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Role of students' academic procrastination in shaping mathematics achievement

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ABSTRACT

This study explores the role of academic procrastination in shaping mathematics achievement in Nepali schools. Utilising a quantitative research design, a cross-sectional survey was conducted with 474 students selected through multi-stage cluster sampling from eight public secondary schools in Nepal. The data were analysed using t-tests, ANOVA, and multiple linear regressions. The findings reveal significantly higher levels of both academic achievement and procrastination. Moreover, a high level of academic procrastination was found to have a significant negative effect on mathematics achievement. Influential factors in this correlation include students' ethnicity, study hours at home, family size, and parents' educational background. Stakeholders, including parents, teachers, and policymakers, should collaborate synergistically to address the underlying causes of procrastination and provide robust support mechanisms to enhance students' learning outcomes.

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Introduction

Mathematics is a compulsory subject at the school level in Nepal, and achieving a high score in this subject is a prerequisite for admission into higher education programmes such as medicine, engineering, or similar technical education. However, at present, the performance of students in mathematics is low, and the nationwide standard of education is declining (Education Review Office, 2015). Many students in higher education fail academically and struggle to address this issue effectively (Kottmann et al., 2015).

Behind this lower academic performance, several factors cause the students' weak performance in mathematics, including individual aptitude, instructional and social-psychological environmental factors, limited institutional resources, poor learning and examination strategies, and a failure to understand instructions (Mazana et al., 2018). Among these factors, students' attitudes and study habits also play a significant role (Capuno et al., 2019) where academic procrastination stands out as a significant causal factor to academic failure (Kim &

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Seo, 2015; Steel, 2007). This behaviour, prevalent in the academic field, negatively affects students' well-being and performance (Balkis et al., 2013; Duru & Balkis, 2017; Hen, 2018).

Academic procrastination is a common issue among many college students who face numerous exams, term papers, and projects throughout their academic careers (Janssen, 2015). This procrastination leads to negative outcomes, including unpleasant feelings, blame, and anxiety (Steel, 2007). Despite being aware of these negative consequences, students find it challenging to mitigate the issue by enhancing their individual performance satisfaction. Klassen et al. (2008) noted that one-fifth of the adult students struggle to keep up with daily homework assignments, a phenomenon that is increasingly becoming widespread. In secondary level students, particularly in the context of mathematics, exhibit high levels of procrastination (Asikhia, 2010; Asri et al., 2017; Ergene & Türk Kurtça, 2020). Several studies have highlighted that a majority of secondary school students procrastinate, especially when it comes to mathematics (Asikhia, 2010). Given that the secondary level education serves as the foundation for higher education (Emmanuel et al., 2017; Joubert, 2015; Nayak, 2019; Saplavska & Jerkunkova, 2018; Sunitha, 2013), it is important to investigate why students procrastinate and what necessary interventions are required to minimise procrastination. In addition, procrastination can function as hinderance to develop students' zone of proximal development, which emerges in and through engagement with learning tasks and pedagogical supports from instructors and students (Vygotsky, 2012). Therefore, pedagogical and sociocultural interventions are required to deal with the burgeoning issue of academic procrastination. In the research conducted by Jaafar (2022), it was revealed that approximately 30% of students were identified as frequent procrastinators. Interestingly, only 28% of these students perceived a high level of support from their teachers. Notably, the study demonstrated that teacher support played a crucial role in moderating the impact of academic procrastination on academic performance. The findings highlight the existence of academic procrastination among students, yet underscore the potential for enhancing academic performance by mitigating procrastination through increased teacher support. Similarly, in the investigation undertaken by Xue et al. (2023), discernible outcomes emerged indicating that the impact of mathematical attitudes on mathematical achievement was, to a certain extent, mediated by academic procrastination. Furthermore, an intricate interplay was observed, wherein mathematical metacognition assumed a moderating role in the association between academic procrastination and mathematical achievement, a moderation effect that was significant among female students but not among their male counterparts. Gareau et al. (2019) also found that academic procrastination had an adverse predictive effect on subsequent academic achievement, persisting even when accounting for factors such as high school achievement and working memory capacity. Moreover, these results underscore the notion that the impact of academic procrastination cannot be solely attributed to a prior history of academic challenges or constrained cognitive abilities, emphasising the significant role of coping mechanisms in shaping the relationship between procrastination and academic achievement. Additionally, Saman et al. (2021) found that the students' Psychological Capital was found to have a direct and adverse effect on academic procrastination, although procrastination itself did not significantly influence students' cumulative Grade-Point Average (GPA). Psychological capital is a notion that emerges from an individual's growth-oriented traits, including

resilience, hope, optimism, and self-efficacy. It makes more sense as a whole than as a collection of these traits separately(Luthans et al., 2007). Similarly, Nabdel et al. (2023) suggested that success is directly anticipated by problem-solving skills, with academic procrastination and motivation for engaging in digital games serving as mediating factors in influencing success.

In Nepali context, this issue is under-researched, while some scant studies have considered factors such as socioeconomic level, parents' educational status, and instructional materials, there is a notable gap in research focusing on student behaviour and academic procrastination (Mathema, 2007; Neupane, 2017; Pangeni, 2014). Similarly, the success rate of secondary school students in mathematics is below the national average for all subjects, standing at 35% (Dahal, 2019; ERO, 2015, 2022). Addressing this research gap, the present study aims to identify the level of school students' procrastination and its role in shaping their mathematics achievement. Further, the following two research questions were investigated:

(1) To what extent does academic procrastination influence mathematics performance among secondary school students in Nepali public schools?
(2) What is the role of demographic factors of students such as gender, ethnicity, study hours, family size, and parental education level to determine academic procrastination and mathematics performance?

Student procrastination: causes and effects

Academic procrastination, a pervasive issue in the educational sector, is characterised by students delaying or avoiding academically related tasks such as completing homework, planning for educational events, and last-minute exam preparations (Afzal & Jami, 2018; Akinsola et al., 2007; Schraw et al., 2007). This issue is notably prevalent in the context of mathematics, a subject often perceived as difficult by students (Akinsola et al., 2007; Asri et al., 2017). Various studies have pinpointed a range of causes behind this procrastination, including the perceived difficulty and unimportance of tasks, inadequate knowledge, excessive perfectionism, poor learning management, stress, and a lack of social support, among others (Asri et al., 2017; Karatas, 2015).

Rozental et al. (2022) distinguished between two dimensions to differentiate student procrastinators experiencing significant negative impacts from those experiencing less severe consequences: among the former, procrastination correlated with decreased life satisfaction and increased levels of stress, depression, and anxiety. However, existing measures of procrastination primarily focus on behavioural components, neglecting the emotional dimension. The Behavioural and Emotional Academic Procrastination Scale (BEPS) developed by Bobe et al. (2022) aims to address the comprehensive nature of procrastination by incorporating both behavioural and emotional components. This scale goes beyond traditional measures that focus solely on behavioural aspects, recognising the importance of emotions in understanding procrastination.

The repercussions of academic procrastination are significant, leading to negative outcomes such as lower grades, increased course withdrawals, poor attendance, and higher dropout rates (Lim, 2016; Onwuegbuzie, 2004; Pychyl et al., 2000). In Nepal, the

average achievement score in mathematics was notably low in 2013 and 2015, highlighting a critical issue in the educational landscape (Education Review Office, 2015). This poor performance fosters mathematics anxiety, a fearful reaction to mathematics assignments perceived as potentially harmful to one's ego, which can divert and distort learning (Fan et al., 2019; Nyroos et al., 2015).

Moreover, a considerable proportion of students admit to procrastinating, with various studies globally indicating a prevalence rate ranging from 23% to over 90% in different student populations (Balkis & Duru, 2009; O'Brien, 2002; Potts, 1987; Jaafar, 2022; Steel & Klingsieck, 2016). Age has been identified as a factor influencing the type of procrastination engaged in, with younger students more likely to actively procrastinate compared to their older counterparts who tend to be passive procrastinators (Chun Chu & Choi, 2005).

Procrastination is not just a matter of willpower; it is deeply rooted in psychological issues including fear of failure, anxiety, and self-worth issues (Pychyl et al., 2002; Rosário et al., 2009). Students who despise mathematics tend to avoid engaging with it, leading to a cycle of avoidance and failure (Rowe & Fitness, 2018; Zeki et al., 2014).

Research has shown mixed results regarding the relationship between gender and procrastination. While some studies found men to procrastinate more than women, others found no significant relationship with gender, age, or number of siblings (Joubert, 2015; Steel & Ferrari, 2013).

Despite the substantial body of research on academic procrastination, it remains a critical issue threatening the educational system globally. The existing literature suggests a pressing need for well-structured educational systems and counselling interventions, particularly in obligatory subjects like mathematics, to curb the rising trend of student procrastination and its detrimental effects on academic achievement (Kachgal et al., 2001; Onwuegbuzie, 2004). Addressing this issue requires a holistic approach that encompasses educational reforms, psychological interventions, and a deeper understanding of the underlying causes through further research. The existing literature paints a concerning picture of the prevalence and impacts of procrastination, highlighting the urgent need for targeted interventions to support students in overcoming this barrier to academic success.

School Education Sector Plan 2022/23–2031/32 of Nepal has set the goal of enhancing the quality and relevance of overall school education by ensuring school readiness, foundational learning and quality learning achievements for each child (MoEST, 2022). However, the decline in National Assessment of Student Achievement (NASA) results serves as a warning that improvement does not happen naturally over time. Without focused efforts to enhance foundational mathematics skills in the early grades, Nepal is unlikely to achieve the desired progress in upper levels of basic education and beyond. Insufficient grasp of mathematical concepts in the early stages hampers success in higher grades where rote learning and standard procedures are insufficient. Several factors contribute to low learning achievement, including teachers with inadequate mathematical knowledge, poor student attendance, an overly ambitious curriculum, language barriers, gender expectations, rural–urban education disparities, lack of cultural and social diversity sensitivity, and a lack of connection to daily life. However, the specific reasons behind poor maths learning outcomes remain unclear. Many students lack interest in learning, exhibit delays in educational activities, show disinterest in

reading and writing, are frequently absent from classrooms, and procrastinate educational tasks until the last minute. Although no research has been conducted about the procrastination in Nepal, there is a gap in understanding how factors like ethnicity, study hours, family size, and parental education level contribute to academic procrastination in the Nepalese context. Hence, the study is needed to identify the contribution of these factors on academic procrastination in mathematics learning and achievement.

Theoretical Perspective

Procrastination, often perceived as the act of delaying tasks, is a phenomenon that is influenced by both social and individual factors. From a sociocultural perspective, learning is inherently social, occurring within a dynamic context shaped by social interactions and cultural norms (Vygotsky, 2012). Within this framework, procrastination can be understood as a result of the interaction between external social environments and internal cognitive processes. Vygotsky's theory emphasises the importance of social interactions in the learning process. According to his theory, learning begins on a social level, where individuals engage in collaborative activities and interactions with others (interpsychological), before internalising knowledge on an individual level (intra-psychological). This suggests that social contexts, such as home, peer, and school environments, play a crucial role in shaping students' motivation and engagement in learning. Research studies have shown that social learning activities, such as group work, have a positive impact on students' procrastination behaviours as they are required to contribute to group activities to complete their tasks (Koppenborg & Klingsieck, 2022).

In supportive and conducive social environments, where students perceive encouragement and assistance from peers, family, and educators, individuals are more likely to feel motivated to complete tasks in a timely manner. When students feel engaged in learning activities and interact with others, they complete tasks without procrastination (Touloupis & Campbell, 2024). Teacher support has also been found to mitigate the negative effects of procrastination on students' academic achievements (Jaafar, 2022). On the other hand, environments characterised by lack of support, criticism, or hostility may lead to feelings of inadequacy and anxiety, contributing to procrastination tendencies. For example, a student may delay completing a task if they perceive the learning environment as unsupportive or hostile, fearing judgement or failure (Touloupis & Campbell, 2024). Additionally, when students struggle to understand a learning concept, they may avoid engaging in learning activities, resulting in procrastination. Furthermore, individual factors such as self-efficacy, time management skills, and self-regulation also influence procrastination tendencies (Ziegler & Opdenakker, 2018). Thus, social and individual factors, which are interconnected, contribute to the prevalence of procrastination. Therefore, procrastination can hinder students' zone of proximal development (Vygotsky, 2012), which is fostered when students engage in learning activities independently with the assistance of teachers and others. Scaffolding, considered a pedagogical strategy in supporting students' engagement in learning activities, can potentially be used as a tool to address procrastination. By providing a structured learning pathway that

encourages incremental task completion, scaffolding can foster a sense of accomplishment and mitigate the tendency to avoid tasks commonly seen in procrastination (Schraw et al., 2007). In conclusion, procrastination is a complex phenomenon influenced by both social and individual factors. Understanding the interplay between external social environments and internal cognitive processes is crucial for effectively addressing procrastination and promoting proactive learning behaviours.

Research methods

This study employed a survey research approach under the quantitative research design and guided by a post-positivist philosophical standpoint. From a total of 8080 students (IEMIS, 2078) in public secondary schools in the Bardiya district, 480 ninth-grade students were selected using a multi-stage cluster sampling method which is detailly presented in Figure 1. During the data cleaning process, six respondents were excluded due to missing cases and outlier issues, resulting in an actual sample size of 474. The sample's representativeness was ensured through the application of Solvin's formula (Costa et al., 2022). The data was collected from November 2022 to March 2023. Written consent was obtained from participants during data collection, participant confidentiality was ensured by excluding the name of participants (used different

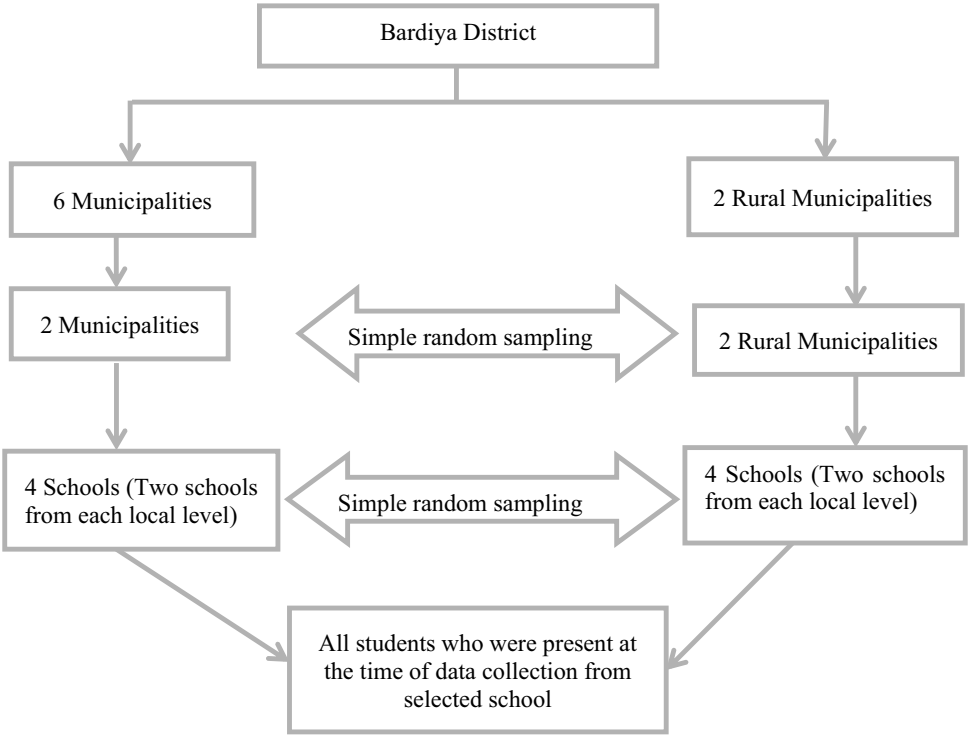


Figure 1. Sampling frame

codes for each participant) in the data set, password protected electronic database, anonymity of participants, and use of data for research purpose only and ethical approval was sought from Nepal Open University (Ref. No. 080–081/85).

Variable information

Gender, ethnicity, study hours, family size, and parental education level are considered as students' demographic factors in this research. The sample exhibited largely a balanced distribution of boys (50.2%) and girls (49.8%). In terms of ethnic groups, Janajati (indigenous people, 40.7%) and Brahmin/Chhetri (so-called upper caste, 40.1%) were similarly represented, while participation was lower among Madhesi (originating from the Terai region, 13.3%) and Dalit (discriminated caste group, 5.9%). Regarding study habits, 41.8% of the students reported studying less than 2 hours daily, 49.8% devoted two to 4 hours, and a small fraction (8.4%) studied for more than 4 hours. Family composition varied, with 21.1% living in small families of fewer than four members and 3.6% residing in joint families with more than 10 members. Parental education levels differed significantly, with a notable percentage of mothers having not received formal education (31.9%).

Description of instrument

Procrastination Assessment Scale-Students (PASS)

The data collection leveraged a survey questionnaire incorporating the Procrastination Assessment Scale-Students (PASS) and a self-constructed Mathematics Achievement Test. The PASS was bifurcated into a demographic profile section and a procrastination assessment section, the latter featuring 18 items spanning six areas: reading/writing/solving, assignment completion, exam preparation, attendance, extra-curricular activities, and student-teacher consultations. These items, based on a scale developed by Solomon and Rothblum (1984), were adapted to suit the study's objectives and were rated on a 5-point Likert scale as never procrastinate to always procrastinate. PASS scale was developed for general subject; hence, the items were modified for measuring academic procrastination in learning mathematics which is detailly presented in Appendix 1. The instrument underwent reliability and validity testing, including expert reviews and a pilot test yielding a satisfactory Cronbach alpha value of 0.83 (Cohen et al., 2017; Creswell, 2014).

Mathematics achievement test

The researchers developed a Mathematics Achievement Test comprising 50 multiple-choice questions derived from the ninth-grade compulsory mathematics syllabus, encompassing arithmetic, algebra, geometry, and statistics. The questions were designed to assess various cognitive levels according to Bloom's revised taxonomy (Airasian & Miranda, 2002; Krathwohl, 2002). The content validity of the test was ensured through expert reviews, adhering to criteria established by Yaghmale (2003) and Lawshe (1975). The test demonstrated high reliability, with a KR-20 reliability coefficient of 0.91 (Mohajan, 2017), confirming its suitability for assessing ninth-grade students' achievement.

Data analysis technique

The data were analysed using both descriptive and inferential statistics. Descriptive statistics, including mean and standard deviation (SD), were employed to delineate the status of procrastination and mathematics achievement. A one-sample t-test was utilised to assess the level of procrastination, assuming a population mean of 3 (Joshi et al., 2022). Correlational analysis facilitated the calculation of relationships between items. To discern significant results based on student demography such as gender, ethnicity, study hours, family size, and parents' educational levels, independent sample t-tests and analysis of variance (ANOVA) were applied. Moreover, multiple linear regressions were employed to evaluate the item-wise impact of academic procrastination on mathematics achievement. The Statistical Package for the Social Sciences (SPSS-23) facilitated the data analysis. Before initiating the data analysis, prerequisites for utilising t-tests, ANOVA, and regression were met, including the removal of outliers and missing cases and the verification of normality, linearity, multicollinearity, and homogeneity of variance (Kao & Green, 2008). Additionally, path analysis technique was employed to find the mediating role of procrastination on mathematics achievement with reference to direct and indirect effect of student demography.

Results

Status of academic procrastination

Table 1 reveals a significantly high level of academic procrastination, with the exception of three items. An item-wise analysis indicated that the desire to reduce procrastination regarding exam preparation exhibited the highest mean (Mean = 3.94, SD = 1.11), followed closely by the inclination to lessen procrastination in meeting with teachers (Mean = 3.93, SD = 1.21). The least procrastination was observed in delaying mathematics assignment project until the last time (Mean = 2.26, SD = 1.19) and ECA activities taking as a bore (Mean = 2.31, SD = 1.32) as compared to the remaining items. Further investigation into mathematics achievement revealed, as shown in Table 1, that the score was significantly higher than the national average; the national average for mathematics achievement at the secondary level stands at 35% (ERO, 2022).

Measures for the significant results based on student demography with academic procrastination

In Table 2, the academic procrastination of girls (Mean = 3.34, SD = 0.50) was found to be slightly higher than that of boys (Mean = 3.27, SD = 0.48) however the result is deemed insignificant, indicating no substantial difference in academic procrastination between boys and girls. Examining different ethnic groups, Dalit students exhibited the highest level of procrastination (Mean = 3.47, SD = 0.32), followed by Janajati (Mean = 3.40, SD = 0.49), Madheshi (Mean = 3.27, SD = 0.51), and Brahmin/Chhetri students (Mean = 3.21, SD = 0.49). The one-way ANOVA results underscored the significant role ethnicity plays in determining the academic procrastination. The Brahmin/Chhetri group had the lowest mean score, suggesting a favourable outcome for this

Table 1. Item-wise status of academic procrastination ($n = 474$).

Items	Mean	SD	t-value	p-value	ITC
Studying mathematics regularly (APSA1)	3.74	1.17	13.85	.00	.34**
Feeling problem when want to study mathematics (APSA2)	3.47	1.07	9.54	.00	.51**
Desire to minimise the tendency to procrastinate on solving mathematics problem (APSA3)	3.83	1.19	15.13	.00	.44**
Reading/writing/solving	3.68	0.56			
Delaying mathematics assignment project until the last time (APSB1)	2.26	1.19	−13.58	.00	.49**
Feeling problem mathematics assignment when doing project (APSB2)	3.47	1.07	9.54	.00	.58**
Desire to minimise the tendency to procrastinate on mathematics assignment project (APSB3)	3.87	1.19	15.92	.00	.49**
Keeping up with assignments	3.19	0.77			
Before mathematics exams, generally have enough time to study for all the subject (APSC1)	3.27	1.37	4.24	.00	.45**
When exam time approaches, they find themselves busy with other things (APSC2)	2.55	1.25	−7.87	.00	.12**
Desire to minimise the tendency to procrastinate on the preparation of exams (APSC3)	3.94	1.11	18.43	.00	.44**
Preparation for exams	3.25	0.66			
Present regularly in school (APSD1)	3.85	1.12	16.56	.00	.35**
Absent in mathematics class when teacher give study assignments (APSD2)	2.45	1.42	−8.48	.00	.54**
Desire to minimise the tendency to procrastinate on the absentee in school (APSD3)	3.19	1.45	2.78	.01	.49**
Absentee/Attendance	3.16	0.81			
Participating and enjoying in ECA activities in school (APSE1)	3.55	1.19	9.98	.00	.46**
ECA activities taking as a bore (APSE2)	2.31	1.32	−11.4	.00	.52**
Desire to minimise the tendency to procrastinate on extra-Curricular activities (APSE3)	3.52	1.35	8.42	.00	.52**
Extra-Curricular activities	3.12	0.83			
Desire to meet and asking the problem with teacher in leisure time (APSF1)	3.17	1.39	2.60	.01	.43**
Feeling uneasy to meet and ask mathematics problem with teacher in leisure time (APSF2)	3.14	1.33	2.35	.02	.46**
Desire to minimise tendency to procrastinate to meet with teacher (APSF3)	3.93	1.21	16.67	.00	.54**
Students' consultation with teacher	3.41	0.83			
Total procrastination	3.31	0.49	13.43	.00	
Achievement Score in Achievement Test	25.59	4.59	38.37	.00	

**$p < 0.01$.

group. Moreover, the post-hoc analysis revealed significant differences between Janajati and Dalit with Brahmin/Chhetri groups.

Regarding study duration at home, students studying less than 2 hours (Mean = 3.37, SD = 0.50) and between 2 and 4 hours (Mean = 3.28, SD = 0.49) demonstrated higher levels of procrastination compared to those studying 4 hours or more (Mean = 3.15, SD = 0.42). The one-way ANOVA results indicated a significant role of home study time in determining the academic procrastination. Students dedicating four or more hours to home study had the lowest mean score, favouring this group. Post-hoc analysis further highlighted a significant difference between students studying less than 2 hours and those studying 4 hours or more.

In Table 2, it is observed that students with more than nine family members (Mean = 3.38, SD = 0.61) and between five and nine family members (Mean = 3.34, SD = 0.48) tend to procrastinate more than those with one to four family members (Mean = 3.18, SD = 0.49). The one-way ANOVA results indicate that the number of family members significantly influences the academic procrastination. Post-hoc statistics revealed a significant result between students with one to four family members and those with five or more.

Table 2. Results on procrastination based on student demography ($n = 474$).

Variables with categories	Frequency (%)	Mean	SD	P-value
Gender				
Female	238 (50.2)	3.34	0.50	0.16
Male	236 (49.8)	3.27	0.48	
Ethnicity				
Janajati	193(40.7)	3.40	0.49	0.00
Dalit	28(5.9)	3.47	0.32	
Madhesi	63(13.3)	3.27	0.51	
Brahmin/Chhetri	190(40.1)	3.21	0.49	
Study hour				
<2hrs	198(41.8)	3.37	0.50	0.01
2-4 hrs	236(49.8)	3.28	0.49	
≥4 hrs	40(8.4)	3.15	0.42	
Number of family				
1-4	100(21.1)	3.18	0.49	0.01
5-9	357(75.3)	3.34	0.48	
Above 9	17(3.6)	3.38	0.61	
Father education				
Illiterate	109(23.0)	3.47	0.49	0.00
School education	292(61.6)	3.28	0.46	
University education	73(15.4)	3.18	0.55	
Mother education				
Illiterate	151 (31.9)	3.40	0.49	0.01
School education	265(55.9)	3.28	0.48	
University education	58(12.2)	3.18	0.51	

Regarding the education level of students' fathers, those with illiterate fathers exhibited higher levels of procrastination (Mean = 3.47, SD = 0.49) compared to those whose fathers had school education (Mean = 3.28, SD = 0.46) or university education (Mean = 3.18, SD = 0.55). The one-way ANOVA results underscored the significant role of fathers' education in determining academic procrastination. Students whose fathers had university education had the lowest mean score, indicating a favourable outcome for this group. Post-hoc analysis further highlighted significant differences in procrastination between students with illiterate and school-educated fathers, and between those with school-educated and university-educated fathers.

In Table 2, it is further noted that students whose mothers were illiterate exhibited a higher tendency to procrastinate (Mean = 3.40, SD = 0.49) compared to those whose mothers had attained school education (Mean = 3.28, SD = 0.48) and university education (Mean = 3.18, SD = 0.51). The one-way ANOVA results indicate that the education level of students' mothers plays a significant role in determining the academic procrastination. Students with university-educated mothers had the lowest mean score, suggesting that this group is less prone to procrastination. Further analysis through post-hoc statistics revealed significant differences in the levels of procrastination between different groups. A notable significant difference was observed between students with illiterate mothers and those with school-educated mothers. Moreover, a significant difference was also found between the groups of students with illiterate mothers and those with university-educated mothers, indicating the result is in favour of students with university-educated mothers.

Table 3. Effect of student demography on academic procrastination on mathematics achievements.

Predictors	B	Beta	t-value	p-value	VIF
(Constant)	26.85		16.46	0.00	
Dalit	−0.22	−0.01	−0.25	0.80	1.12
Madheshi	1.21	0.09	1.95	0.05	1.17
Brahmin/Chhetri	1.18	0.13	2.67	0.01	1.25
Study 2-4 hour/day	1.82	0.20	4.35	0.00	1.17
Study >4 hours/day	2.48	0.15	3.26	0.00	1.20
Having up to 4 family members	0.41	0.04	0.84	0.40	1.08
Having >9 family members	−2.33	−0.10	−2.15	0.03	1.09
Fathers' education: School level	0.47	0.05	0.81	0.42	2.09
Fathers' education: University level	2.19	0.17	3.03	0.00	1.83
Mothers' education: Illiterate	−0.41	−0.04	−0.77	0.44	1.61
Mothers' education: University level	1.05	0.08	1.63	0.10	1.20
Academic procrastination	−1.11	−0.12	−2.68	0.01	1.10

Effect of procrastination on mathematics achievement

Table 3 shows that the effect of student demography and academic procrastination on mathematics achievement. The model explains the 16% variance with significant ANOVA $F(12, 461) = 7.67$, $p < 0.05$. The results were analysed by making them as binary variables as coded by zero and one. The results showing that the significant predictors to the model are Madheshi (Beta = 0.09), Brahmin/Chhetri (Beta = 0.13), study 2–4 hour/day (Beta = 0.20), study greater than 4 hours/day (Beta = 0.15), having more than nine family members Beta = −0.10), university-level education of father (Beta = 0.17), and academic procrastination Beta = −0.12). Higher study hour and university-level education fathers are the main predictors of the model because of having highest absolute beta value. Among the significant predictors, the number of family member and academic procrastination have a negative role in determining mathematical achievement. The variables as Janajati, study <2 hours/day, having 4–9 family members, fathers' education: illiterate, and mothers' education: school level was excluded by the software during analysis; hence, these variables are not included in the table.

The direct, indirect and total effects were calculated based on the dependent (achievement) and independent variable (student demography) by taking the mediating role of procrastination. The path analysis technique was applied to find these direct and indirect effects. Figure 2 shows that the student demography explains 7% variance in academic procrastination whereas the student demography with academic procrastination explains a 12% variance in the mathematics achievement score suggesting a modest fit for the model (Cohen et al., 2007). Figure 2 and Table 4 show that the results are found to be significant in all cases except as gender and number of families in the mathematics achievement. The ethnicity (Beta = 0.12), study hour (Beta = 0.18), fathers' education (Beta = 0.15), and mothers' education (Beta = 0.08) level have positive effect on mathematics achievement. The positive effect of ethnicity indicating that the result is in favour to Brahmin/Chhetri and Madhesi ethnic group as compared to Janajati and Dalit. Similarly, the positive significant effect of study hour, father and mother education level indicates that those students study more hour, having father and mother with university qualification have higher achievement in mathematics. The effect of procrastination Beta = −0.13) found to be negatively significant indicates that those students

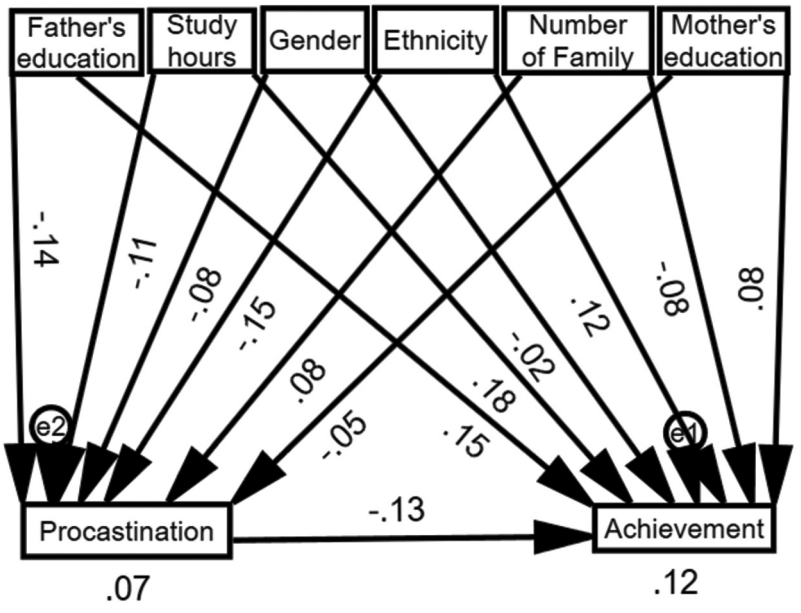


Figure 2. Effect of student demography on mathematics achievement with mediating role of academic procrastination

Table 4. Direct effects of student demography and academic procrastination in academic performance.

Independent variables		Predictors	B	Beta	S.E.	C.R.	P-value
Achievement	<—	Gender	−0.22	−0.03	0.39	−0.57	0.57
Achievement	<—	Ethnicity	0.41	0.12	0.14	2.85	0.00
Achievement	<—	Study hour	1.29	0.18	0.31	4.15	0.00
Achievement	<—	Number of families	−0.73	−0.08	0.42	−1.77	0.08
Achievement	<—	Fathers' education	1.06	0.15	0.32	3.35	0.00
Achievement	<—	Mothers' education	0.59	0.08	0.30	1.93	0.05
Achievement	<—	Procrastination	−1.19	−0.13	0.41	−2.92	0.00
Procrastination	<—	Gender	−0.08	−0.08	0.04	−1.75	0.08
Procrastination	<—	Ethnicity	−0.05	−0.15	0.02	−3.31	0.00
Procrastination	<—	Study hour	−0.08	−0.11	0.04	−2.42	0.02
Procrastination	<—	Number of families	0.08	0.08	0.05	1.76	0.08
Procrastination	<—	Fathers' education	−0.11	−0.14	0.04	−3.12	0.00
Procrastination	<—	Mothers' education	−0.04	−0.05	0.03	−1.14	0.26

S.E-Standard Error; C.R.- Critical Ratio.

having high procrastination in mathematics learning to reduce the achievement. The effect of the number of families was found to be negative Beta = −0.08); however, the result is significant at 92% confidence level ($p = 0.08$) instead of 95% indicating that those having more family members help to negatively increase the mathematical achievement score.

Figure 2 and Table 4 further show that the ethnicity Beta = −0.15), study hour Beta = −0.11), and fathers' education Beta = −0.14) are significant predictors to the academic procrastination. The negative beta value with respect to ethnicity indicate that Brahmin/Chhetri as well as Madhesi have less procrastination as compared to Dalit and Janajati.

Table 5. Direct, indirect and total effect of student demography on mathematics achievement.

	Effect on achievement		
Predictors	Total Effect	Direct effect	Indirect effect
Gender	−0.13	−0.22	0.09
Ethnicity	0.47	0.41	0.06
Study hour	1.39	1.29	0.10
Number of families	−0.83	−0.73	−0.10
Fathers' education	1.19	1.06	0.13
Mothers' education	0.63	0.59	0.05

The negative beta value in study hour and fathers' education also indicates that those students having less study hour and having illiterate father have higher academic procrastinations in mathematics learning. The result based on number of families has significant at 92% confidence interval ($p = 0.08$) having positive beta value (Beta = 0.08) indicates that the procrastination increases if the number of the family also increases.

Table 5 shows the total (direct and indirect) effect of gender on mathematics achievement is −0.13 indicating that when gender goes up by one unit, the achievement goes down by 0.13 (β_{tot} =-0.13). That is due to the both direct (β_{dir}=-0.22) and indirect ($\beta_{ind} = 0.09$) effects of gender on achievement indicate that the mediating role of procrastinating reduces the effect of gender on mathematics achievement. With respect to ethnicity, the total effect on mathematics achievement is 0.47 ($\beta_{tot} = 0.47$) indicates that when ethnicity goes up by one unit, the achievement goes up by 0.47. That effect due to the both direct (β_{dir}=-0.41) and indirect ($\beta_{ind} = 0.06$) effects indicates that the mediating role of procrastinating increases the effect of ethnicity on mathematics achievement. The total effect ($\beta_{tot} = 1.39$) is due to both direct ($\beta_{dir} = 1.29$) and indirect ($\beta_{ind} = 0.10$) effects of study hour on mathematics achievement indicating that study hour goes up by 1, mathematics achievement goes up by 1.39. Similarly, number of families, fathers' education, and mothers' education have a direct effect β_{dir}=-0.73, $\beta_{dir} = 1.06$, and $\beta_{dir} = 0.59$ whereas indirect effects are β_{ind}=-0.10, $\beta_{ind} = 0.13$, and β_{ind} = 0.05, respectively. In overall result, the mediating role of academic procrastinating was found to be higher with respect to gender and ethnicity (low direct effect and comparatively high indirect effect); however, it has a slight role with respect to the remaining sample characteristics. The direct effects of the academic procrastination (β_{dir}=-1.19) on achievement and student demography on academic procrastination are presented in Table 3 hence these values are not repeated in Table 4.

Table 6 illustrates the item-wise effects of academic procrastination on mathematics achievements. The regression model explains 85.7% variance with significant ANOVA $F(17,456) = 160.73$. Furthermore, the adjusted R-square value is 0.85, denoting a strong fit for the model (Cohen et al., 2007). In the item-wise analysis, only two items emerged as significant predictors of mathematics achievement: delaying mathematics assignment projects until the last moment (APSB1) and encountering problems with mathematics assignments when undertaking projects (APSB2). The absolute beta value of APSB1 (Beta = −0.80) found to be higher as compared to APSB2 (Beta = −0.30) indicating that APSB1 establishing as the main predictor in the model. It is important to note that both items have negative beta values, indicating that an increase in these variables leads to a reduction in mathematics achievement. Figure 3(a-f) shows the detail of the

Table 6. Item-wise effect of academic procrastination in mathematics achievement of the students ($n = 474$).

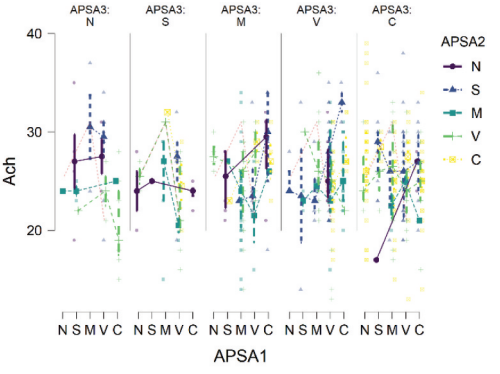
Items	B	Beta	p-value
Constant	37.99		0.00
APSA1	−0.28	−0.07	0.36
APSA3	−0.05	−0.01	0.58
APSB1	−3.09	−0.80	0.00
APSB2	−1.27	−0.30	0.00
APSB3	−0.03	−0.01	0.71
APSC1	0.00	0.00	0.96
APSC2	0.02	0.00	0.81
APSC3	0.01	0.00	0.90
APSD1	−0.03	−0.01	0.69
APSD2	−0.05	−0.02	0.50
APSD3	−0.04	−0.01	0.58
APSE1	0.04	0.01	0.64
APSE2	−0.09	−0.03	0.22
APSE3	−0.01	0.00	0.88
APSF1	0.11	0.03	0.13
APSF2	−0.05	−0.02	0.49
APSF3	0.14	0.04	0.11

achievement based on each category of procrastination-related items, whereas N, S, M, V, and C represent never procrastinate, almost never procrastinate, sometimes procrastinate, nearly always procrastinate, and always procrastinate, respectively.

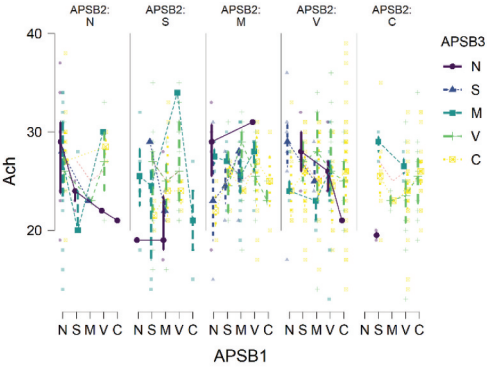
Discussion

This study aimed to explore the role of academic procrastination in shaping mathematics performance among secondary school students in Bardiya district, Nepal. The findings revealed a notably high level of academic procrastination, particularly in exam preparation and student–teacher interactions. This aligns with prior research that reported widespread procrastination in mathematics-related tasks (Agustin & Winarso, 2021; Setiyowati et al., 2020). However, a study by Wan Hussin and Mohd Matore (2023) presented contrasting findings, indicating a shift from high to low procrastination levels among students, suggesting that academic procrastination may not be static and might change with targeted interventions or variations in school settings. This difference highlights the importance of context in understanding the role of procrastination in students' academic experiences. Despite the high levels of procrastination in this study, students expressed a strong willingness to address and reduce their procrastination tendencies, echoing similar findings from Akinsola et al. (2007), which underscores the potential for self-regulation and improvement when appropriate support is provided.

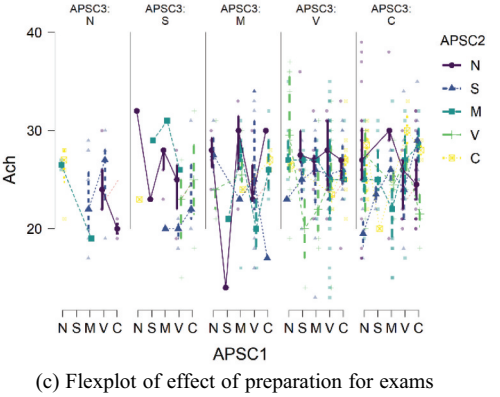
Ethnicity emerged as a significant factor in procrastination levels, with Dalit students exhibiting the highest procrastination, followed by Janajati, Madhesi, and Brahmin/Chhetri students. This finding extends the work of Upadhyay (2013), who noted the historical and systemic disadvantages faced by marginalised groups in Nepal. The comparison suggests that academic procrastination may function as a coping



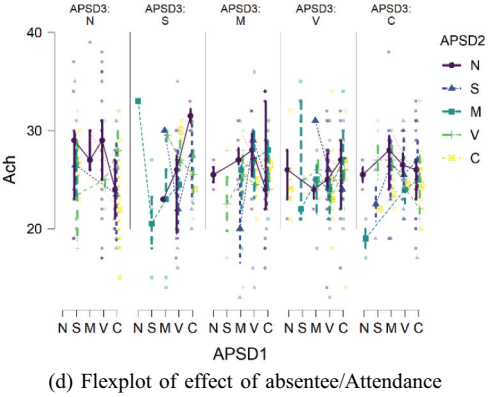
(a) Flexplot of effect of reading/writing/solving related procrastination on mathematics achievement



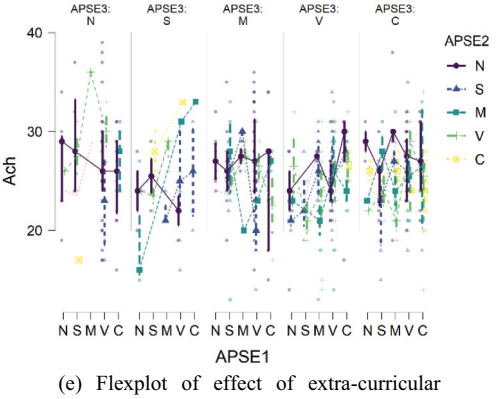
(b) Flexplot of effect of keeping up with assignments related procrastination on mathematics achievement



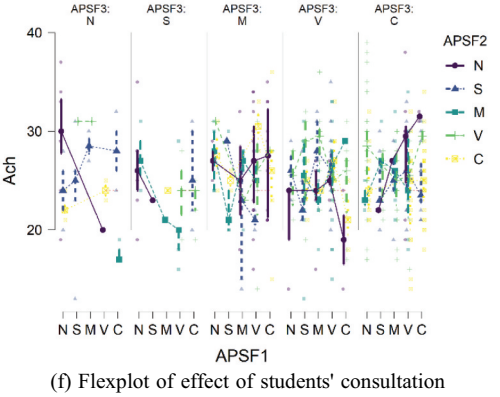
(c) Flexplot of effect of preparation for exams related procrastination on mathematics achievement



(d) Flexplot of effect of absentee/Attendance related procrastination on mathematics achievement



(e) Flexplot of effect of extra-curricular activities related procrastination on mathematics achievement



(f) Flexplot of effect of students' consultation with teacher related procrastination on mathematics achievement

Figure 3. (a) Flexplot of effect of reading/writing/solving related procrastination on mathematics achievement. (b) Flexplot of effect of keeping up with assignments related procrastination on mathematics achievement. (c) Flexplot of effect of preparation for exams related procrastination on mathematics achievement. (d) Flexplot of effect of absentee/Attendance related procrastination on mathematics achievement. (e) Flexplot of effect of extra-curricular activities related procrastination on mathematics achievement. (f) Flexplot of effect of students' consultation with teacher related procrastination on mathematics achievement

mechanism for students from socio-economically disadvantaged backgrounds, where limited resources and additional domestic responsibilities restrict their ability to focus on academic tasks. Unlike prior studies that did not disaggregate procrastination levels by ethnic groups, this study highlights the intersection of academic procrastination with broader social and cultural contexts, suggesting that socioeconomic and ethnic disparities contribute to higher procrastination among marginalised students.

The study also examined gender differences in procrastination and found no statistically significant variations between boy and girl students. This result is consistent with studies by Amoke et al. (2021) and Joubert (2015), which also found no notable gender differences in academic procrastination. This suggests that procrastination in mathematics may not be heavily influenced by gender, contradicting common assumptions that gender plays a role in procrastination tendencies. Both boy and girl students exhibited similar tendencies to delay academic tasks, challenging the gendered narratives that often surround discussions of academic procrastination.

Further, this research underscored the role of factors such as study time, family size, and parental education in shaping academic procrastination. Students who devoted less time to studying at home were more prone to procrastination, mirroring findings from Steel and Ferrari (2013) and Rosário et al. (2009). These studies highlight how home environments influence study habits, suggesting that the role of procrastination is shaped by a lack of structured time dedicated to academic tasks. Additionally, smaller family sizes and higher parental education levels were linked to lower procrastination tendencies, aligning with previous findings. These demographic factors contribute to a more nuanced understanding of academic procrastination, emphasising its relationship with family dynamics and socio-economic backgrounds rather than inherent student traits.

When considering the role of procrastination in mathematics performance, two key predictors emerged: delays in completing mathematics assignments and difficulties encountered while doing so. These delays appeared to limit students' capacity to engage deeply with the subject, thereby hindering their academic performance. In comparison to Joubert's (2015) study, which similarly found that time dedicated to studying at home plays a critical role in academic success, the present research extends this understanding by emphasising procrastination as a central element. The more time students devoted to focused study at home, the less they procrastinated, and subsequently, the better their mathematics performance, illustrating the close relationship between effective time management and academic achievement in mathematics.

The high prevalence of procrastination among students raises concerns for their future academic and professional success, particularly as mathematical competency becomes increasingly essential in a data-driven world. O'Brien (2002) noted that 80% to 90% of undergraduate students experience procrastination, a statistic that echoes the findings of the present study, and suggests that procrastination may have long-term consequences if left unaddressed. Therefore, addressing the role of procrastination in academic contexts, particularly in mathematics, is essential for fostering both short- and long-term academic success.

Furthermore, academic procrastination may hinder students' development within Vygotsky's (2012) Zone (ZPD. Procrastination limits meaningful engagement with learning materials and reduces opportunities for interaction with teachers and peers,

which are crucial for scaffolding learning and advancing through the ZPD. Students who procrastinate often rush through tasks, resulting in superficial engagement with mathematical concepts. This impedes their ability to master these concepts fully (Aalbers et al., 2022; Svartdal & Nemtcan, 2022), as the ZPD requires sustained effort, active involvement, and timely task completion. Vygotsky's theory emphasises the importance of collaborative learning and interaction, which procrastination undermines, thereby slowing the development of higher-order mathematical thinking. The comparison of the present findings with Vygotsky's framework suggests that procrastination plays a detrimental role in students' ability to benefit from collaborative learning environments.

Nevertheless, not all forms of procrastination necessarily hinder academic progress. Brinthaupt and Shin (2001) found that some students, especially those who engage in cramming, can perform well under pressure. This suggests a distinction between procrastination driven by the need for more time or resources and procrastination that stems from avoidance or disengagement. Makhambetova et al. (2021) stressed that students who procrastinate due to a need for additional time and support may benefit from differentiated instruction or personalised learning strategies. In contrast, procrastination rooted in avoidance, often linked to anxiety or low motivation, poses a greater risk to academic success (Calonia et al., 2023). Understanding these nuances is critical for educators, as different types of procrastination may require different interventions.

In summary, this study suggests that academic procrastination plays a multifaceted role in students' mathematics performance. While procrastination driven by legitimate academic challenges may not always negatively affect outcomes, procrastination due to avoidance is closely linked to poorer performance, particularly in mathematics. Educators should consider these different roles when addressing procrastination, providing targeted support for students based on their specific procrastination tendencies. By fostering proactive study habits and encouraging meaningful engagement with learning materials, students can reduce procrastination, better navigate their ZPD, and ultimately improve their performance in mathematics.

Pedagogical interventions to tackle academic procrastination

To address the pervasive issue of academic procrastination, particularly within the domain of mathematics, a variety of pedagogical interventions can be developed to accommodate the complexities associated with students' diverse socio-economic backgrounds and the influence of familial factors on learning outcomes. Research indicates that procrastination can significantly undermine students' ability to engage effectively in learning activities, complicating the facilitation of students' Zone of Proximal Development (ZPD) in mathematics education. Therefore, the following enhanced interventions are proposed.

- *Organise study skill workshops:* Schools should offer workshops specifically designed to improve students' time management, organisational skills, and effective study habits. These workshops ought to be adaptable to varying familial backgrounds and levels of parental involvement, recognising that students from disadvantaged socio-economic contexts may require targeted support.

Incorporating cultural sensitivity into these workshops can assist students from marginalised groups in developing study techniques that resonate with their home environments. Furthermore, these workshops should emphasise the importance of consistent study habits over last-minute cramming, directly addressing procrastination by promoting proactive learning strategies.

- *Create an engaging classroom environment*: Teachers can play a crucial role in mitigating academic procrastination by fostering engaging and interactive classroom environments. Strategies such as gamification, peer-led discussions, and project-based learning can render lessons more dynamic, thereby enhancing intrinsic motivation and diminishing opportunities for procrastination. Empirical research supports the assertion that when students are actively involved and derive enjoyment from the learning process, they are less susceptible to delaying academic tasks. This perspective aligns with the findings of Akinsola et al. (2007), which advocate for the development of collaborative and interactive learning environments to combat procrastination by making the educational experience more appealing and manageable.
- *Parental involvement and awareness programmes:* Schools can implement programmes designed to educate parents, particularly those with lower educational attainment, about the significance of academic support and time management in the home environment. Such initiatives may provide guidance on establishing structured study environments, offering emotional support, and recognising indicators of academic procrastination. Parental involvement is crucial in alleviating procrastination; parents who understand the importance of their child's academic progress can contribute to cultivating a more supportive and proactive learning atmosphere, thereby facilitating the development of the student's ZPD.
- *Structured feedback mechanisms*: Teachers should implement regular and constructive feedback loops designed to assist students in identifying their academic strengths and weaknesses. Timely feedback on assignments and assessments can mitigate procrastination by allowing students to address gaps in their understanding at an early stage. This feedback should be aligned with the student's progress within their ZPD, providing them with clear targets for improvement and the necessary scaffolding. Research conducted by Rosário et al. (2009) underscores the significance of early intervention through feedback, as it enables students to rectify issues related to procrastination before they adversely affect overall academic performance.
- *Family support networks*: Schools could establish family support groups to inform parents about the influence of familial structures and home environments on students' study habits and academic achievements. Such groups would serve as a platform for parents to exchange strategies for creating conducive study environments and offering emotional and logistical support for their children's learning. For students from larger families or those bearing additional domestic responsibilities, these sessions could provide practical strategies for ensuring adequate time is allocated for studying, thereby mitigating procrastination stemming from external pressures.
- *Teachers' professional development*: Teacher training should include specialised programmes focused on identifying and addressing academic procrastination.

Educators need to be equipped with strategies that can be adapted to meet the diverse capabilities and learning needs of students, as well as those that align with their ZPD. This training should emphasise the early identification of procrastination tendencies, particularly among students from marginalised groups, and methodologies for creating personalised interventions that guide students through their academic challenges. Incorporating insights from Vygotsky's ZPD theory will enable teachers to scaffold learning in a manner that minimises procrastination and fosters sustained academic engagement

- *Targeted counselling services*: Schools and other stakeholders (e.g. school management committees) should ensure access to counselling services that focus on identifying the emotional, psychological, or situational factors contributing to procrastination. Students may engage in procrastination due to anxiety, lack of motivation, or other underlying issues; therefore, counselling can provide the necessary support to help them overcome these barriers. Counsellors can collaborate with students to develop individualised strategies for time management and task completion, addressing procrastination in a comprehensive manner. This approach, as articulated by Calonia et al. (2023), underscores the role of counselling in assisting students in navigating the emotional challenges frequently associated with procrastination.
- *Extracurricular support*: Given the significant correlation between study time at home and mathematics achievement, it is imperative for schools to extend structured study opportunities beyond conventional school hours. Initiatives such as extended library hours, after-school tutoring, and homework clubs provide students with additional time to engage with their academic tasks in a focused and supportive environment. These programmes are particularly beneficial for students who struggle with time management at home, as they offer a designated space for study and mitigate the likelihood of procrastination.

By implementing these pedagogical interventions, schools and teachers can more effectively address the complexities associated with academic procrastination. The integration of tailored study support, parental involvement, structured feedback, and targeted counselling services can foster a comprehensive strategy aimed at reducing procrastination and enhancing students' overall academic performance, particularly in mathematics. Furthermore, by cultivating a proactive and supportive learning environment, educators can assist students in overcoming procrastination and developing their ZPD, ultimately augmenting their potential for academic success.

Conclusion

This study examined the relationship between academic procrastination and mathematics performance among ninth-grade students, revealing a significant prevalence of procrastination. Notably, students who exhibited fewer tendencies to procrastinate achieved higher scores in mathematics, highlighting the necessity for targeted interventions. If ninth graders can effectively combat procrastination through improved study habits, there exists substantial potential for enhanced academic achievement, particularly in mathematics. A positive classroom

environment appears to be crucial in mitigating procrastination. Educators who prioritise creating engaging, supportive, and conducive mathematics classes tend to decrease procrastination among students. Additionally, timely feedback on assignments plays a vital role in fostering better academic habits and, consequently, improving performance. The study further substantiates the influence of parental education and family structure on academic outcomes. Specifically, children of educated parents and those from smaller, nuclear families typically perform better in academic assessments. This information serves as a valuable resource for educational policymakers seeking to develop focused strategies to address procrastination at the secondary school level. Among the critical findings is the observation that difficulties in completing mathematics assignments often precede procrastination. Therefore, educators should strive to make mathematics classes more interactive and enjoyable to encourage student engagement and minimise procrastination.

The study is limited to a secondary public school in the Bardiya district; consequently, the findings can only be generalised within similar contexts. Further research is necessary across various school types, including diverse classes, utilising a larger sample from different regions of the country. This study is restricted to academic procrastination within the realm of mathematics learning; hence, additional studies are warranted in diverse subject contexts. The research is confined to survey methodology; thus, future studies could employ a mixed-methods approach, incorporating qualitative research. Furthermore, while this study focused on five socio-cultural factors – gender, ethnicity, study hours, family size, and parental educational background – other factors, such as the financial status of parents, parents' occupations, and school types, may also play a role in determining academic procrastination and achievement. Hence, further studies are needed to address these issues. Confirmatory Factor Analysis (CFA) and Exploratory Factor Analysis (EFA) were not applied due to the presence of three factors in each domain of the existing research instrument; however, validity and reliability were appropriately established. Therefore, future research could validate the instrument by applying CFA or EFA.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix Academic Procrastination in Mathematics Learning Measurement Scale

Group A

Personal information

What is your gender () Female () Male
What do you want say yourself (Ethnicity):
() Janajati () Dalit () Madhesi () Brahmin/Chhetri
How many hours do you study at home per day?
() < 2 hours () 2–4 hours () ≥ 4 hours
Number of family members:
() 1–4 members () 5–9 members () Above 9 members
What is the education level of your father?
() Illiterate () School education () University education
What is the education level of your mother?
() Illiterate () School education () University education

Group B

Academic Procrastination

Based on the following statements related to academic procrastination in mathematics learning, please tick in each raw as per your fitting level [NT-Not at all true for me, ST-Slightly true for me, MT-Moderately true for me, VT-Very true for me, CT-Completely true for me]

Statements	NT	ST	MT	VT	CT
I study mathematics regularly					
I feel problem when I want to study mathematics					
I want to decrease my tendency to procrastinate on solving mathematics problem					
I delay my mathematics assignment project until the last time					
I feel problem my mathematics assignment when i do project					
I want to decrease my tendency to procrastinate on mathematics assignment project					
Before mathematics exams, I generally have enough time to study for all the subject					
When exam time approaches, I find myself busy with other things					
I want to decrease my tendency to procrastinate on the preparation of exams					
I present regularly in school.					
I absent in my class when teacher give study assignments.					
I want to decrease my tendency to procrastinate on the absentee in school.					
I participate and enjoy in ECA activities in school.					
ECA activities bore to me.					
I want to decrease my tendency to procrastinate on extra-Curricular activities					
I want to meet and ask my problem with my teacher in leisure time.					
I feel uneasy to meet and ask my problem with my teacher in leisure time.					
I want to decrease my tendency to procrastinate to meet with teacher					