Variables	*M*	*SD*	*M*	*SD*	*MS*	*F*	*P*	η^2
A+	2.71	.36	3.32	.32	29.15	259.24	<.01	.188
A-	2.45	.48	3.25	.45	50.10	231.60	<.01	.323
NA+	3.54	.50	2.75	.37	48.46	271.41	<.01	.312
NA-	3.53	.39	2.78	.40	42.60	274.76	<.01	.275

Factors Influencing Teacher Support Adaptivity

Several possible explanations for these findings emerge from the literature. One important factor is the lack of professional training in gifted education. Previous research (e.g., Barbier et al., 2022; VanTassel-Baska & Stambaugh, 2005) suggests that many teachers do not receive specific training on differentiating instruction for gifted learners. As a result, they may rely on general teaching strategies that do not adequately address gifted students' advanced cognitive, emotional, and motivational needs. The absence of targeted pedagogical training may explain why gifted students in this study perceived less adaptive support from their teachers.

Another potential factor is the rigidity of mainstream curriculum structures. Many national education systems emphasize standardized instruction, which limits teachers' ability to adapt their teaching methods (Pak et al., 2020). Without curricular flexibility, teachers may struggle to provide enrichment opportunities or differentiated tasks that challenge gifted students while supporting non-gifted learners. This aligns with prior research suggesting that gifted students often experience boredom and disengagement in traditional classrooms due to repetitive content and insufficient academic challenge (Subotnik et al., 2011).

Implications for Teaching Practice

The findings of this study underscore the need for systematic teacher training programs that emphasize instructional strategies tailored to gifted learners. Pre-service and in-service professional development should focus on adaptive scaffolding techniques, differentiation strategies, and curriculum modifications for greater flexibility in physics classrooms.

Additionally, fostering a growth mindset among teachers could encourage more individualized support for all students. Research suggests that teachers' beliefs about students' potential significantly influence how they provide academic support (Egloff & Souvignier, 2020). If teachers perceive gifted students as self-sufficient and not requiring additional support, they may unintentionally neglect their academic needs. Training programs should emphasize the importance of continuous challenge and engagement for gifted learners.

Furthermore, integrating student-centered learning approaches, such as inquiry-based learning and project-based activities, could enhance the adaptivity of support in physics education. These methods encourage students to take ownership of their learning while allowing teachers to provide scaffolded assistance based on individual progress (Makkonen et al., 2021).

CONCLUSION

This study highlights a significant gap in teacher support adaptivity for gifted students in mainstream physics classrooms. While gifted and non-gifted students perceive teacher support as moderate, gifted students report lower satisfaction, indicating that their unique academic needs are not effectively met. Teachers struggle to differentiate their support based on students' levels of understanding, often providing excessive guidance where it is unnecessary (NA+) and insufficient assistance when needed (NA-). This imbalance suggests a lack of adaptive scaffolding strategies, which may hinder gifted learners' engagement and academic success. The findings emphasize the urgent need for professional development programs focused on gifted education. Training initiatives should better equip teachers with differentiation techniques, adaptive scaffolding strategies, and curriculum modifications to support their students' diverse learning needs. Additionally, fostering a growth mindset in educators can help ensure that gifted students receive the necessary challenges and academic enrichment to reach their full potential. Systemic changes, including greater curricular flexibility and student-centered teaching approaches, are essential for creating inclusive classrooms where both gifted and non-gifted students thrive. Future research should explore the long-term impact of adaptive teaching practices, investigate the role of teacher training in gifted education, and identify effective instructional models that promote equity in learning opportunities. Enhancing teacher support adaptivity is crucial for fostering a dynamic and responsive learning environment. By prioritizing teacher training and instructional flexibility, educators can bridge the gap in academic support and ensure that all students, regardless of their cognitive abilities, receive the guidance they need to succeed in physics education and beyond. Limitations and Future Research, While this study provides valuable insights into teacher support adaptivity, several limitations should be acknowledged. First, the study relies on student perceptions, which, while informative, may not fully capture teacher intentions or instructional challenges. Future research could complement these findings with teacher self-reports, classroom observations, or qualitative interviews to comprehensively understand instructional adaptivity. Second, this study does not account for variations in teacher training backgrounds. Future studies could explore whether teachers with specific training in gifted education demonstrate higher levels of support adaptivity. Examining how different instructional strategies impact gifted students' academic performance and engagement would provide further insights into effective teaching practices.

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