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How an autonomy-supportive learning environment influences students' achievements in science and mathematics

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Abstract
In Eastern cultures, teaching is challenging due to students' increasing needs for autonomy and refusal to be controlled in traditional ways. Understanding the relationship between autonomy-supportive practices and students' learning outcome is essential for assisting teachers to create supportive learning environment to satisfy the needs for autonomy and intrinsic motivation. Using self-determination theory, we investigated how an autonomy-supportive environment related to students' need of autonomy, motivation, and achievement in science and mathematics. We considered the association between the autonomy support from school, teacher, and family and the students' achievement in both science and mathematics. A sample of 810 8th grade students, 15 science teachers and 15 mathematics teachers from 15 schools in Myanmar were included. Multilevel structure equation modelling was used to examine the relationships among variables from both individual and school level. Overall findings indicated that students' perceived teacher and parent autonomy support were significantly associated with the students' engagement, anxiety, and academic achievement in both science and mathematics. Teachers' perceived autonomy from school significantly related to students' perceived autonomy support from their teachers. In addition, teachers' perceived autonomy from school indirectly related to students' achievement in science and directly related to students' achievement in mathematics. The finding also showed no synergistic effect between teacher autonomy support and parent autonomy support on students' outcome variables.

Keywords Achievement · Anxiety · Autonomy support · Engagement · Self-determination theory

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1 Introduction

In the rapidly evolving social landscape of East Asia, motivating middle school adolescents has become an increasingly complex challenge. Traditional methods of discipline and control, once staples of Eastern educational culture, are diminishing in effectiveness as students exhibit a greater desire for independence and autonomy. This shift necessitates innovative approaches to foster sustainable motivation among students, with a particular focus on enhancing student engagement and motivation in basic education. Science and mathematics education, as integral components of the STEM curriculum, are especially impacted by these changes. Understanding these subjects promotes students' critical and logical thinking and facilitates their performance and academic achievement in other areas (Singh et al., 2002). The advancement of science and mathematics is crucial for Myanmar to transition from a developing to a developed nation. Despite abundant natural resources, limited human resources capable of applying advanced technology hinder economic growth. Thus, scientific and mathematical knowledge is essential for implementing modern technology in education and socio-economic sectors. This need is reflected in the Ministry of Education's new policies (Ministry of Education, 2020), which aim to upgrade educational standards to international levels and provide knowledge for socio-economic application. Thus, the role of development of science and mathematics education has become truly important in Myanmar.

Therefore, the onus is on educators to discover strategies that not only engage students but also enhance their intrinsic motivation in these two critical subjects. Self-Determination Theory (SDT) serves as a vital framework in this endeavor, advocating for the provision of autonomy support to fulfill students' psychological needs, thereby bolstering intrinsic motivation, a key driver of learning behaviors and academic success in science and mathematics (Ahn et al., 2021; Grolnick et al., 1997). Previous studies have delineated the effects of autonomy support across three primary environments: the classroom, where teacher-provided autonomy support correlates with increased student motivation and achievement (Froiland et al., 2012; Jang et al., 2010); the home, where parental autonomy support predicts positive child development outcomes (Chirkov & Ryan, 2001; Mageau et al., 2015); and the school, where institutional support for teachers can lead to more autonomy-supportive teaching practices (Robertson, 2010). Despite these insights, research has often examined these settings in isolation, overlooking the synergistic potential of an integrated, autonomy-supportive learning environment.

Our extensive literature review has identified two critical gaps: first, the need for a holistic examination of the interconnected roles of family, classroom, and school autonomy-supportive environments in shaping students' autonomous learning (Goldberg & Loth, 2020), second, the scarcity of research considering the effects of autonomy support on negative learning outcomes, such as learning anxiety, and the mediating role of learning anxiety in the relationship between autonomy support and academic achievement (Sowislo & Orth, 2013).This study aims to bridge these gaps by adopting an integrative perspective to analyze the collective association of autonomy support provided by parents, teachers, and schools. We will investigate how this integrated autonomy-supportive environment can fulfill students' needs

for autonomy, subsequently enhancing intrinsic motivation, reducing anxiety, and improving engagement and achievement in science and mathematics.

2 Background

2.1 Satisfaction of autonomy needs

Self-determination theory (SDT) is a theory of motivation and self-determined volition. It claims that human beings have three basic psychological needs: autonomy, competence, and relatedness; thus, the fulfillment of these needs is indispensable for healthy human functioning (Ryan, 2009). The significance of these needs is considered within the domains of education and classroom practices (Guay, 2022; Ryan & Deci, 2000), given that their satisfaction is a basic requirement for improving intrinsic motivation in educational contexts (Haw & King, 2022; Ryan & Deci, 2000).

SDT describes three types of motivation: intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation drives students to act for action's sake, and when under the influence of intrinsic motivation, students are prone to experience delight and fulfillment (Bureau et al., 2022; Reeve & Cheon, 2021; Ryan & Deci, 2020). Extrinsic motivation involves performing an activity as a necessary chore to fulfill a demand, avoid punishment, or receive a reward. Amotivation is a state in which an individual lacks the intention to act at all (Cheung & Zerouali, 2024; Turner et al., 2009). Based on the self- determination continuum, the motivational needs range from the intrinsic motivation, extrinsic motivation, to amotivation (Abah et al., 2022; Deci & Ryan, 1985; Ryan & Deci, 2020). On the one side of this continuum, intrinsic motivation is a kind of motivation to take part in behavior and conduct accordingly. It is to encounter enjoyment and happiness, no reward, and no punishment. On the other end is amotivation. Amotivated people are not motivated to do any task (Cheung & Zerouali, 2024; Ryan & Deci, 2020).

Intrinsic motivation refers to "doing something because it is inherently interesting and enjoyable" (Ryan & Deci, 2000). Intrinsic motivation can be facilitated by the social contexts such as teachers, parent, and school climates (Deci & Ryan, 2000; Niemiec & Ryan, 2009). As indicated by self-determination theory (SDT), intrinsic motivation is the principal subject to promote and advance high quality of learning. Numerous experimental studies based on self-determination theory assumption propose that intrinsic motivation and autonomous type motivation are helpful for internationalization, optimal learning and engagement and ideal learning in classroom (Abah et al., 2022; Savage-Speegle, 2017).Numerous educators and researchers have examined the influences of intrinsic motivation in classroom contexts (Chirkov & Ryan, 2001). Cultivating intrinsic motivation for learning can improve engagement and academic achievement and reduce anxiety and depression (Howard et al., 2021; Ryan & Deci, 2000).

According to the self-determination theory, autonomy is defined as "feeling free and volition in one's actions and is a basic human need" (Deci, 1995). It is nourished by and in turn nourishes our intrinsic motivation and our proactive interest in the world around us (Deci, 1995). Since autonomy is a critical psychological need

involving the experience of volition and self-direction in thought, feeling, and action, it serves as the foundation for other needs such as competence and relatedness (Haw & King, 2022; Legault, 2016; Niemiec & Ryan, 2013). One of the notable meta-analysis in work context shows that the need for autonomy is the driving factor in explaining motivation in workforce (Van den Broeck et al., 2016). In addition, the recent meta-analysis shows that the need for autonomy is the most effective in predicting in intrinsic motivation, but less in predicting in other types of motivation (Bureau et al., 2022). As explained in SDT, autonomy support is also an interpersonal style in which a teacher or parent considers the opinions and views of the students or children, explains the rationale behind and provides options and opportunities for self-initiation (Chirkov & Ryan, 2001; Ryan & Deci, 2000).

2.2 Autonomy support in the classroom

Autonomy support means that "an individual in a position of authority (e.g., an instructor in the classroom and parent in the home) takes the other's (e.g., a student's in the classroom and the children's in the home) perspective, acknowledges the other's feelings, and provides the other with pertinent information and opportunities for choice, while minimizing the use of pressures and demands" (Black & Deci, 2000; Deci & Ryan, 1985).

According to SDT, when students receive the autonomy support from their teachers, their intrinsic motivation will increases, leading to improved performance (Painter, 2011). In the classroom, teachers who apply autonomy-supportive teaching strategies enhance engagement and autonomous motivation by considering the students' thoughts and perceptions, sparking an interest in learning, providing choices and options, identifying effective learning objectives, and using interesting activities and resources (Reeve, 2009). Many experimental-designed studies confirmed that autonomy support from teachers significantly influences engagement (Niemiec & Ryan, 2009), academic achievement, and autonomous motivation in the classroom (Datu et al., 2018; Froiland et al., 2016; Grolnick et al., 1997). In addition, several studies have showed that students with teachers who provide autonomy support have more positive learning outcomes and higher engagement in the classroom than those with controlling teachers (Jang et al., 2012; Reeve, 2009). Moreover, students' need for autonomy was found to be a significant mediating variable in such relationships (Jang et al., 2012). Teacher autonomy support is also associated with other factors of non-academic performance such as self-regulated learning behaviours confidence (Alivernini & Lucidi, 2011; Mammadov & Schroeder, 2023) and psychological well-being (Mongiovi, 2018). Autonomy support can also be used to give students initiative during lessons to increase their interest and curiosity.

Extensive literature review have pointed out that, most of the studies showing the positive relations between autonomy support and positive learning outcomes are based on the North America sample (Deci et al., 1981; Ginsburg & Bronstein, 1993; Grolnick et al., 1997; Jian et al., 2018; Ryan & Grolnick, 1986; Vallerand, 1997) and European sample (Bieg et al., 2011; Großmann et al., 2023; Hofferber et al., 2016). Similar studies have been done on all levels of schooling including elementary (Ryan & Grolnick, 1986), high school (Vallerand, 1997), college (Black & Deci, 2000)

and postgraduate education (Williams & Deci, 1996). Only a few are conducted in Eastern contexts, such as Russia (Chirkov & Ryan, 2001), China (Chen et al., 1997) and Korea (Jang et al., 2012). In addition, some of the cross-cultural studies have found that the provision of autonomy support is associated with achievement across both Western and Eastern cultures (Cal, 2019). Some cross-cultural researchers have highlighted the application of SDT in non-Western cultures. In Myanmar, education policymakers and teachers are shifting from a traditional teacher-centered approach to a more constructivist method, emphasizing students' choice and engagement. This shift underscores the importance of enhancing teachers' pedagogical skills to support student autonomy and intrinsic motivation in learning (Kyaw, 2023; Marie, 2021; Ministry of Education, 2016; Soe et al., 2017). Therefore, exploring the application of SDT, particularly regarding autonomy support and student learning outcomes, is crucial in Myanmar.

Teacher autonomy support can reduce negative learning outcomes such as anxiety, depression, and boredom (Yu et al., 2016), and studies have found that teacher autonomy support is related to attitude and anxiety towards mathematics. Hall and Webb (2014) find that instructor support is positively related to interest and enjoyment and negatively related to anxiety. Piechurska-kuciel (2011) performs a correlational study with 621 Polish students in secondary school and finds that a higher level of teacher support is related to a lower level of language anxiety. Moreover, teacher autonomy support can reduce school drop-out rate (Alivernini & Lucidi, 2011). The influence of teacher autonomy support on anxiety is also noted in sports. In the correlational study conducted by Quested and Duda (2011), perceived autonomy support is negatively related to social anxiety and body dissatisfaction. However, research examining the influences of teacher autonomy support on negative learning outcomes remains limited.

2.3 Autonomy support in the family

There are two main types of parenting behaviours: supportive behaviours and controlling behaviours (Joussemet et al., 2008). Supportive parents provide choices and options for their children (Grolnick et al., 1997), while parents who apply controlling behaviours nurture their children with psychological control (Joussemet et al., 2008). These psychological controls can cause antisocial behaviour (Vansteenkiste et al., 2005). In contrast, if the children receive parent autonomy support, they will feel more autonomous and can better adjust to the environment (Joussemet et al., 2008). Autonomy-supportive parenting is "a parenting style which is based on self-determination theory in which parents are supportive, display warmth towards their children, and encourage them to act from an internally regulated belief system" (Daniels et al., 2018, p.10). Many studies have showed that parent autonomy support both directly and indirectly influences their children's learning outcomes. Autonomy support from a parent is positively correlated to intrinsic motivation, competence, and academic performance (Adie et al., 2012; Grolnick et al., 1997).

Parental support plays an important role in developing children's psychological constructs, and it benefits non-academic outcomes, including self-esteem, self-efficacy, and social and psychological well-being (Fan & Williams, 2010; Gofen,

2009; Vasquez et al., 2016). For example, Fousiani et al. (2014) have found that parent autonomy support is significantly correlated to self-endorsement in Belgium and Greece. Other studies have showed that a lack of parental autonomy support can cause negative outcomes, such as social, behavioural and emotional problems (Cohen et al., 2008).

Studies on parent autonomy support is very scarce in Myanmar. Culture contextualization of Myanmar is different from the Western context (Win, 2023). Culture varies based on the goals of collectivism and individualism. These two aspects affect education policies, family structure, and organization management. People in Western countries are high in the mechanism of individualism (Hofstra et al., 2002; Robertson, 2010), which emphasizes the role of personal freedom of options and choice and independence (Robertson, 2010). Myanmar is one of the Asian countries that mainly relied on collectivism. Students in Myanmar prefer to work with together and are more productive collaborating in learning than learning solo. In addition, they are dependant on adults to make a decision or to do something new (Oo, 2015; Rudkin & Erba, 2018; Speckien & Ku, 2022; Win, 2023).

Many studies on autonomy support have been done in the Western context (Afia et al., 2019; Bean et al., 2003; Deci & Ryan, 1985, 2000; Grolnick et al., 1997; Marbell-Pierre et al., 2019; Soenens et al., 2009, 2017). A few researches in the Eastern context (e.g., Indonesia, Korea, China, Singapore) have found that the positive effect of autonomy support (Feng et al., 2019; Feril et al., 2016; Jang et al., 2012; Lan & Mastrotheodoros, 2022; Wang et al., 2017). However, as our generation in the Eastern context moves in the direction of less collectivism and more individualism, we are more likely to increase warmth and support and decrease control in educational styles as well as parenting styles. More research is needed to understand the importance of parent autonomy support on students' development, as Myanmar will be more oriented towards individualism in coming decade (Rarick & Nickerson, 2006).

2.4 Autonomy support in school

Autonomy support for employees in the workplace is an important way to empower workers and thereby improves engagement and motivation and reduces anxiety (Deci & Ryan, 1985, 2000). Moreover, the degree of autonomy support that an employee receives in their environment will increase the positive organizational outcomes (Deci & Ryan, 2000), such as job satisfaction (Pearson & Moomaw, 2005). In the education and school setting, teachers are the employees who most influence students, as they play a major role in the education and instruction (Sehrawat, 2014). Therefore, providing teachers with autonomy support can serve as a way to empower teachers in their position of authority and responsibility in the school (Akbarpour-Tehrania et al., 2012).

Teacher autonomy refers to a teacher's freedom to create strategies and to promote an interactive structure and innovation in the classroom (Lee, 2014). In the school management setting, teacher autonomy is defined as the teacher's "self-rule and independence in conducting their tasks in terms of process, decision making, and time management" (Song et al., 2012, p.65). Teacher autonomy positively affects teachers' attitude and motivation towards autonomy in the classroom (Iachini, 2008).

If the teachers have autonomy in planning a curriculum and teaching, then they can provide autonomy to their students; on the contrary, if teaching is controlled by the school and factors related to the school, then teachers will be less likely to provide autonomy support to their students (Pelletier, 2002). In addition, autonomy support from the school allows the teachers to make decisions regarding classroom practices and encourages teacher-student interactions in the classroom (Gurganious, 2017). If the teacher has a high degree of teacher autonomy in the classroom, then students-teacher interactions will be more active and more different types of activities can be performed (Sehrawat, 2014). Teacher autonomy is also essential for professional development. If teachers have autonomy, then they will have many opportunities to develop and improve, and they will be autonomous teachers who can teach more effectively (Robertson, 2010; Sehrawat, 2014). It has been found that teacher autonomy is one of the main characteristics of the 21st century learner-center constructivist classroom (Gurganious, 2017).

Therefore, the autonomy of teachers by the school and the autonomy support of students by teachers are directly related (Akbarpour-Tehrania et al., 2012). In a constructivist classroom, instructors are responsible for providing autonomy to students (Ryan & Deci, 2000). Teacher autonomy is a tool for creating learner autonomy and positive learning outcomes (Bhushan, 2018). As a result, to provide autonomy support for students, the teachers should have the autonomy to decide their approaches and curricula. To examine the reason why some teachers are still employing control-based strategies in the classroom, it is necessary to explore whether the school has established an autonomy-supportive environment for the teachers (MacBeath, 2012).

2.5 Present study

Based on the review of the previous findings, we have known that the autonomy support from both teacher and parent might relate with students' academic and non academic outcomes through mediating the basic needs and motivation (Adie et al., 2012; Cal, 2019; Chirkov & Ryan, 2001; Deci & Ryan, 2000). We have also found that the importance of teacher autonomy for providing autonomy support for the classroom in the school setting. A few studies have also showed that if the teachers are supported by school and administrative function, they could provide autonomy support for students in the classroom (Pelletier et al., 2002). In addition, the positive association of teacher autonomy and students achievement has been revealed in many studies (Ayral et al., 2014). In conclusion, the previous findings have highlighted the importance of autonomy support to students from different perspective.

Despite the growing literature highlighting the importance of autonomy support in fostering intrinsic motivation and learning engagement, several research gaps remain. First, few studies have investigated the combined role of teachers, parents, and the school environment, particularly the interaction of autonomy support from these different sources. Second, the dual impact of motivation and anxiety, as mediators in the relationship between autonomy support from teachers or parents and students' academic performance, has been under-explored. Third, while most research has focused on Western samples (Afia et al., 2019; Bean et al., 2003), there is a scarcity of studies on samples from Myanmar, which presents a distinct cultural context.

Grounded in self-determination theory, this study aims to address the identified research gaps by examining the impact of autonomy support from teachers, parents, and the school environment on the academic performance of Myanmar students. The study also investigates how autonomy need satisfaction, intrinsic motivation, engagement, and anxiety mediate this relationship. Two-level structural equation model will be used to answer the questions. At the student level, our research will explore the predictive association of perceived autonomy support from parents and teachers on students' engagement, anxiety, and academic achievement, mediated by the satisfaction of autonomy needs and intrinsic motivation. At the school level, we will examine the association of institutional autonomy support and teachers' autonomy-supportive practices. The hypothesized model is shown in Fig. 1. Based on the above theoretical and empirical studies, it was hypothesized that:

H1 Students' perceived teacher autonomy support predicts students' academic achievement through the mediating of autonomy need satisfaction, intrinsic motivation, engagement and anxiety in science and mathematics.

H2 Students' perceived parent autonomy support predicts students' academic achievement through the mediating of autonomy need satisfaction, intrinsic motivation, engagement and anxiety in science and mathematics.

H3 Teachers' perceived autonomy from school predicts students' academic achievement through the mediating of teacher autonomy support in science and mathematics.

H4 The relationship of students' perceived teacher autonomy support and their academic outcomes will depend on the extent to which they perceive autonomy support from their parents in science and mathematics.

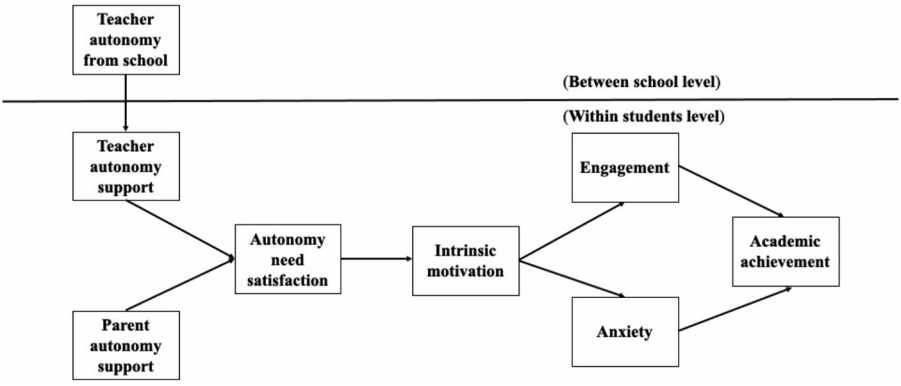

Fig. 1 Hypothesized Autonomy-supportive Environment Model

3 Method

3.1 Participants and procedure

Participants were selected from Yesagyo Township (Magway Region) and Sagaing Township (Sagaing Region) in Myanmar. The target participants were 810 8th students from 15 science and mathematics classes from 15 schools and their science (2 male and 13 females) and mathematics (6 male and 9 female) teachers. Detailed information on schools and classes were presented in Appendix I. These schools were selected based on their willingness to take the same monthly science and mathematics tests. In Myanmar, the basic education school was characterized as level A, B, or C. These levels were based on four criteria: school compound, communication and transportation, student-teacher ratio, and university entrance ratio range. A type A school was located in an urban area with well-equipped multimedia classrooms, convenient transportation, and sufficient areas for playgrounds and gardens; the student-teacher ratio was 27.25 to 1. For a type B School, although most of the above criteria were satisfied, the transportation and communication was not convenient. Most type C schools were located in rural areas. For this type of school, the student-teacher ratio was typically very large (around 65 students per class). In these schools, one teacher has to teach multiple subjects in multiple grades. In our study, we included all type of schools (A, B, C). Data collection was conducted before Covid 19 pandemic.

3.2 Measures

Students were asked to take both science and mathematics tests, and to answer a survey on their perception of teacher autonomy support, parent autonomy support, autonomy need satisfaction, intrinsic motivation, engagement and anxiety. Both science and mathematics teachers were also asked to answer a survey on teacher autonomy support from the school. For all measurement scales, previously validated questionnaires were used, and those measures were translated for Myanmar. The initial translation of the materials from English to Myanmar was completed by a teacher educator who was an expert in both English and Myanmar. The initial translated version was then translated back to English by a second teacher educator who was also an expert in both English and Myanmar and didn't have the access to the original English version. Then, the consistency between the second English version and the original English version was checked and discussed with the researcher. As the influences of autonomy support on learning were studied for science and mathematics, all questionnaires, except the questionnaire for parent autonomy support, were modified for both science and mathematics. All items adapted a five-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree). To ensure that these standardized questionnaires were suitable for Myanmar, the reliability of the instruments (Cronbach's alpha) was calculated, and confirmatory factor analysis (CFA) was performed. The model results and lowest and highest score for each measure were presented in Table 1.

Table 1 Confirmatory factor analysis results for measurement models

Model (CFA)	χ2/df	CFI	TLI	RMSEA	Factor Loading Lowest	Factor Loading Highest
Perceived Teacher autonomy support (S)	4.19	0.98	0.96	0.06	0.56	0.73
Perceived Teacher autonomy support (M)	5.74	0.98	0.96	0.08	0.61	0.73
Autonomy need satisfaction S	3.94	0.99	0.98	0.06	0.66	0.74
Autonomy need satisfaction M	4.99	0.99	0.96	0.11	0.71	0.74
Intrinsic motivation S	3.1	0.99	0.98	0.051	0.59	0.80
Intrinsic motivation M	3.16	0.99	0.98	0.052	0.57	0.87
Engagement S	4.06	0.93	0.92	0.06	0.46	0.75
Engagement M	5.42	0.92	0.92	0.07	0.54	0.82
Anxiety S	4.18	0.99	0.98	0.06	0.66	0.74
Anxiety M	7.81	0.99	0.97	0.09	0.72	0.82
Parent autonomy support	3.89	0.96	0.96	0.06	0.52	0.76

Note: "S" indicates Science, "M" indicates Mathematics

3.2.1 Perceived teacher autonomy support

To assess perceived teacher-provided autonomy support, participants were asked to complete the short six-item version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). The example item was "I feel that my teacher provides me choices and options". The reliability coefficients of the questionnaires for teacher autonomy support in science and mathematics (STAS and MTAS) were 0.80 and 0.84, respectively. CFA was also conducted to test the structural validity of this instrument. The results showed that the structure of teacher autonomy support in both science and mathematics fitted the data adequately.

3.2.2 Parent autonomy support

To assess perceived parental autonomy support, participants were asked to complete the Perceived Parental Autonomy Support Scale (P-PASS) questionnaire. This questionnaire was the final version developed by Mageau et al. (2015), and it included two dimensions: autonomy and psychological controls. In this study, autonomy support dimension was only evaluated using seven items. The example item was "My parents gave me many opportunities to make my own decisions about what I was doing". The participants were asked to complete a survey for each parent. The reliability coefficients of mother and father autonomy support were 0.85 and 0 0.89, respectively. In the model test, the average score of each item of mother and father autonomy support was used to measure parent autonomy support (PAS). The structure of PAS fitted the data adequately.

3.2.3 Autonomy need satisfaction

To assess the extent to which students experienced autonomy psychological need satisfaction, the Perceived Autonomy subscale from the Activity–Feelings States Scale (AFS) was used (Reeve & Sickenius, 1994). In this sub scale, three items were

included to assess autonomy need satisfaction. The example was "During the class, I feel I am doing what I want to be doing". The reliability coefficients of autonomy need satisfaction in science and mathematics (SANS and MANS) were 0.71 and 0.76, respectively. The structures of autonomy need satisfaction in science and math fitted the data adequately.

3.2.4 Intrinsic motivation

To assess intrinsic motivation, the students were asked to complete an academic self-regulation questionnaire (Ryan & Connel, 1989). This questionnaire covered four topics, i.e., external regulation, introjected regulation, identified regulation, and intrinsic motivation, and there were 32 items for four sub-topics (nine for external regulation, nine for introjected regulation, seven for identified regulation and seven for intrinsic motivation). However, in this study, we only used the sub-dimension of intrinsic motivation. The reliability coefficients of intrinsic motivation for science and mathematics (SIM and MIM) were 0.87 and 0.91, respectively. All factor loadings are greater than 0.4. However, the model fit indices for the dimension of intrinsic motivation with original 7 items were not acceptable ($\chi 2/df = 24.1 > 5$, RMSEA = 0.169 > 0.08, CFI = 0.875 < 0.9, TLI = 0.812 < 0.9, and $\chi 2/df = 31.31 > 5$, RMSEA = 0.193 > 0.08, CFI = 0.886 < 0.9, TLI = 0.829 < 0.9, respectively in science and mathematics). According to model modification indices, we added two correlation parameters between the items. The first one was between the items "I do my science/mathematics homework because it's fun" and "I do my science/mathematics homework because I enjoy doing my homework", and the second one was between the items "I try to answer hard science/mathematics question in class because I enjoy answering hard questions" and "I try to answer hard science/mathematics questions in class because it's fun to answer hard questions". The final overall model fits for science and mathematics improved ($\chi 2/df = 3.1$, RMSEA = 0.051, CFI = 0.990, TLI = 0.983, and $\chi 2/df = 3.16$, RMSEA = 0.052, CFI = 0.993, TLI = 0.988, respectively in science and mathematics) and all factor loadings were greater than 0.4.

3.2.5 Classroom engagement

Classroom engagement refers to the extent of students' active involvement in learning activities (Jang et al., 2012). To assess classroom engagements, the students were asked to complete rate four aspects of engagement: agentic engagement (e.g., "During class, I express my preferences and opinions"), behavioural engagement (e.g., "I listen carefully in class"), emotional engagement (eg., "I enjoy learning new things in class") and cognitive engagement (eg., "When doing schoolwork, I try to relate what I'm learning to what I already know"). The adapted version including four parts of engagement was used (Reeve & Tseng, 2011), and 21 items were included. Students' engagement were traditionally measured from three dimensions, including behavioural, emotional, and cognitive engagement (Fredricks et al., 2004; Jimerson et al., 2003). However, these three types of involvement were emerged from the directional process initiated by the teacher and they represent only incomplete understanding of engagement (Reeve, 2012). Therefore, the agentic engagement was incorporated

to contribute to understanding of how students really engaged themselves and it was initiated by the learner (Reeve, 2012). Therefore, four-dimensional measure of engagement involved two directional processes. It was also indicated that the four-dimensional structure of students' engagement (behavioural, emotional, cognitive, and agentic) showed stronger psychometric qualities with high internal consistency and good external validity (Reeve & Tseng, 2011; Reeve & Lee, 2013; Veiga, 2016). Thus, four-dimensional measure of students' engagement was used in this study. The reliability coefficients of engagement for science and mathematics (SENG and MENG) were 0.93 and 0.95, respectively. The structures of classroom engagement for both science and mathematics fitted the data adequately.

3.2.6 Learning anxiety

Anxiety is the feeling of worry, nervousness, or unease about something. Learning anxiety is a kind of anxiety which relates to feeling of worried come from the authority, such as teachers, or specific subjects like English, mathematics etc. (Aparnath, 2014). To test anxiety, the class-related anxiety scale of the achievement emotion questionnaire was used because this questionnaire has been validated for pre-adolescents (Peixoto et al., 2015). This questionnaire included four items. The example items is "I feel nervous in Science and Math class". The reliability coefficients of classroom anxiety for science and mathematics were 0.78 and 0.85, respectively. The structures of learning anxiety for science and mathematics fitted the data adequately.

3.2.7 Achievement score

There were three types of assessment in Basic Education in Myanmar, monthly test, two short-term tests, and final test (Tanaka & Khine, 2020). For academic achievement, the score from the test conducted in December was used in this study. We organized a panel of 5 teachers to develop this achievement, all of them were experienced teachers. A professor in the filed of Science & Mathematics education from local university examined each item to make sure the content validity of the test was good. It took 1.5 h to finish each test. The test for science included true/false items, multiple choice items, completion items and open-ended questions. The test for mathematics included true/false items, multiple choice items, and short and long open-ended questions. The test for mathematics covered ratios, proportions, variation, and social mathematics, while the test for science covered environmental conservation, space and meteorology, and information and communication technology.

3.2.8 Teacher autonomy scale

To assess teacher autonomy, the teacher autonomy scale was used. This scale was developed by Pearson and Hall (1993). In 2005, Pearson and Moomaw modified the teacher autonomy scale, which included 18 items. The reliability coefficients of science and mathematics teacher autonomy were 0.95 and 0.92, respectively. Due to the small sample size for teacher group ($n = 15$), CFA was not conducted. However, this instrument has been found to have high validity in another study (Yazici, 2016),

in which 497 teachers in Turkey were included. The goodness of fit indices obtained through CFA were as follows: $\chi 2/df = 2.23$, GFI = 0.90, RMSEA = 0.06, SRMR = 0.06, CFI = 0.97, IFI = 0.97, NFI = 0.94, NNFI = 0.96. This instrument was also used in the Eastern context (Malaysia) in a study of 471 schoolteachers (Varatharaj et al., 2015). Given that Malaysia and Myanmar are both in Asia and have similar cultural backgrounds, this instrument of teacher autonomy was used to collect data from teachers in this study. For the teachers' level (between), teachers' gender and class-level performance were also considered as the controlling variables.

3.3 Data analysis

To test our hypothesized model, structure equation modeling was employed. According to Hoyle (1995, p.1), SEM was a "comprehensive statistical approach to testing hypotheses about relationships among observed and latent variables". The structural model indicated the relationships between the one latent variable to other latent or unobserved variable. It specified the pattern by which "particular latent variables directly or indirectly influence changes in the values of certain other latent variables in the model" (Byrne, 2010, p.13). Harman's single-factor test was the most widely used techniques to identify the issue of common method variance. In present study, the result of this value for science was 34.59% and for mathematics was 40.58%, both of them were below the critical value of 50% (Podsakoff & Organ, 1986), which meant that there was no common method bias. According to the theoretical framework we proposed, two level (student-level and school-level) structure equation model was established.

All the analysis were conducted with Mplus version 7.4. We interpreted the model fit based on the following cut-of values following the recommendations by Byrne (2006), Hooper et al. (2008), and Hu and Bentler (1999): the ratio of chi-square to the number of degree of freedom below 3 is considered good and below 5 is acceptable, the comparative fit index (CFI) above 0.90, tucker lewis index (TLI) above 0.90, and root-mean-square error of approximation (RMSEA) smaller than 0.08 are considered as acceptable.

4 Results

4.1 Preliminary analysis

Preliminary analysis was conducted with Pearson's correlation coefficient. According to the correlation and descriptive results, teacher autonomy from school was positively correlated to perceived teacher autonomy support, and perceived autonomy support from teachers and parents was positively related to engagement and academic achievement and negatively related to anxiety in both science and mathematics. Tables 2 and 3 showed the correlation results among variables in science and mathematics.

Table 2 Correlations, means, and standard deviations of variables (science)

Variable	1	2	3	4	5	6	7	8
1. STA	-							
2. STAS	0.06**	-						
3. PAS	0.06**	0.15**	-					
4. SANS	0.05**	0.74**	0.26**	-				
5. SIM	0.04**	0.51**	0.18**	0.68**	-			
6. SENG	0.06**	0.77**	0.41**	0.76**	0.78**	-		
7. SAX	-0.04**	-0.51**	-0.23**	-0.47**	-0.45**	-0.53**	-	
8. SA	0.17**	0.55**	0.33**	0.52**	0.50**	0.65**	-0.53**	-
Mean	3.88	3.83	4.02	3.81	3.92	3.82	2.62	81.32
SD	0.43	0.56	0.59	0.66	0.67	0.58	0.86	13.84

Note: STA: Science teacher autonomy from school; STAS: Science Teacher Autonomy Support; PAS: Parent Autonomy Support; SANS: Science Autonomy Need Satisfaction; SIM: Science Intrinsic Motivation; SENG: Science Engagement; SAX: Science Anxiety; SA: Science Achievement; $^{**}p < .01$

Table 3 Correlations, means, and standard deviations of variables (mathematics)

Variable	1	2	3	4	5	6	7	8
1. MTA	-							
2. MTAS	0.05**	-						
3. PAS	0.05**	0.15**	-					
4. MANS	0.05**	0.76**	0.32**	-				
5. MIM	0.04**	0.59**	0.25**	0.78**	-			
6. MENG	0.05**	0.80**	0.42**	0.80**	0.80**	-		
7. MAX	-0.04**	-0.52**	-0.31**	-0.54**	-0.55**	-0.57**	-	
8. MA	0.16**	0.57**	0.36**	0.57**	0.55**	0.68**	-0.59**	-
Mean	3.48	3.12	3.97	3.70	3.79	3.81	2.75	78.59
SD	0.39	0.613	0.54	0.828	0.81	0.70	1.03	17.87

Note: MTA: Mathematics teacher autonomy from school; MTAS: Mathematics Teacher Autonomy Support; PAS: Parent Autonomy Support; MANS: Mathematics Autonomy Need Satisfaction; MIM: Mathematics Intrinsic Motivation; MENG: Mathematics Engagement; MAX: Mathematics Anxiety; MA: Mathematics Achievement; $^{**}p < .01$

4.2 Two-level structure equation modelling (SEM) results for science

To examine if multilevel modelling was appropriate, intraclass correlation coefficient (ICC) were calculated for the amount of the between level variance in students' achievement. The ICC of science achievement was 0.268. Therefore, it was suitable to do multilevel model (Preacher et al., 2011).

We tested the hypothesized model (Fig. 1) for science as the initial model. The result showed that the initial model received acceptable model fit. However, according to the model modification report from Mplus software, we modified the model by adding the direct association from teacher and parent autonomy support to the students' engagement and anxiety. Then, adjustments were made according to the modification indices to develop the final model. As shown in Table 4, compared with the initial model, the final model (Fig. 2) showed better model fit. Therefore, the results were explained according to the final model. Parametric residual bootstrap method is an effective method for calculating mediation effects of data with multi-level struc-

Table 4 Model fit indices for two-level structure equations for science

Model	χ2	df	χ2/df	RMSEA	CFI	TLI
Initial Model	1502.556	331	4.54	0.066	0.91	0.90
Finalized Model	1134.090	327	3.47	0.055	0.94	0.93

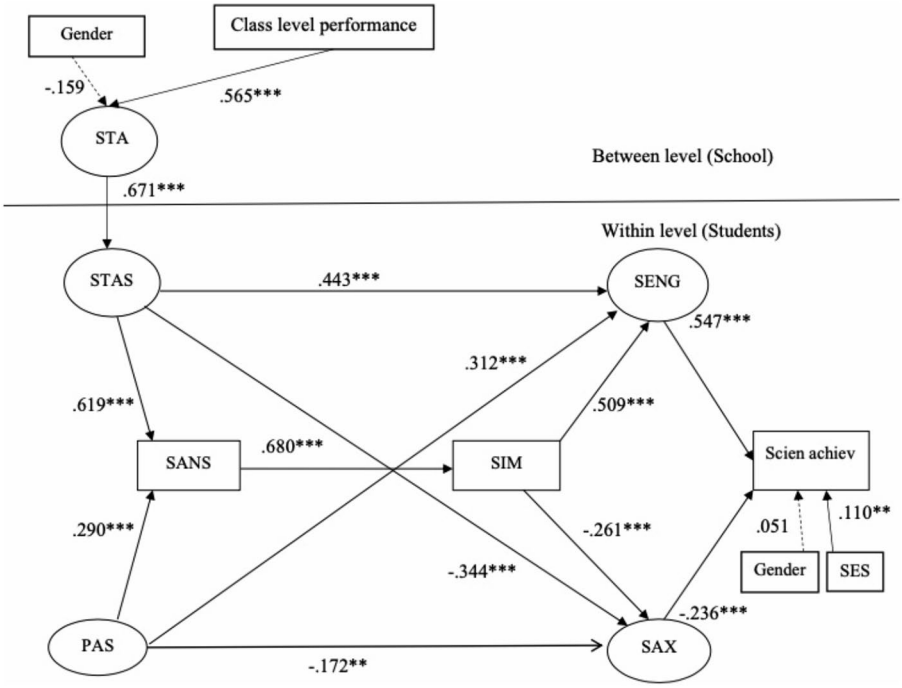

Fig. 2 Final Two-Level Structure Equation Model for Science *Note*: ∗ p<.05; ∗∗ p<.01; ∗∗∗ p<.001. ICC=0.268 STA: Science Teacher Autonomy; STAS: Science Teacher Autonomy Support; PAS: Parent Autonomy Support; SANS: Science Autonomy Need Satisfaction; SIM: Science Intrinsic Motivation; SENG: Science Engagement; SAX: Science Anxiety; Scien achiev: Science achievement

ture (Fang et al., 2019), therefore, it was adopted in current study. Table 5 showed the direct and indirect associations of predictors and outcome variables for science.

According to the model results, at the student level (within), science teacher autonomy support and parent autonomy support were positively related to science autonomy need satisfaction (β=0.619, p<.001 and β=0. 290, p<.001, respectively), which was in turn positively correlated to science intrinsic motivation (β=0.680, p<.001). Science intrinsic motivation positively related to science engagement (β=0.509, p<.001) and negatively related to science anxiety (β = -0.261, p<.001). In addition, science teacher autonomy support directly correlated with engagement (β=0.443, p<.001) and science anxiety (β = -0.344, p<.001). Parent autonomy support also directly correlated with science engagement (β=0.312, p<.001) and science anxiety (β = -0.172, p<.001). Science academic achievement was positively predicted by engagement (β=0.547, p<.001) and negatively predicted by anxiety in the science classroom (β = -0.236, p<.001). Chained mediating effects were discovered

Table 5 Significance test of direct and indirect effects on engagement, anxiety and achievement in science (final model)

	From	Path	Mediator	To	Effect size	*p*-value	Total	Percentage
Between	STA	Direct		Sci-achiev	0.285	0.076	0.285	47.7%
		Indirect	STAS SENG		0.162	<0.05	0.312	52.3%
			STAS SANS SIM SENG		0.079	0.056		
			STAS SAX		0.054	0.123		
			STAS SANS SIM SAX		0.017	0.080		
Within	STAS	Direct		Engagement	0.443	<0.001	0.443	67.4%
		Indirect	SANS SIM		0.214	<0.001	0.214	32.6%
	PAS	Direct			0.312	<0.001	0.312	75.7%
		Indirect	SANS SIM		0.100	<0.01	0.100	24.3%
	STAS	Direct		Anxiety	-0.344	<0.001	-0.344	75.8%
		Indirect	SANS SIM		-0.110	<0.001	-0.110	24.2%
	PAS	Direct			-0.172	<0.01	-0.172	77.1%
		Indirect	SANS SIM		-0.051	<0.01	-0.051	22.9%
	STAS	Indirect	SENG	Sci-achiev	0.242	<0.001	0.466	--
			SANS SIM SENG		0.117	<0.001		
			SAX		0.081	<0.01		
			SANS SIM SAX		0.026	<0.001		
	PAS	Indirect	SENG	Sci-achiev	0.171	<0.001	0.279	--
			SANS SIM SENG		0.055	<0.01		
			SAX		0.041	<0.05		
			SANS SIM SAX		0.012	<0.01		

Note: MTA: Math Teacher Autonomy; MTAS: Math Teacher Autonomy Support; PAS: Parent Autonomy Support; MANS: Math Autonomy Need Satisfaction; MIM: Math Intrinsic Motivation; MENG: Math Engagement; MAX: Math Anxiety; Math achiev: Math achievement

connecting science teacher autonomy, science teacher autonomy support and parent autonomy support with science academic achievement. Socioeconomic status was associated with students' academic achievement ($\beta = 0.110$, $p < .01$).

At the school level (between), science teacher autonomy positively related to science teacher autonomy support ($\beta = 0.671$, $p < .001$) but was not directly related to students' achievement. However, the indirect path from science teacher autonomy to students' achievement through the mediating of science teacher autonomy support and engagement was significant (see Table 5). For the between level, teacher's gender and class-level performance were used as the controlling variables. According to the results, teachers' gender does not associate with teachers' perceived autonomy.

Table 6 Model fit indices for two-level structure equations for mathematics

Model	$\chi 2$	df	$\chi 2$/df	RMSEA	CFI	TLI
Initial Model	1499.109	331	4.53	0.066	0.93	0.92
Finalized Model	1234.400	327	3.77	0.059	0.95	0.94

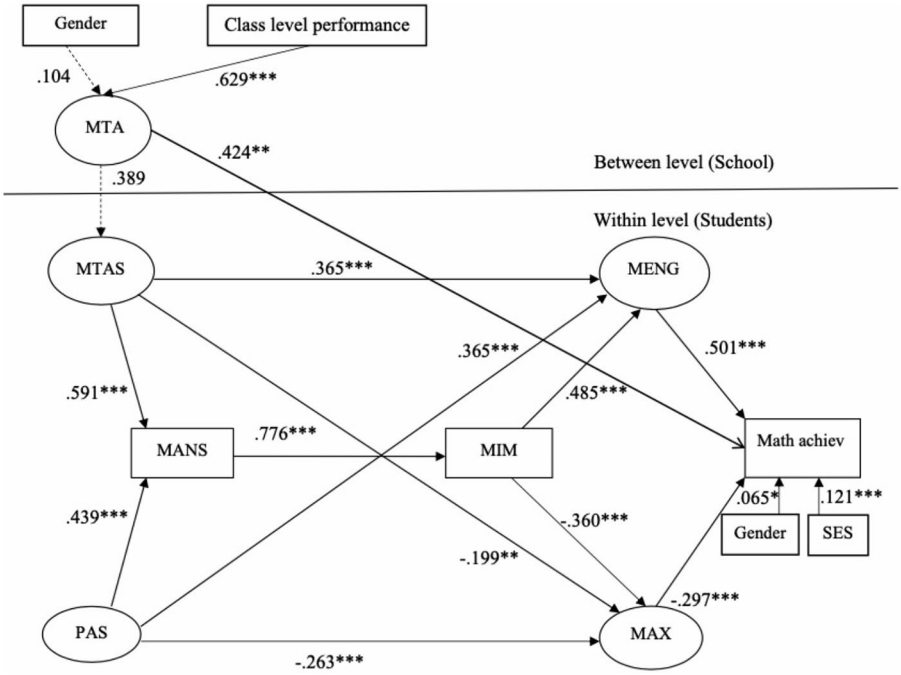

Fig. 3 Final Two-Level Structure Equation Model for Mathematics *Note*.* $p<.05$; ** $p<.01$; *** $p<.001$. ICC = 0.344 MTA: Math Teacher Autonomy; MTAS: Math Teacher Autonomy Support; PAS: Parent Autonomy Support; MANS: Math Autonomy Need Satisfaction; MIM: Math Intrinsic Motivation; MENG: Math Engagement; MAX: Math Anxiety; Math achiev: Math achievement

Among 15 science teachers, only two teachers were males. Class level performance significantly related to teachers autonomy ($\beta = 0.565$, $p<.001$).

4.3 Two-level structure equation modelling results for mathematics

ICC was also calculated to examine whether multilevel modelling was suitable for math (ICC = 0.344). Therefore, it was also suitable to do multilevel modelling (Mutheen & Mutheen, 2007; Preacher et al., 2011). Similar to the science data, we also modified final model for mathematics by adding the direct association from teacher and parent autonomy support to the students' engagement and anxiety. As shown in Table 6, compared with the initial model, the final model (Fig. 3) fitted better. Therefore, the results were explained according to the final model. Table 7 showed the direct and indirect relationships of the predictors and the outcome's variables for mathematics. The only difference between the model for mathematics and

Table 7 Significance test of direct and indirect effects on engagement, anxiety and achievement in mathematics (final model)

	From	Path	Mediator	To	Effect size	*p*-value	Total	Percentage
Between	MTA	Direct		Math achiev	0.424	<0.01	0.424	73.1%
		Indirect	MTAS MENG		0.071	0.079	0.156	26.9%
			MTAS MANS MIM MENG		0.043	0.125		
			MTAS MAX		0.023	0.142		
			MTAS MANS MIM MAX		0.019	0.119		
Within	MTAS	Direct		Engagement	0.365	<0.001	0.365	62.2%
		Indirect	MANS MIM		0.222	<0.001	0.222	37.8%
	PAS	Direct			0.365	<0.001	0.365	68.9%
		Indirect	MANS MIM		0.165	<0.001	0.165	31.1%
	MTAS	Direct		Anxiety	-0.199	<0.01	-0.199	54.7%
		Indirect	MANS MIM		-0.165	<0.001	-0.165	45.3%
	PAS	Direct			-0.263	<0.001	-0.263	68.1%
		Indirect	MANS MIM		-0.123	<0.001	-0.123	31.9%
	MTAS	Indirect	MENG	Math achiev	0.183	<0.001	0.402	--
			MANS MIM MENG		0.111	<0.001		
			MAX		0.059	<0.05		
			MANS MIM MAX		0.049	<0.001		
	PAS	Indirect	MENG	Math achiev	0.183	<0.001	0.381	--
			MANS MIM MENG		0.083	<0.001		
			MAX		0.078	<0.01		
			MANS MIM MAX		0.037	<0.001		

Note: MTA: Math Teacher Autonomy; MTAS: Math Teacher Autonomy Support; PAS: Parent Autonomy Support; MANS: Math Autonomy Need Satisfaction; MIM: Math Intrinsic Motivation; MENG: Math Engagement; MAX: Math Anxiety; Math achiev: Math achievement

the one for science was that we found a direct association of mathematics teacher autonomy and students' achievement which was not identified for science. Therefore, we could conclude that both models showed similar trends in terms of mechanism of relationship.

4.4 The synergistic effects of autonomy support from different sources

To test hypothesis 4, we investigated the synergistic effect of teacher autonomy support and parent autonomy support on academic achievement. As illustrated in Fig. 4, latent interaction variables derived from teacher autonomy support and parent autonomy support, referred to as STPAS and MTPAS respectively, were incorpo-

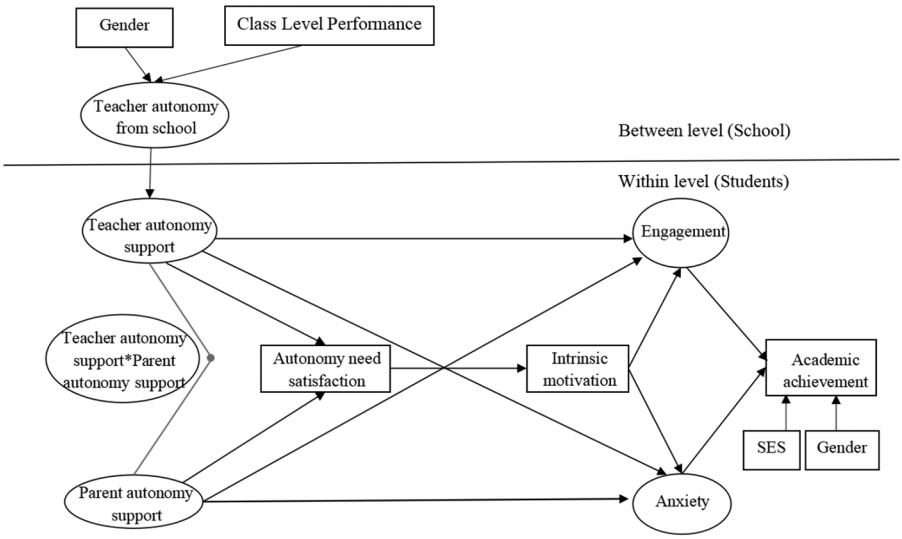

Fig. 4 Two-Level Structure Equation Model for Synergistic Effects

rated into both the science and mathematics models. The interaction effects between teacher and parent autonomy support on *Engagement*, *Anxiety*, and *Autonomy Need Satisfaction* were analyzed separately, with results presented in Tables 8 and 9. The findings indicated that none of the interactions were significant in either mathematics or science, suggesting that the synergistic effects of autonomy support from different sources were not significantly related with students' learning engagement, anxiety, and autonomy need satisfaction. As shown in Table 8, the interaction variable synthesized from teacher autonomy support and parent autonomy support was negatively related to science autonomy need satisfaction ($\beta = -0.068$, $p = .050$). Figure 5(A) illustrated that when students perceived different levels of autonomy support from their parents, the relationships between science teachers' autonomy support and students' autonomy need satisfaction in science learning were nearly identical.

According to the model results, at the student level (within), mathematics teacher autonomy support and parent autonomy support were positively related to mathematics autonomy need satisfaction ($\beta = 0.591$, $p < .001$ and $\beta = 0.439$, $p < .001$, respectively), which was positively correlated with mathematics intrinsic motivation ($\beta = 0.776$, $p < .001$). Mathematics intrinsic motivation positively related to mathematics engagement ($\beta = 0.485$, $p < .001$) and negatively related to mathematics anxiety ($\beta = -0.360$, $p < .001$). In addition, mathematics teacher autonomy support positively correlated with engagement ($\beta = 0.365$, $p < .001$) and negatively correlated with mathematics anxiety ($\beta = -0.199$, $p < .001$). Parent autonomy support directly and positively correlated with mathematics engagement ($\beta = 0.365$, $p < .001$) and directly and negatively related with anxiety ($\beta = -0.263$, $p < .001$). Mathematics academic achievement was positively predicted by engagement ($\beta = 0.501$, $p < .001$) and negatively predicted by anxiety in the mathematics classroom ($\beta = -0.297$, $p < .001$). Chained mediating effects were discovered to connect mathematics teacher autonomy support and parent autonomy support with mathematics academic achievement. In the students' level,

Table 8 Result of synergistic effects for science

New Path added to SEM		Outcome Variable: SENG			Outcome Variable: SAX			Outcome Variable: SANS		
		STAS→ SENG	PAS→ SENG	STPAS→ SENG	STAS→ SAX	PAS→ SAX	STPAS→ SAX	STAS→ SANS	PAS→ SANS	STPAS→ SANS
STPAS→ SENG	$\chi^2/df = 3.02$ RMSEA = 0.050 CFI = 0.914 TLI = 0.902	0.459 p <.001	0.330 p <.001	0.038 p =.124	-0.339 p <.001	-0.173 p <.001		0.622 p <.001	0.290 p <.001	
STPAS→ SAX	$\chi^2/df = 3.02$ RMSEA = 0.050 CFI = 0.913 TLI = 0.902	0.460 p <.001	0.329 p <.001		-0.338 p <.001	-0.168 p <.01	0.021 p =.637	0.624 p <.001	0.287 p <.001	
STPAS→ SANS	$\chi^2/df = 3.03$ RMSEA = 0.050 CFI = 0.913 TLI = 0.901	0.461 p <.001	0.333 p <.001		-0.338 p <.001	-0.171 p <.001		0.612 p <.001	0.283 p <.001	-0.068 p =.050

students' gender and socioeconomic status showed significant relation with students' achievement (β = 0.065, $p < .05$ and β = 0.121, $p < .001$, respectively).

Mathematics teacher autonomy from the school was positively related to students' perceived teacher autonomy support (β = 0.389, $p = .096$). In addition, the mathematics teacher autonomy was directly related to students' achievement (β = 0.424, $p < .01$). For the model of mathematics, teachers' gender and class level performance were also used as the controlling variables at the between level. Only class level performance showed significant association with teacher autonomy (β = 0.629, $p < .001$).

As illustrated in Table 9, the interaction between teacher and parent autonomy support was negatively related to the satisfaction of students' autonomy needs in mathematics (β = -0.073, $p = .058$). Figure 5(B) depicts the synergistic effect of autonomy support from both teachers and parents on students' anxiety regarding math learning. This suggests that when students perceive varying levels of autonomy support from their parents, the relationship between the autonomy support provided by their mathematics teachers and the students' anxiety about learning math remains consistently negative.

5 Discussion

Despite the growing acknowledgment of autonomy support, there remained a lack of comprehensive understanding of its psychological underpinnings and integrated effects. This study contributed to the literature by addressing several key research gaps. First, it examined the association of an integrated autonomy-supportive environment including combined role of teachers, parents, and the school environment on students' learning outcomes. Second, we examined the interaction of autonomy support from these sources, offering a nuanced understanding of its interactive relationship. Third, we explored the dual impact of motivation and anxiety as mediators in the relationship between autonomy support and students' academic performance. Forth, we focused on a sample from Myanmar, providing insights into a distinct cultural context.

Grounded in self-determination theory (SDT), this study aimed to explore how autonomy support from various sources relates to Myanmar students' academic performance, mediated by autonomy need satisfaction, intrinsic motivation, engagement, and anxiety. The hypothesized relationships among these variables were confirmed through our analysis. Specifically, we found that when students perceived autonomy support from both teachers and parents, they experienced higher intrinsic motivation, lower anxiety, and consequently, improved academic outcomes. These findings align with the internalization mechanism of autonomy support, as explained in SDT. However, it is important to note that additional significant relationships beyond the initial theoretical framework were uncovered through structural equation modeling (SEM). In particular, we discovered that students' motivation, anxiety, and academic achievement were directly related to teacher autonomy from school, teacher autonomy support, as well as parental autonomy support. This data-driven exploratory approach provided further insights into these direct relationships. Moreover, our further exploratory analysis did not find a significant synergistic effect of autonomy

Table 9 Result of synergistic effects for mathematics

New Path added to SEM		Outcome Variable: MENG			Outcome Variable: MAX			Outcome Variable: MANS		
		MTAS→MENG	PAS→ MENG	MTPAS→MENG	MTAS→MAX	PAS→ MAX	MTPAS→MAX	MTAS→ MANS	PAS→ MANS	MTPAS→ MANS
MTPAS→ MENG	$\chi^2/df = 3.30$ RMSEA = 0.053 CFI = 0.914 TLI = 0.900	0.103 p <.01	0.597 p<.001	-0.011 p =.620	-0.068 p =.191	-0.395 p <.001		0.100 p <.01	0.801 p<.001	
MTPAS→ MAX	$\chi^2/df = 3.31$ RMSEA = 0.053 CFI = 0.913 TLI = 0.900	0.096 p <.01	0.614 p <.001		-0.064 p =.233	-0.412 p <.001	-0.073 p=.058	0.105 p <.01	0.797 p <.001	
MTPAS→ MANS	$\chi^2/df = 3.30$ RMSEA = 0.053 CFI = 0.914 TLI = 0.900	0.101 p <.01	0.600 p<.001		-0.061 p =.249	-0.399 p <.001		0.091 p<.05	0.797 p<.001	-0.041 p =.155

support from different sources on the outcome variables. This finding helps refine our understanding of how autonomy support operates in isolation and interaction. As such, the investigation of these pathways, contextualized within the Myanmar education setting, was informed by a combination of both confirmatory and exploratory approaches. The overall fit of the Structural Equation Model (SEM) demonstrates a strong alignment with the data collected from Myanmar, indicating that the final model provides a good representation of the observed relationships among the variables. This suggests that the theoretical framework and proposed pathways are well-supported by the empirical evidence, confirming the robustness and validity of our model in this specific educational context. In conclusion, the findings of this study will offer valuable insights for educators, policymakers, and parents, underscoring the critical role of a supportive environment in enhancing students' academic performance. Additionally, understanding the interplay between different sources of autonomy support and psychological mediators can inform targeted interventions aimed at improving educational outcomes.

5.1 Understanding the relationship between autonomy support in a learning environment from three perspectives and student learning outcome

In this autonomy-supportive system, we considered autonomy support in home, classroom, and school. In the home setting, parents is the major provider of autonomy support. In the classroom, teachers have two important roles: implementer of autonomy support for students and recipient of autonomy support from the school. In term of autonomy support from school, the research findings emphasized the importance of assessing the extent to which teachers could be granted a certain level of autonomy from the school if we want to understand why some teachers didn't provide autonomy support for students in the classroom. In line with the work of Lee (2014), teachers may be discouraged from providing autonomy support to students if they do not receive sufficient autonomy support from the school. This finding implied that there was a positive cycle associated with the delivery of autonomy support. If the teachers have more autonomy in school (e.g., they can implement their own ideas, determine the plan and pace of their lessons, or develop diverse teaching approaches and learning activities), they tend to show higher autonomous motivation in teaching and more self-determination. As a result, autonomy support satisfied the psychological needs of autonomy of teachers and increased empathy towards and willingness to provide autonomy support to students in the classroom. In contrast, the long-term exposure to an autonomy-thwarting school environment can cause teachers to become motivational disengaged from teaching and to simply consider teaching as a job. In this way, maladaptive outcomes, such as low work motivation, stress, and decreased interest in work are more likely, and it is not surprising that similar patterns of control will occur in the classroom.

Students have strong interpersonal connections with both their teachers and their parents, who are their main authority figures. In this regard, the motivating styles adopted by teachers and parents (home) are fundamental. The present findings further confirmed the significance of the autonomy support provided by parents and teachers and was in line with the recent result of meta-analysis showing the importance

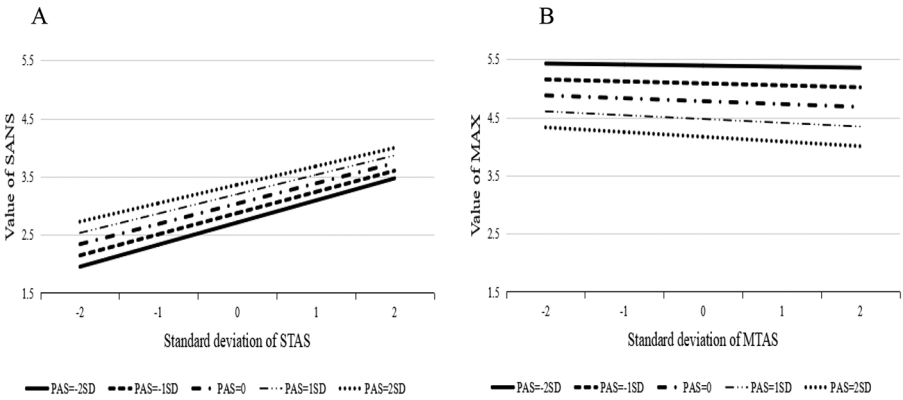

Fig. 5 Interactions between Teacher Autonomy Support and Parent Autonomy Support

of providing teacher and parent autonomy support for promoting positive learning outcomes (Mammadov & Schroeder, 2023). First, the present findings indicated that parent autonomy support directly and indirectly related to academic and non-academic outcomes, which was consistent with previous findings (Chirkov & Ryan, 2001; Vallerand, 1997) and was also consistent with local research findings which showed the positive relationship between the authoritative parenting styles (psychological autonomy granting) and students' academic performance (Thida, 2017). In particular, it was revealed that exposure to a home environment that was perceived to support autonomy was associated with psychological need fulfillment, which was related to autonomous motivation and positive learning outcomes. Such findings also reinforced the importance of a motivating parenting style, which was closely related to the parent-adolescent relationship. Due to the increasing need for autonomy in puberty, students from a controlling family environment are more likely to have low self-determination and strong feelings of being controlled, which are associated with decreased autonomous motivation and increased maladaptive behaviours, including low learning engagement (Soenens et al., 2017; Vasquez et al., 2016). In such situations, parents tend to use hostile control methods and harsh punishments to force compliance. Unfortunately, such authoritarian parenting tends to lead to a negative cycle of controlling behaviours, undesired outcomes, more controlling behaviours, and more undesired outcomes (Daniels, 2018).

A similar positive association pattern was observed for the classroom, which was largely in line with previous work (Alivernini et al., 2011; Black & Deci, 2000). If students received autonomy support from their teachers, they were more likely to experience autonomy needs and intrinsic motivation, which could increase engagement. Thus, perceived autonomy support was positively related to psychological well-being, adjustment in class, and academic performance but negatively related to learning anxiety and stress (Feril et al., 2016). In addition, autonomy support might evoke a positive dynamic in the classroom, as students will be willing to put effort into learning and thus teachers could offer more choices and opportunities for students to explore; in turn, students will have an increased interest in learning and higher motivation (Tang et al., 2013).

An interesting finding worth further exploration was that, compared to parents, teachers showed a stronger association with students. A possible reason for this phenomenon was that teachers took a more critical role in learning. Teenagers tend to respect and believe in the legitimacy of teacher authority in learning; therefore, they recognized and accepted suggestions and instructions from teachers. In contrast, parents usually provide only daily care and financial support. This interpretation was corroborated by Bureau and colleagues' (2022) meta-analysis result showing teacher autonomy support predicts students' need satisfaction and self-determined motivation more strongly than parental autonomy support. The previous research from Asia context (India) also supported that teacher autonomy support more strongly influenced on academic motivation and achievement than parent autonomy support (Banerjee & Halder, 2021). However, one of the previous meta-analytic research pointed out that parent autonomy support had a stronger influence on non-academic motivational outcomes than academic outcomes (Vasquez et al., 2016). Therefore, parent autonomy support seemed to be continually important for children.

Additionally, this investigation revealed that there were no significant synergistic effects from teacher autonomy support and parent autonomy support on students' learning. Both parents and teachers play crucial roles as socialization agents in the development of children's learning (Banerjee & Halder, 2021). Previous research has indicated that receiving autonomy support from various sources, including teachers, mothers, fathers, and peers, leads to improved outcomes in both academic and non-academic domains (Banerjee & Halder, 2021; Guay et al., 2013; Laursen & Mooney, 2008). The current research findings suggest that, regardless of the level of parental autonomy support perceived by students, the positive relationships between teacher autonomy support and students' perceptions of learning and academic engagement were robust in both science and mathematics. This implies that even if children do not receive high levels of autonomy support from their parents, sufficient autonomy support from their teachers can motivate them to exert greater effort and achieve better learning outcomes. Therefore, this study underscores the critical importance of teacher autonomy support.

5.2 Understanding the psychological mechanism of relationships in an autonomy-supportive environment

As expected, a chained mediating role of autonomy needs satisfaction and intrinsic motivation were also supported for both science and mathematics. Taken together, these two variables fully mediated the linking covariation between autonomy support and learning outcomes. Such a finding was not only in line with other studies that explained the relationship between autonomy support and learning outcomes (Chew & Wang, 2014; Jang et al., 2012), but also confirmed the critical role of autonomy needs and motivation in learning as explained by SDT (Alivernini & Lucidi, 2011; Chirkov & Ryan, 2001). According to SDT, the satisfaction of basic needs was fundamental for increasing intrinsic motivation (Chirkov & Ryan, 2001; Reeve & Cheon, 2021). Intrinsic motivation was fostered by satisfying the basic psychological need for autonomy (Bureau et al., 2022; Niemiec & Ryan, 2009; Van den Broeck et al., 2016), through autonomy support from social contexts. Previous research also

confirmed that the need for autonomy was a driving factor for intrinsic motivation (Bureau et al., 2022; Van den Broeck et al., 2016). Interestingly, this mediating mechanism was revealed in autonomy-supportive environments both at home and in the classroom (Chew & Wang, 2014; Chirkov & Ryan, 2001; Marzuki et al., 2023). It was also important to noted that intrinsic motivation associated with engagement, learning anxiety, and academic achievement in both science and mathematics. Cultivating intrinsic motivation can improve engagement and academic achievement and reduce anxiety. The results showed that parent autonomy support can directly and indirectly reduce learning anxiety in both science and mathematics. A similar finding was discussed in previous research showing the relationship between parent autonomy support and children mathematics homework (Feng et al., 2019).

5.3 Limitations and future directions

Despite of the important implications of the present study, this study relies on cross-sectional survey which can only explore the relationships or associations among variables. Therefore, further studies must apply alternative approach, such as longitudinal or experimental methods, to examine the effect and influence of autonomy support on the performance of teachers and students. It is also necessary to investigate other mediating variables through which autonomy support influences students and teachers. Although well-established scales were chosen as instruments for this study to ensure the validity of the variables, the CFA results primarily represent construct validity, which was found to vary across different cultural contexts. Therefore, future research might investigate such influences by measuring autonomy supportive behaviours more objectively, such as through observation. In addition, the needs for competence and relatedness should be considered in further studies since we included only autonomy need satisfaction in our analysis. It would be interesting to examine how the autonomy support provided by parents and teachers influences other outcomes, such as the psychological well-being or maladaptive behaviours of students because these behaviours can result in classroom inattentiveness, refusing to get homework and increasing school drop-out rate (Oostdam et al., 2018), and to explore whether parent autonomy support influences more on academic outcome than on non-academic outcomes. Finally it is suggested to conduct the related study in other subjects such as English and Social Science in both high school sector and higher education sector in Myanmar.

5.4 Implications for establishing autonomy-supportive environments in Myanmar

In the evolving educational landscape of East Asia, traditional methods of motivating individuals through directive commands, rooted in obedience to authority within both school and family, are facing challenges. Today's youth, driven by a desire for self-expression, initiative, and autonomy, are increasingly resistant to such authoritarian methods. This shift requires educators and parents to reassess motivational strategies. Our research finding shows the importance of providing autonomy-supportive environment in nurturing students' learning outcomes. Our findings also delineate

significant indirect associations, illustrating the chained mediating roles of need satisfaction, intrinsic motivation, engagement, and anxiety on learning outcomes. These trends, consistent across both science and mathematics, underscore the importance of integrated autonomy support and signal a pressing need for further research. The study's insights into the psychological mechanisms of autonomy support provide valuable implications for educational practices in East Asia and beyond.

Myanmar is an Asian country with a traditional Eastern culture. The parenting styles of this culture were quite different from those of Western cultures, which focus on individualism (Oo, 2015; Rudkin & Erba, 2018). However, the current findings show that autonomy-supportive parenting benefit adolescents. As cultural adaption occurs, individuals in the younger generation tend to prefer choices and to take initiative for their actions. As such, it is worth noting that traditional control strategies that attempt to compel children to follow rules would very likely damage their self-determination. In contrast, autonomy-supportive parenting can be employed to nurture the next generation in Myanmar.

In recent years, Myanmar teachers started to realize that they should change their pedagogical practices from teacher-centred to learner-centred (Soe et al., 2017). The Ministry of Education has introduced new basic education curriculum since 2016 (Ministry of Education, 2016, 2020). Some of the recent studies have showed that students and student teachers (prospective teachers) are more constructive oriented which mean they prefer constructive approach to traditional ways because it can allow students to be active and autonomous learner (Kyaw, 2023). Therefore, these teacher autonomy support strategies should be incorporated in the curriculum and planning and teaching learning processes in Myanmar education reforms.

In summary, this study highlights the importance of establishing an autonomy-supportive environment that can produce a beneficial dynamic cycle for both teachers and students. First, it is critical to create a school administrative system in which teachers feel respected and encouraged. Furthermore, a positive classroom environment motivates students and encourages confidence and self-determination. In addition, a harmonious family environment is essential for building a good parent-children relationship and thereby improves motivation and engagement in learning. These findings have practical implications for school administrators, policy makers, teachers, and parents.

Appendix

The total number of schools, teachers and students.

No	School Number	School level	Region	No. of Science Teacher	No. of MathTeacher	No of Students	No. of Response Students
1	School A	A	Sagaing	1	1	53	51
2	School B	A	Sagaing	1	1	56	54
3	School C	A	Sagaing	1	1	55	53
4	School D	B	Sagaing	1	1	59	51

No	School Number	School level	Region	No. of Science Teacher	No. of MathTeacher	No of Students	No. of Response Students
5	School E	B	Sagaing	1	1	57	52
6	School F	C	Sagaing	1	1	62	49
7	School G	A	Yesagyo	1	1	60	59
8	School H	A	Yesagyo	1	1	62	61
9	School I	A	Yesagyo	1	1	64	61
10	School J	B	Yesagyo	1	1	68	63
11	School K	B	Yesagyo	1	1	60	55
12	School L	B	Yesagyo	1	1	60	54
13	School M	C	Yesagyo	1	1	63	47
14	School N	B	Yesagyo	1	1	60	53
15	School O	C	Yesagyo	1	1	62	47
Total	**15**			**15**	**15**	**901**	**810**

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Declarations

Ethical approval I testify on behalf of all co-authors that our article submitted to Social Psychology of Education, I assure that for the manuscript "How an Autonomy-Supportive Learning Environment Influences Students' Achievements in Science and Mathematics" the following is fulfilled: The manuscript does not submitted to more than one journal for simultaneous consideration. The manuscript is original work and has not been previously published elsewhere. The split part of this article is not aurrently being considered for publication elsewhere to increase the quantity of submission. Results are presented clearly, honestly and without fabrication, falsification or inappropriate data manipulation. All sources used are properly disclosed (correct citation). All authors have been personally and actively involved in substantial work leading to the paper, will take public responsibility for its content.

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References

Abah, J. A., Ogugua, K. K., & Okoh, V. L. (2022). Impact of intrinsic motivation on junior secondary school students' academic performance in Mathematics despite family background in Ohimini local government area of Benue State, Nigeria. *VillageMath Educational Review (VER)*, *3*(1), 72–96. https://doi.org/10.2139/ssrn.4061815

Adie, J. W., Duda, J. L., & Ntoumanis, N. (2012). Perceived coach-autonomy support, basic need satisfaction and the well- and ill-being of elite youth soccer players: A longitudinal investigation. *Psychology of Sport and Exercise*, *13*(1), 51–59. https://doi.org/10.1016/j.psychsport.2011.07.008

Afia, K., Dion, E., Dupere, V., Archambault, I., & Toste, J. (2019). Parenting practices during middle adolescence and high school dropout. *Journal of Adolescence*, *76*(1), 55–64. https://doi.org/10.1016/j.adolescence.2019.08.012

Ahn, I., Chiu, M., M., & Patrick, H. (2021). Connecting teacher and student motivation: Student-perceived teacher need-supportive practices and student need satisfaction. *Contemporary Educational Psychology*, 64(2021), 101950. https://doi.org/10.1016/j.cedpsych.2021.101950

Akbarpour-Tehrania, I., Adlina, W. F., & Mansor, W. (2012). The influence of 'teacher autonomy in obtaining knowledge' on 'class practice'. *Procedia - Social and Behavioral Sciences*, *66*(3), 544–554. https://doi.org/10.1016/j.sbspro.2012.11.299

Alivernini, F., & Lucidi, F. (2011). Relationship between social context, self-efficacy, motivation, academic achievement, and intention to drop out of high school: A longitudinal study. *Journal of Educational Research*, *104*(4), 241–252. https://doi.org/10.1080/00220671003728062

Aparnath, A. K. (2014). A study of academic anxiety of secondary school students with relation to their gender and religion. *The International Journal of Indian Psychology*,1(4), 53–58. https://doi.org/10.25215/0104.024

Ayral, M., Ozdemir, N., Turedi, A., Yılmaz-Fındık, L., Buyukgoze, H., Demirezen, S., Ozarslan, H., & Tahirbegi, Y. (2014). The relationship between teacher autonomy and student achievement: PISA sample. *Journal of Educational Sciences Research*, *4*(1), 207–218. https://doi.org/10.12973/jesr.2014.4os12a

Banerjee, R., & Halder, S. (2021). Effect of teacher and parent autonomy support on academic motivation: A central focus of self-determination theory. *World Futures*, *8*(1). https://doi.org/10.1080/02604027.2021.1959253

Bean, R. A., Bush, K. R., McKenry, P. C., & Wilson, S. M. (2003). The impact of parental support, behavioral control, and psychological control on the academic achievement and self-esteem of African American and European American adolescents. *Journal of Adolescent Research*, *18*(1), 523–541. https://doi.org/10.1177/0743558403255070

Bhushan, A. (2018). *Teachers autonomy: A tool for creating learners autonomy*. College of Education and Research, Kalyan, University of Mumbai.

Bieg, S., Backes, S., & Mittag, W. (2011). The role of intrinsic motivation for teaching, teachers' care and autonomy support in students' self-determined motivation. *Journal for Educational Research Online*, 3(1), 122–140. https://doi.org/10.25656/01:4685

Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science Education*, *84*(6), 740–756. https://doi.org/10.1002/1098-237X(200011)84:6%3C;740::AID-SCE4%3E;3.0.CO;2-3

Bureau, J. S., Howard, J. L., Chong, J. X. Y., & Guay, F. (2022). Pathways to student motivation: A meta-analysis of antecedents of autonomous and controlled motivations. *Review of Educational Research*, *92*(1), 46–72. https://doi.org/10.3102/00346543211042426

Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, applications, and programming* (2nd ed.). Lawrence Erlbaum Associates.

Byrne, B. M. (2010). *Structural equation modelling with AMOS: Basic concepts, applications, and programming* (2nd ed.). Routledge.

Cal, Y. (2019). Autonomy is equally important across East and West: Testing the cross-cultural universality of self-determination theory. *Journal of Adolescence*, *78*, 67–72. https://doi.org/10.1016/j.adolescence.2019.12.009

Chen, X., Dong, Q., & Zhou, H. (1997). Authoritative and authoritarian parenting practices and social and school performance in Chinese children. *International Journal of Behavioral Development*, *21*(4), 855–873. https://doi.org/10.1080/016502597384703

Cheung, K. K. C., & Zerouali, A. (2024). The mediating role of science intrinsic motivation: effects of homework on science achievement in Western and Asian regions. *International Journal of Science Education*, *46*, 8. https://doi.org/10.1080/09500693.2024.2354145

Chew, E., & Wang, J. (2014). Perceptions of parental autonomy support and control, and aspirations of student athletes in Singapore. *Journal of Personality*, 231–248. https://doi.org/10.1142/9789814304092_0015

Chirkov, V. I., & Ryan, R. M. (2001). Parent and teacher autonomy-support in Russian and US adolescents– Common effects on well-being and academic motivation. *Journal of Cross-Cultural Psychology*, *32*(5), 618–635. https://doi.org/10.1177/0022022101032005006

Cohen, E., Sade, M., Benarroch, F., Pollak, Y., & Gross-Tsur, V. (2008). Locus of control, perceived parenting style, and symptoms of anxiety and depression in children with Tourette's syndrome. *European Child & Adolescent Psychiatry*, *17*(1), 299–305. https://doi.org/10.1007/s00787-007-0671-7

Daniels, V., Davids, E. L., & Roman, N. V. (2018). The role of family structure and parenting in first year university adjustment. *South African Journal of Psychology*, *49*(3), 446–459. https://doi.org/10.1177/0081246318805267

Datu, J. A. D., King, R. B., & Valdez, J. P. (2018). M. Psychological capital bolsters.
Deci, E. L. (1995). *Why we do what we do: understanding self-motivation*. Penguin Books.
Deci, E. L., & Ryan, R. M. (2000). The what and why of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01
Deci, E. L., Schwartz, A., Sheinman, L., & Ryan, R. M. (1981). An instrument to assess adult's orientations toward control versus autonomy in children: Reflections on intrinsic motivation and perceived competence. *Journal of Educational Psychology*, *73*(5), 642–650. https://doi.org/10.1037/0022-0663.73.5.642
Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum. https://doi.org/10.1007/978-1-4899-2271-7
Fan, W., & Williams, C. M. (2010). The effects of parental involvement on students' academic self-efficacy, engagement and intrinsic motivation. *Educational Psychology*, *30*(1), 53–74. https://doi.org/10.1080/01443410903353302
Fang, J., Wen, Z., & Hau, K. T. (2019). Mediation effects in 2-1-1 multilevel model: An evaluation of alternative estimation methods. *Structural Equation Modeling*, *26*(4), 591–606. https://doi.org/10.1080/10705511.2018.1547967
Feng, X., Xie, K., Gong, S., Gao, L., & Cao, Y. (2019). Effects of parental autonomy support and teacher support on middle school students' homework effort: homework autonomous motivation as mediator. *Frontier in Psychology*, *10*, 612. https://doi.org/10.3389/fpsyg.2019.00612
Feril, R., Soemantri, D., & Jusuf, A. (2016). The relationship between autonomous motivation and autonomy support in medical students' academic achievement. *International Journal of Medical Education*, *7*(1), 417–423. https://doi.org/10.5116/ijme.5843.1097
Fousiani, Petegem, S. V., Soenens, B., Vansteenkiste, M., & Chen, B. (2014). Does parental autonomy support relate to adolescent autonomy? An in-depth examination of a seemingly simple question. *Journal of Adolescent Research*, *29*(3), 299–330. https://doi.org/10.1177/0743558413502536
Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059
Froiland, J. M., Oros, E., Smith, L., & Hirchert, T. (2012). Intrinsic motivation to learn: The nexus between psychological health and academic success. *Contemporary School Psychology*, *16*, 91–100. https://doi.org/10.1007/BF03340978
Froiland, J. M., Davison, M. L., & Worrell, F. C. (2016). Aloha teachers: Teacher autonomy support promotes Native Hawaiian and Pacifc Islander students' motivation, school belonging, course-taking and math achievement. *Social Psychology of Education*, *19*(4), 879–894. https://doi.org/10.1007/s11218-016-9355-9
Ginsburg, G. S., & Bronstein, P. (1993). Family factors related to children's intrinsic extrinsic motivational orientation and academic performance. *Child Development*, *64*, 1461–1474. https://doi.org/10.1111/j.1467-8624.1993.tb02964.x
Gofen, A. (2009). Family capital: How first-generation higher education students break the intergenerational cycle. *Family Relations*, *58*, 104–120. https://doi.org/10.1111/j.1741-3729.2008.00538.x
Goldberg, W. A., & Lothe, L. R. (2020). Effects of maternal and paternal employment. In Benson J. B.(Eds.), *Encyclopedia of Infant and Early Childhood Development* (Second Edition), 522–536. Netherlands: Elsevier.
Grolnick, W. S., Deci, E. L., & Ryan, R. M. (1997). Internalization within the family: The self determination theory perspective. In J. E. Grusec, & L. Kuczynski (Eds.), *Parenting and Children's Internalization of Values: A Handbook of Contemporary Theory* (pp. 135–161). John Wiley.
Großmann, N., Hofferber, N., Wilde, M., & Basten, M. (2023). Students' motivation in biology lessons:Can student autonomy reduce the gender gap? *European Journal of Psychology of Education*, *38*, 409–434. https://doi.org/10.1007/s10212-022-00604-1
Guay, F. (2022). Applying self-Determination theory to education: Regulations types, psychological needs, and autonomy supporting behaviors. *Canadian Journal of School Psychology*, *37*(1), 75–92. https://doi.org/10.1177/08295735211055355
Guay, F., Ratelle, C., Larose, S., Vallerand, R. J., & Vitaro, F. (2013). The number of autonomy-supportive relationships: Are more relationships better for motiv- ation, perceived competence, and achievement? *Contemporary Educational Psychology*, *38*(4), 375–382. https://doi.org/10.1016/j.cedpsych.2013.07.005

Gurganious, N. J. (2017). *The relationship between teacher autonomy and middle school students' achievement in Science*. Walden University.

Hall, N., & Webb, D. (2014). Instructors' support of student autonomy in an introductory physics course. *Physical Review Special Topic- Physics Education Research*, *10*(2), 020116. https://doi.org/10.1103/PhysRevSTPER.10.020116

Haw, J. Y., & King, R. B. (2022). Need-supportive teaching is associated with reading achievement via intrinsic motivation across eight cultures. *Learning and Individual Differences*, *97*, 102–161. https://doi.org/10.1016/j.lindif.2022.1021

Hofferber, N., Basten, M., Grobmann, N., & Wilde, M. (2016). The effects of autonomy-supportive and controlling teaching behavior in biology lessons with primary and secondary experiences on students' intrinsic motivation and flow-experience. *International Journal of Science Education*, *38*(13), 2114–2132. https://doi.org/10.1080/09500693.2016.1229074

Hofstra, M. B., Van Der Ende, J., & Verhulst, F. C. (2002). Child and adolescent problems predict DSM-IV disorders in adulthood: a 14-year follow-up of a Dutch epidemiologica sample. *Journal of the American Academy of Child & Adolescent Psychiatry*, *41*, 182–189. https://doi.org/10.1097/00004583-200202000-00012

Holye, R. H. (1995). The structural equation modelling approach: Basic concepts and fundamental issues. In R. H. Hoyle (Ed.). *Structural equation modelling: concepts, issues and applications* (pp.1–15). Thousand Oaks, CA: Sage Publications, Inc.

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *6*(1), 53–60.

Howard, J. L., Bureau, J. S., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student motivation and associated outcomes: A meta-analysis from self-determination theory. *Perspectives on Psychological Science*, *16*(6), 1300–1323. https://doi.org/10.1177/1745691620966789

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Iachini, A. L. (2008). *Factors influencing the provision of autonomy -support*. The Ohio State University.

Jang, H., Reeve, J., & Deci, E. L., (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, *102*(3), 588–600.

Jang, H., Kim, E. J., & Reeve, J. (2012). Longitudinal test of self-determination theory's motivation mediation model in a naturally occurring classroom context. *Journal of Educational Psychology*, *104*(4), 1175–1188. https://doi.org/10.1037/a0028089

Jian, L., Mengdi, D., Xiaohan, W., & Yun, T. (2018). Teachers' and parents' autonomy support and psychological control perceived in junior-high school: Extending the dual process model of self- determination theory. *Learning and Individual Difference*, *68*, 20–29. https://doi.org/10.1016/j.lindif.2018.09.005

Jimerson, S. R., Campos, E., & Greif, J. (2003). Toward an understanding of definitions and measures of student engagement in schools and related terms. *The California School Psychologist*, *8*(1), 7–28. https://doi.org/10.1007/BF03340893

Joussemet, M., Landry, R., & Koestner, R. (2008). A self-determination theory perspective on parenting. *Canadian Psychology*, *49*(3), 194–200. https://doi.org/10.1037/a0012754

Kyaw, T. P. (2023, March 14). *Teaching-learning perceptions of Myanmar student teachers: A pilotstudy* [Conference Paper]. Teaching & Learning for an Inclusive, Interconnected World, Eötvös Loránd University, Budapest, Hungry. Retrieved from http://www.researchgate.net/piblication/369224986_Teaching-Learning_Perception_of_Myanmar_Student_Teachers_A_Pilot_Study

Lan, X., & Mastrotheodoros, S. (2022). Teacher autonomy support and internalizing problems of adolescents from divorced and intact families: moderation by personality typologies. *Child Psychiatry Hum*, *13*, 1–13. https://doi.org/10.1007/s10578-022-01392-x

Laursen, B., & Mooney, K. S. (2008). Relationship network quality: Adolescent adjustment and perceptions of relationships with parents & friends. *American Journal of Orthopsychiatry*, *78*(1), 47–53. https://doi.org/10.1037/0002-9432.78.1.47

Lee, C. (2014). *Autonomy-support: How it is managed in intermediate and secondary English classrooms*. University of Toronto.

Legault, L. (2016). The need for autonomy. In V. Zeigler-Hill, & T. Shackelford (Eds.), *Encyclopedia of Personality and Individual Differences*. Springer. https://doi.org/10.1007/978-3-319-28099-8_1120-1

MacBeath, J. (2012). Future of teaching profession.University of Cambridge.
Mageau, G. A., Ranger, F., Joussemet, M., Koestner, R., Moreau, E., & Forest, J. (2015). Validation of the perceived parental autonomy support scale (P-PASS). *Canadian Journal of Behavioural Science*, *47*(3), 251–262. https://doi.org/10.1037/a0039325
Mammadov, S., & Schroeder, K. (2023). A meta-analytic review of the relationships between autonomy support and positive learning outcomes. *Contemporary Educational Psychology*, *75*, 102235. https://doi.org/10.1016/j.cedpsych.2023.102235
Marbell-Pierre, K. N., Grolnick, W. S., Stewart, A. L., & Raftery-Helme, J. N. (2019). Parental autonomy support in two cultures: The moderating effects of adolescents' self-construals. *Child Development*, *90*(3), 825–845. https://doi.org/10.1111/cdev.12947
Marie, L. (2021). *Myanmar's education reforms: A pathway to social justice?* UCL.
Marzuki., I. I., & Yunus, I. H. (2023). Teachers' Challenges in Promoting Learner Autonomy: The Socio-Cultural Barriers of Indonesian EFL Teachers. Pioneer: *Journal of Language and Literature*, 15(1), 119–137. https://doi.org/10.36841/pioneer.v15i1.2853
Ministry of Education (2016). *National education strategies plan (2016–2021)*. Retrieved from https://www.britishcouncil.org/sites/default/files/myanmar_national_education_strategic_plan_2016-21.pdf
Ministry of Education (2020). *Education policy.* Retrieved from http://www.moe.gov.mm/en/?q=content/policy
Mongiovi, B. (2018). *The relationship between self-regulation and perceived autonomy of psychological well-being among fifth grade christian private school students*. Liberty University.
motivation, engagement, and achievement: Cross-sectional and longitudinal studies. *The Journal of Positive Psychology*, 13(3), 260–270. https://doi.org/10.1080/17439760.2016.1257056
Mutheen, L. K., & Mutheen, B. O. (2007). *Mplus user's guide* (5th ed.). Los Angeles, CA.
Niemiec, P. C., & Ryan, M. R. (2009). Autonomy, competence, and relatedness in the classroom Applying self-determination theory to educational practice. *Theory and Research in Education*, *7*(2), 133–144. https://doi.org/10.1177/1477878509104318
Niemiec, C. P., & Ryan, R. M. (2013). *What makes for a life well lived? Autonomy and its relation to full functioning and organismic wellness.* In The *Oxford handbook of happiness* (pp.214–226). Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199557257.013.0016
Oo, W. H. (2015). The evolution of cultural practices: Are changes to education in Myanmar leading to a shift in the way in which child - adult relationships are constructed? *Global Studies of Childhood*, *5*(4), 395–403. https://doi.org/10.1177/2043610615612949
Oostdam, R. J., Koerhuis, M. J. C., & Fukkink, R. G. (2018). Maladaptive behavior in relation to the basic psychological needs of students in secondary education. *European Journal of Psychology of Education*, *34*(3), 601–619. https://doi.org/10.1007/s10212-018-0397-6
Painter, J. (2011). *Autonomy, competence, and intrinsic motivation in science education: A self-determination theory perspective*. University of North Carolina at Chapel Hill.
Pearson, L. C., & Hall, B. C. (1993). Initial construct validation of the teaching autonomy scale. *The Journal of Educational Research*, *86*(3), 172–177. https://doi.org/10.1080/00220671.1993.9941155
Pearson, L. C., & Moomaw, W. (2005). The relationship between teacher autonomy and stress, work satisfaction, empowerment, and professionalism. *Educational Research Quarterly*, *29*(1), 38–54. https://files.eric.ed.gov/fulltext/EJ718115.pdf
Peixoto, F., Mata, L., Monteiro, V., & Sanches, C. (2015). The achievement emotions questionnaire: Validation for pre-adolescent students. *European Journal of Developmental Psychology*, *12*(4), 472–481. https://doi.org/10.1080/17405629.2015.1040757
Pelletier, L. G., Legault, L., & Vesque, C. S. (2002). Pressure From Above and Pressure From Below as Determinants of Teachers' Motivation and Teaching Behaviors. *Journal of Educational Psychology*, *94*(1), 186–196. https://doi.org/10.1037/0022-0663.94.1.186
Piechurska-kuciel (2011). Perceived teacher support and language anxiety in Polish secondary school of EFL learners. *Studies of Second Language Learning and Teaching*, *1*(1), 83–100. https://doi.org/10.14746/ssllt.2011.1.1.5
Podsakoff, P. M., & Organ, D. W. (1986). Self-reports in organizational research: Problems and prospects. *Journal of Management*, *12*(4), 531–544. https://doi.org/10.1177/014920638601200408
Preacher, K. J., Zhang, Z., & Zyphur, M. J. (2011). Alternative methods for assessing mediation in multilevel data: the advantages of multilevel SEM. *Structural Equation Modeling. A Multidisciplinary Journal*, *18*(2), 161–182. https://doi.org/10.1080/10705511.2011.557329

Quested, E., & Duda, J. (2011). Perceived autonomy support, motivation regulations and the self-evaluative tendencies of student dancers. *Journal of Dance Medicine and Science*, *15*(1), 3–14. https://doi.org/10.1177/1089313X1101500101

Rarick, C., & Nickerson, I. (2006). *An exploratory study of Myanmar culture using Hofstede's value dimensions*. AIB-Southeast Asia Division Conference, Bangkok, Thailand. https://doi.org/10.2139/ssrn.1114625

Reeve, J. (2009). Why teachers adopt a controlling motivating style toward students and how they can become more autonomy supportive. *Educational Psychologist*, *44*(3), 159–175. https://doi.org/10.1080/00461520903028990

Reeve, J. (2012). A self-determination theory perspective on student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 149–172). Springer US. https://doi.org/10.1007/978-1-4614-2018-7_7

Reeve, J., & Cheon, S. H. (2021). Autonomy-supportive teaching: Its malleability, benefitsand potential to improve educational practice. *Educational Psychologist*, *56*(1), 54–77. https://doi.org/10.1080/00461520.2020.1862657

Reeve, J., & Lee, W. (2013). Students' classroom engagement produces longitudinal changes in classroom motivation *Journal of Educational Psychology*, 106(2), 527–540. https://doi.org/10.1037/a0034934

Reeve, J., & Sickenius, B. (1994). Development and validation of a brief measure of the three psychological needs underlying intrinsic motivation: The AFS scales. *Educational and Psychological Measurement*, *54*, 506–515. https://doi.org/10.1177/0013164494054002025

Reeve, J., & Tseng, C. (2011). Agency as a fourth aspect of students' engagement during learning activities. *Contemporary Educational Psychology*, *36*(4), 257–267. https://doi.org/10.1016/j.cedpsych.2011.05.002

Robertson, L. E. (2010). *Autonomy and self-determination theory in different contexts comparison of middle school science teachers' motivation and instruction in China and the United States*. North Carolina State University..

Rudkin, A., & Erba, J. (2018). Myanmar's cultural dimensions: Exploring the relationship among the social identity, attitudes towards globalisation and preferences of Myanmar consumers in Yangon. *International Journal of Asia Pacific Studies*, 14(1), 191–226. https://doi.org/10.21315/ijaps2018.14.1.8

Ryan, R. M. (2009). Self-determination theory and wellbeing. *Social Psychology*, *84*, 822–848.

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*, 54–67. https://doi.org/10.1006/ceps.1999.1020

Ryan, R., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*(3), 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Ryan, R. M., & Grolnick, W. S. (1986). Origins and pawns in the classroom: Self-report and projective assessments of individual differences in children's perceptions. *Journal of Personality and Social Psychology*, *50*(3), 550–558. https://doi.org/10.1037/0022-3514.50.3.550

Savage-Speegle, A. L. (2017). *Autonomy supportive teaching strategies and student motivation in middle school physical education*. Walden University.

Sehrawat, J. (2014). Teacher autonomy: Key to teaching success. *International Journal of Research & Education*, *4*(1), 1–8.

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and Science Achievement: Effects of Motivation, Interest, and Academic Engagement. *The Journal of Educational Research*, *95*(6), 323–332. https://doi.org/10.1080/00220670209596607

Soe, M. Z., Swe, A. M., Aye, N. K. M., & Mon, N. H. (2017). *Reforms of the education system: Case study of Myanmar*. Parliamentary Institute of Cambodia.

Soenens, B., Vansteenkiste, M., & Van Petegem, S. (Eds.). (2017). *Autonomy in Adolescent Development: Towards Conceptual Clarity* (1st ed.). Psychology Press. https://doi.org/10.4324/9781315636511

Soenens, B., Vansteenkiste, M., & Sierens, E. (2009). How are parental psychological control and autonomy-support related? A cluster-analytic approach. *Journal of Marriage and Family*, *71*, 187–202. https://doi.org/10.1111/j.1741-3737.2008.00589

Song, J. H., Uhm, D., & Kim, J. (2012). Creativity and knowledge creation practices in the school context: The moderating role of task-related job autonomy. *Performance Improvement Quarterly*, *24*(4), 61–79. https://doi.org/10.1002/piq.20122

Sowislo, J. F., & Orth, U. (2013). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*, *139*(1), 213–240. https://doi.org/10.1037/a0028931

Speckien, M. A., & Ku, H. Y. (2022). A case study of western teachers' perceptions of Myanmar high school student college readiness in western society, *Journal of Educational Research and Innovation*, 10(1), 6. https://digscholarship.unco.edu/jeri/vol10/iss1/6f

Tanaka, Y., & Khine, M. M. (2020). Education of Myanmar. In P. Sarangapani, & R. Pappu (Eds.), *Handbook of Education Systems in South Asia. Global Education Systems*. Springer. https://doi.org/10.1007/978-981-13-3309-5_15-1

Tang, Q., Fang, X., Hu, W., Chen, H., Wu, M., & Wang, F. (2013). The association between parental and teacher autonomy support and high school students' development. *Psychological Development and Education*, *29*(6), 604–615.

Thida, A. (2017). The relationship of parenting styles with middle school students' academic performance. *Taunggyi University Research Journal*, *8*(1), 49–55.

Turner, E. A., Chandler, M., & Heffer, R. F. (2009). The influence of parenting styles, achievement motivation, and self-efficacy on academic performance in college students. *Journal of College Student Development*, *50*(3), 337–346. https://doi.org/10.1353/csd.0.0073

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology*, 29, 271–360. Academic Press. https://doi.org/10.1016/S0065-2601(08)60019-2

Van den Broeck, A., Ferris, D. L., Chang, C. H., & Rosen, C. C. (2016). A review of selfdetermination theory's basic psychological needs at work. *Journal of Management*, *42*(5), 1195–1229. https://doi.org/10.1177/0149206316632058

Vansteenkiste, M., Zhou, M., Lens, W., & Soenens, B. (2005). Experiences of autonomy and control among Chinese learners: Vitalizing or immobilizing? *Journal of Educational Psychology*, *97*(3), 468–483. https://doi.org/10.1037/0022-0663.97.3.468

Varatharaj, R., Abdullah, A. G. K., & Ismail, A. (2015). The Effect of Teacher Autonomy on Assessment Practices among Malaysian Cluster School Teachers. *International Journal of Asian Social Science*, *5*(1), 31–36. https://doi.org/10.18488/journal.1/2015.5.1/1.1.31.36

Vasquez, A. C., Patall, E. A., Fong, C. J., et al. (2016). Parent Autonomy Support, Academic Achievement, and Psychosocial Functioning: A Meta-analysis of Research. *Educational Psychology Review*, *28*, 605–644. https://doi.org/10.1007/s10648-015-9329-z

Veiga, F. H. (2016). Assessing student engagement in school: Development and validation of a four-dimensional scale. *Social and Behavioral Sciences*, *217*, 813–819. https://doi.org/10.1016/j.sbspro.2016.02.153

Wang, J., Liu, R., Ding, Y., Le, X., Liu, Y., & Zhen, Y. (2017). Teacher's Autonomy Support and Engagement in Math: Multiple Mediating Roles of Self-efficacy, Intrinsic Value, and Boredom. *Frontiers in Psychology*, *8*, 1006. https://doi.org/10.3389/fpsyg.2017.01006

Williams, G. C., & Deci, E. L. (1996). Internalization of bio psychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology*, *70*(4), 767–779. https://doi.org/10.1037/0022-3514.70.4.767

Win, C. C. (2023). Myanmar English majors' perceptions of learner autonomy in learning English at tertiary level. *Journal of Adult Learning Knowledge and Innovation*, *5*(2), 79–90. https://doi.org/10.1556/2059.2022.00059

Yazici, A. Ş. (2016). The relationship between the teacher autonomy and learner autonomy support behaviors. *Journal of Educational Sciences Research*, 6(2), 1–23. http://ebad-jesr.com/

Yu, C., Li, X., Wang, S., & Zhang, W. (2016). Teacher autonomy support reduces adolescent anxiety and depression: An 18-month longitudinal study. *Journal of Adolescence*, *49*, 115–123. https://doi.org/10.1016/j.adolescence.2016.03.001

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