CHAPTER – VI

SUMMARY & OVERVIEW

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6.1 Summary of the Research Work

Towards this end, the current study examines the associations among school climate, scientific reasoning, procrastination tendency, and parental autonomy support with academic achievement in physics of senior secondary school students. A major factor influencing learning outcomes and development is what has been called the school climate; that is, values, relationships, safety, and organisational structure (Hoy & Sabo, 1998; Freiberg & Stein, 1999). Cognitive (Piaget, 1970) and sociocultural development theory (Vygotsky, 1978) undergird scientific reasoning, drawing on logical problem solving and hypothesis development. The inclination to procrastinate has been associated with low self-regulation and motivational deficits and has a negative influence on academic success (Steel & König 2006). Parental autonomy support, referring to the degree to which parents encourage independence and decision-making, boosts motivation and learning outcomes (Deci & Ryan, 1985). Such insight is expected to provide valuable evidence-based factors that will help to improve physics challenges at this stage.

The problem statement is formulated as: "School Climate, Scientific Reasoning, Procrastination Tendency, and Parent Autonomy Support of Senior Secondary School Students in Relation to their Academic Achievement in Physics."

6.1.1 Objectives of the Study

1. To find out the school climate, scientific reasoning, procrastination tendency, parent autonomy support, and academic achievement levels in physics of senior secondary school students.
2. To study and compare school climate, scientific reasoning, procrastination tendency, and parent autonomy support of senior secondary school students in relation to their gender, locality, and type of institution.
3. To study the relationship between school climate and academic achievement, scientific reasoning and academic achievement, procrastination tendency and academic achievement, and parent autonomy support and academic achievement in physics of senior secondary school students.

4. To study the joint contribution of School climate, scientific reasoning, procrastination tendency, parent autonomy support on academic achievement in Physics of senior secondary school students.

6.1.2 Operational definitions of the Terms Used

School climate: In this study, school climate has been assessed through a self-developed questionnaire.

Scientific reasoning: In this study, scientific reasoning has been measured with the help of the Lawson classroom test of scientific reasoning (LTCSR, 2000).

Procrastination Tendency: In this study, academic procrastination tendency has been measured with the help of the Procrastination Scale adapted from Lay (1986).

Parent Autonomy Support: In this study, parental autonomy support has been measured with the help of the Perceived Parental Autonomy Support Scale (P-PASS) adapted from Mageau et al. (2015).

Academic achievement of students in Physics: It is the performance of the students in the achievement test in Physics developed by the investigator for the present study.

Senior secondary students: The students studying in Class XII in HPBSE (Himachal Pradesh Board of School Education) in the science stream.

Gender: Boys or girls studying in Class XII in Himachal Pradesh.

Locality of institution: This refers to the locality in which the school is constructed in Himachal Pradesh. It can be rural or urban.

Type of institution: Private or government senior secondary school in the state of Himachal Pradesh.

6.1.3 Delimitations of the Study

The study has been delimited to:

- Senior secondary students of Himachal Pradesh studying in Class XII.
- Students of the science stream studying physics as one of the major subjects in Kangra district of Himachal Pradesh.
- Senior secondary schools in Himachal Pradesh are affiliated to HPBSE, Dharamshala.

6.1.4 Research Methodology

Descriptive Survey Method is the research methodology chosen for the study, which describes and reveals the existing state of the phenomenon accurately. This is appropriate to collect quantitative data that could provide a quantitative response to these variables. The population for the research consists of senior secondary school students studying in the science stream with a major subject of physics in the Kangra district of Himachal Pradesh. All such students make up the study population, while a sample of 560 students is selected through a multistage sampling process. The first phase involves the selection of 41 out of 407 schools through simple random sampling. In a second step, stratified random sampling is applied to the selection of students in those schools. The dependent variable is academic achievement in Physics, while the independent variables are school climate, scientific reasoning, procrastination tendency, and parental autonomy support. This encompasses demographic variables such as gender, location of institution, and type of institution.

Data collection tools included a combination of standardised and self-developed tools: self-developed School Climate Questionnaire, Lawson's Classroom Test of Scientific Reasoning (LTCSR) from Lawson (2000), Procrastination Scale from Lay (1986), Perceived Parental Autonomy Support Scale (P-PASS) from Mageau et al. (2015), and the self-developed Physics Achievement Test. The researcher obtained formal consent from the Deputy Director of Higher Education, Kangra–Dharamshala, and later from school principals. As such, before the tools are administered, rapport has been built up with the students to help encourage trustworthy data collection. Statistical techniques will be performed according to the type of data and objectives of the study to analyse the collected data: mean, standard deviation, frequency, percentages, bar graphs, skewness, kurtosis, normality test, independent samples t-test, Pearson correlation, and regression. This approach allows for a comprehensive and systematic examination of the factors and their interconnections.

6.1.5 Structure of the Thesis

This thesis has been presented in six chapters:

- The chapter first includes the thesis statement, dependent and independent variables, conceptual and theoretical framework, objective of research, research gap, hypothesis, and operational definition.

- Chapter two reviews relevant literature (2010-2024), identifies gaps in the research, and comes up with relevant research questions.
- Chapter three discusses the methods of research, which discuss the design of the research, population and sample, instruments of the research, collection of data, and use of statistics.
- Chapter four includes the research findings and the analysis that have been presented according to each objective.
- Chapter five compares these findings with the previous literature to make sense of these findings and interprets these results.
- Chapter six summarises the thesis, educational implications, limitations of the research, and suggestions for future research.

6.2 Conclusions

- A large group of students (39.28%) rated their school climate as "average," defined as the combination of relationships, safety, resources and infrastructure, quality of teaching, and relationships with peers in school. However, most of the students exhibited neutral views, not taking extreme positions.
- Scientific reasoning skills were deemed to be at an average level for 40.89% of students, and 33.75% were at a below average level (due to the complex nature of physics and gaps in pedagogical strategies). It shows that few of them are high achievers, but it also points to the need for more personalized ways to develop critical thought.
- 33.93% of students had average procrastination tendencies and 26.61% were below average. Stress, poor time management and difficulty with self-regulation were major causes. The results indicate that only 2.14% showed low procrastination tendencies, emphasizing the urgent need for interventions to improve study habits and lower stress levels.
- 41.79% of students reported an average level of parent autonomy support, with differences related to socio-economic and cultural factors. Zero percent receiving extremely high support is also not what we would expect– nor is the 0.71% of students receiving extremely high in the low range (the sample descriptors of “extremely low” and “extremely high,” certainly imply a set of gaps).

- 32.32% and 29.29% of students had average and below average academic achievement (respectively) in physics. Among the contributing reasons were poor structures, unavailability of resources, severally disadvantaged teacher-student interactions, and little or no parental help. School climate, scientific learning opportunities and parent engagement level need to improve, to enhance education/academic outcome.
- In addition, male senior secondary physics students' perception of school climate is significantly different with that of female students and the school climate of female senior secondary physics students is significantly more positive than that of male students.
- Mean score of school climate for female students (218.20) is greater than male students (211.46) with a mean difference 6.735.
- But they have better indicators of physical and socio-emotional security, support in learning, human relationships, and school connectedness than their female counterparts.
- There was no significant difference on the dimension of Rules and Norms, indicating that both males and females have a shared understanding of school rules and appropriate behaviour.
- Differences in scientific reasoning scores are linked to resource access, social norms, and perceptions of the school climate.
- Male students (mean: 7.60) out performed female students (mean: 6.72) on scientific reasoning.
- There is difference in level of procrastination tendency between male and female students, where female students have relatively higher level of procrastination tendencies than male students with mean difference of 1.685 and t-value of 2.612.
- Differences between the genders in procrastination are evident, especially in 4 and 5 (Good and Poor Time Management) where t-values are above the critical threshold 1.965.
- Findings of no significant gender difference in dimensions 1 (Good Planning), 2 (Delay), and 3 (Doing Things at the Last Moment) of procrastination proved that planning and execution remain from the perspective of the male or female consistently.

- Results indicated significant differences in paternal psychological control due to parental influences (f-value: 2.399), with female students experiencing more psychological control than males.
- There were no significant differences in paternal autonomy support (t-value: 0.688) suggesting fathers encourage independence similarly for sons and daughters.
- There is no significant difference between genders in academic achievement scores (males mean: 34.41, females mean: 34.83, p-value: 0.34).
- This indicates an equitable learning environment and teaching practices inside schools, as well as equal access to resources and (hopefully) similar experiences regarding school climate for both girls and boys.
- The mean school climate score for senior secondary physics students of rural and urban areas are 217.24 and 213.67 respectively with difference of mere 3.57 which is not statistically significant indicating that school climate is almost similar in both the contexts.
- This might be explained by government policies designed to equalise infrastructure, teachers and human capital in schools whether in urban or rural areas.
- There are also stark differences in dimensions 3 ("support for learning") and 5 ("school connectedness") where rural students report higher scores, perhaps as a result of close-knit communities and more personalized attention from staff.
- Similar perceptions on rules and norms, socio-emotional security and interpersonal relations between rural and urban students are seen in dimensions 1, 2 and 4.
- M also indicates that mean scientific reasoning scores between rural (6.97) and urban (7.15) students are negligible (-0.179) and not statistically significant.
- This is attributed to equal scrutiny of educational resources in and across the two regions and the influence of government reforms in Himachal Pradesh, which leads to uniform cognitive and critical thinking development in scientific reasoning among both areas.
- Urban students procrastinate more (mean score: 62.86) than rural students (mean score: 64.20) and this finding is evidenced by the urban life factors like social distractions, fast-paced urban life and more media influence.

- In contrast, urban students had a higher standard deviation of procrastination tendency (7.694), indicating socio-economic disparities or differing urban living environments.
- The t-value (2.181, p = 0.030) indicates the significant differences in procrastination levels, verifying the hypothesis that urban students procrastinate more than their counterparts in rural areas.
- In dimensions 1 ("good planning and time management") and 4, there is shown to be a higher t-value (3.961, 2.966) for rural students in comparison to the urban students showing that rural students score higher in good planning and time management.
- The disparity is due to sociodemographic factors, with rural students having less distractions and peer pressure, leading to better time management skills.
- There are no significant differences in dimensions 2, 3, and 5 indicating that the procrastination behaviours (i.e. delaying task and poor time management) are distributed equally in both the rural and urban groups.
- Rural areas have a significantly higher level of paternal psychological control, which highlights stricter and more tightening paternal discipline and control, commonly reflected in traditional rural family styles.
- Paternal autonomy support does not differ significantly, as shown by the t-value of -0.980, indicating that parental support for autonomy development remains consistent across rural and urban areas.
- Such support enables senior secondary students in rural and urban areas to build self-reliance and skills for decision-making.
- Means of the academic achievement scores in physics are almost the same out for both rural (mean 34.93) and urban (mean 34.33) senior secondary physics students, and the p-value being 0.159 shows insignificant differences.
- Better infrastructure, teachers and digital learning opportunities which are a part of initiatives such as RMSA, Samagra Shiksha Abhiyan, Digital India have contributed to bridging the gaps in education and brought it at par with the cities.
- The small standard deviations (4.96 for rural and 5.14 for urban) indicate no variations across both the regions, and this further infers that geographic or environmental factors would not have a significant impact on academic outcomes.

- Overall school climate experience among private and government school students differed (mean school climate score of private school students = 223.19, mean school climate score of government school students = 210.10; t = 5.856, p = 0.000); this could be explained by better facilities, resources and individual development focus for private school students.
- Government schools have overcrowding, fewer teachers and a lower teacher-student ratio which affects the students' academic, social and overall response towards perception of school climate.
- The higher mean in the private schools indicates a more supportive and conducive learning environment.
- With no significant difference in scientific reasoning scores between private (mean 6.90) and government school students (mean 7.16; t = -1.408, p = 0.160), we see similar teaching methods, implementation of the curriculum, and support systems as working just as equally, in both the private and the government school systems.
- Socio-economic and educational factors have contributed towards a statistically significant difference between the procrastination tendency score of students in private schools (mean 64.45) as compared to government schools (mean 62.99).
- Due to increased stress from academic scaling, competitiveness, and failing fear, private school students tend to procrastination more than public school students.
- The students studying in government schools have a balanced cyclical environment, which causes them to procrastinate less.
- Government school students were found to be significantly better planners with time management abilities and a less tendency to procrastinate when compared to private school students as indicated by their procrastination scores.
- There was no stark difference in paternal autonomy support (48.4% private schools vs 42.6% government schools), paternal psychological control (measured as parental psychological control, 49.77% for private schools vs 48.61% for government schools; Tung et al. 2023), which suggests equal parental involvement in both school types.
- Parental support goes beyond the school type; it's largely dependent on community support and socio-economic aspects.

- The reason for Government schools having a lower mean score (33.97) versus private schools (35.61) is attributed to varying structures within the private schools where infrastructure is better, education is focused, and high-quality teaching resource guidelines are followed.
- Private school education offers the advantage of smaller class sizes, allowing teachers to provide a more individual approach for students and expand their conceptual understanding and ability to critically analyse a problem.
- Such advancements and innovations are extremely needed in Indian Government schools because Government schools are often characterized by overcrowded classrooms, poor infrastructure, lack of resources, etc., which restricts individual learning, their evaluations, and academic performance.
- School climate had a weak association with academic achievement ($r = 0.137$), indicating a significant yet low correlation, with external factors such as family support, personal motivation and socio-economic status playing a role.
- A weak correlation (0.135) between scientific reasoning and academic achievement reflects that scientific reasoning skills do not generalise academic performance strongly. This might be due to a lack of focus in a curriculum on practical experimentation, collaborative projects and inquiry-based, ethical learning.
- The relationship between procrastination tendency with academic achievement is poor because the correlation coefficient is 0.114. Procrastination is associated with ineffective time management, ineffective study habits, and poor understanding of complex concepts, leading to reduced academic performance.
- A weak yet positive and significant association ($r = 0.090$) was found between dimension 1 of parental autonomy support and students' academic achievement. Many parents may have low literacy levels and be unable to provide adequate academic help to their children, while the economic challenges faced by parents too can act as a huge hindrance in motivating or providing the right support to their children.
- Parental psychological control - Dimension 2 The Dimension 2 of parental psychological control to has no significant relationship ($p > 0.05$) with academic performance. A weak--almost 0--positive correlation ($r = 0.059$) suggests a

negligible practical association. Psychological control can lead to pressure and stress, which in turn undermine intrinsic motivation and academic achievement.

- This portfolio capacity is also reflected in the regression test results to regression models can be used to predict academic achievement based enter of school psycho-social capabilities school climate, scientific reasoning is used tendency procrastination and parental autonomy support and predictive capacity test results obtained from the regression analysis that these four independent variables explain the dependent variable of 5.3% variations in achievement.
- The most significant predictors were scientific reasoning ($\beta = 0.162$, $p < 0.001$) and procrastination tendency ($\beta = 0.101$, $p < 0.019$), emphasizing the importance of logical thinking and effective time management.
- More specifically, although perceived school climate, parental autonomy support and psychological control had all been identified in previous research as potential predictors of academic performance, none were significant predictors in analysis, leading us to conclude that their effect on academic performance might be mediated or secondary to cognitive and behavioural factors.

6.3 Educational Implications of the Study

The results of this study have many implications for education, as they can serve as a basis for informing teaching practices, curricula, and institutional policies that support high academic performance among senior secondary school students, especially in physics. Here are implications based on the study:

Educational Implications for Teachers/ Educators based on conclusions:

- Teachers should aim for school climate fundamental relationships, safety, resource quality, quality of teaching. This can make for a more conducive learning environment.
- Addressing average and below-average levels of scientific reasoning skills require personalized teaching strategies. These skills can be developed by encouraging critical thinking through inquiry-based learning, collaborative projects, and hands-on activities.
- Teachers have to work on procrastination habits and should introduce time management, stress-easing and self-regulation techniques into the curriculum to develop better studying habits.

- Teachers are encouraged to implement gender-sensitive approaches to overcome differences in perceptions between boys and girls on school climate and procrastination, ensuring equal attention, supporting both genders, etc.
- The missing link is parental engagement. Teachers can come together to form workshops which prepare parents to aid their children with effective learning methods irrespective of socio-economic or cultural backgrounds.
- Use of government initiatives such as RMSA and Samagra Shiksha Abhiyan so that urban and rural disparity in educational outcome is minimised. Urban school teachers should focus on reducing distractions, while rural teachers should as much as possible capitalize on their strengths in the form of close-knit communities.
- Usage of innovative teaching practices and optimized use of the available resources teachers in the government schools should - find ways to overcome the school infrastructure and other resources limitations (compared to private schools).
- Teachers should understand that there is a weak connection between school climate and academic performance and do their best to strengthen this relationship by increasing motivation, shaping environment conditions in a supportive direction, and tailoring teaching to match the needs of each student in the group and the feedback received from a student.
- Interventions into procrastination and the development of scientific reasoning have shown to have a positive influence and are key indicators of academic performance. They should focus on problem-solving exercises, logical reasoning tasks and time management strategies in their teaching.
- The teachers are playing a significant role in developing cognitive and metacognitive skills. Physics education training programs need to teach the value of promoting these skills within the classroom setting. Innovative practices such as the framework of Predict-Observe-Explain (POE), concept mapping, and technology-based learning tools are helping to cultivate scientific reasoning and engagement in physics. In addition, we recommend teacher preparation programs to integrate modules on understanding procrastination, supporting students' autonomy, and fostering a healthy classroom climate.

Educational Implications for Students/ Learners based on conclusions:

- Schools must foster an inclusive and supportive climate by enhancing relationships, safety, and infrastructure and resources for the majority of students who perceive their school as average. Neutral students can think more positively about it and their experience will be better.
- Tailored instructional interventions are fundamental to the development of scientific reasoning, hence the importance of personalized support systems even more so in complex subjects such as physics, where many students achieve average/ below-average scores. Critical thinking and logical reasoning can be developed through these strategies.
- The tendency of students towards procrastination requires targeted intervention like workshops on stress management, time management training, and self-regulation exercises. This task is essential for nearly all students who find it difficult to suspend their judgment.
- Programs targeting parent engagement should focus on promoting autonomy support and reducing psychological control to offset high involvement that supports academic and emotional development.
- Support of enhanced teacher-student interactions and availability of academic resources was found to be key to improved physics academic achievement, especially for average and below-average performance students.
- Gender-sensitive pedagogical approaches could help address gender differences in procrastination and scientific reasoning to promote gender-equitable learning outcomes. Specific strategies that help female students curb procrastination and male students improve their planning can have a big impact.
- Expansion of programs such as RMSA (Rashtriya Madhyamik Shiksha Abhiyan) and Digital India, which promote opportunities for education equity for all students regardless of their backgrounds in rural/urban settings; uniformity in scientific reasoning and academic excellence must be achieved across the student body through quality programs.
- While urban students need varying support systems to cope with social distractions and on-the-go lives that lead to more procrastination, rural students require resources to continue leveraging time management and planning.

- Collaborative learning opportunities, inquiry-based experiments, and practical problem-solving activities should be integrated into the curriculum to improve the weak association between scientific reasoning and academic achievement.
- According to the findings from the regression analysis conducted in the study, improving logical thinking (scientific reasoning) and lessening procrastination are the best predictors of academic success which can be achieved through workshops and modules.

Educational Implications for Administrators (Principals/ Schools Heads) based on conclusions:

- The educational implications for administrators such as principals / head to learning point out many areas. School administrators must put a greater emphasis on school climate: the teachers, the tools they have to create a safe environment for learning, even whether or not they have all the basics of school supplies. Two generic pedagogical strategies are proposed to underpin a personalized learning experience to achieve significant improvements in science with a focus on physics, regarding students' scientific reasoning and critical thinking. Future interventions on time management and study habits should be utilized to decrease tendencies toward procrastination, while considering the gender differences found in this study.
- Since psychological control has subtle adverse effects on academic outcomes, parental autonomy-supportive programs are needed and should be promoted as such. They must encourage equitable distribution of resources to ensure that students have similar exposure to learning experiences across rural and urban pockets, using government schemes and initiatives like RMSA and Digital India.
- For government schools, overcoming crowding and improving teacher-student interactions is of paramount importance. To balance the performance gap with private schools, these state schools should also adopt new age teaching methodologies like inquiry-based learning, collaborative learning etc. Tracking and reinforcing strong time management skills can help urban students procrastinate less. On the other hand, rural students may find that engagement in close-knit communities works in their favour.

- Enhancements in the climate of government schools must take care of overcrowding and teacher-student ratios. Strategies may entail investing more in infrastructure or employing competent teachers to assist in establishing a learning-friendly environment.
- Administrators need to understand the significance of cognitive and behavioural factors (for example, seven scientific reasoning or time management) compared to environmental or school climate or parental predictors. Teacher training, infrastructure improvement, and innovative curriculum development together will advance academic achievement.

Educational implications for Policy Makers and Curriculum Developers based on conclusions:

- These findings offer implications to policymakers, guiding their decision-making on how to best allocate resources and support services in the state school system to optimize educational achievement.
- Provide a balanced approach to schools with a focus on an environment that is conducive to positive relationships, safety and belonging among students. Therefore, it is imperative to design and implement the curriculum in a way that strengthens the components of scientific reasoning by involving elements of practical and inquiry-based learning. In order to combat procrastination tendencies of students, we need to be able to introduce time management and stress-reduction workshops, as well as counselling services.
- School climate, procrastination, and scientific reasoning correlated with gender differences are factors necessitating gender-sensitive interventions to effectively aid both male and female students. In addition, there are gaps between rural and urban areas, each with its own educational practices and outcomes, which creates a need for specific strategies that utilize the advantages offered by the rural schools, as well as a need to focus on the factors that contribute to poorer performance in urban students.
- The fact that the perception of school climate and academic results so starkly divides private and government schools demonstrates the pressing need for innovative reforms in government schools, including equitable allocation of resources, smaller class sizes, and individual level teaching. Within its ambit,

programs under initiatives such as RMSA, Samagra Shiksha Abhiyan, and Digital India require further outreach to work towards gaps in infrastructure and teaching quality.

- Enhanced autonomy support and less psychological control can be achieved through awareness campaigns and community programs related to parental involvement. Yet collaboration between schools and parents is crucial for boosting academic success and overcoming socio-economic challenges.
- The low correlations between factors—in school climate, procrastination, scientific reasoning, and academic performance—indicate that broader contextual factors (including family support, motivation, and socio-economic factors) should be integrated into policy planning.
- Policymakers should follow up on these findings by focusing on crafting comprehensive and inclusive policies that take into account the diverse needs of students to improve equity in education, and promote a more holistic approach to academic and personal development.

Educational implications for Parents/ Guardians are based on these conclusions:

- Something parents can do is help create a climate at home that supports and nurtures kids beyond the school environment for better academic outcomes. Regularly engage and communicate with schools to learn more about difficulty rating of school climate or struggle with scientific reasoning, and collaborate with teachers to address them.
- To prevent procrastination, parents can help children develop positive time management skills and reduce stress by creating a schedule that outlines study time as well as free time. Providing tips on the organization and prioritization of tasks can be helpful for addressing inclinations such as procrastination or lack of self-regulation.
- In parents of toddlers, encouraging supportive autonomy by granting a slightly higher level of choice and independence to their toddler may help. There is evidence that this approach improves both academic achievement and life skills. Attempt to balance independence with emotional and psychological support without overly controlling movements to not harm motivation and performance.

- Understanding of socio-economic or cultural factors that impact educational outcomes. Parents must demand equitable opportunities, and we must work with government to improve city and rural infrastructure and learning environments.
- Provide opportunities and supportive practices that mitigate gender-based tendencies, like procrastination for female students. Parents should also encourage participation in school activities balanced their involvement enough in school work should be done to promote sustainability and environmental prospects, promote scientific reasoning to help child scientifically back up their ideas backed from facts, provide and constructive feedback on the areas requiring improvement.
- For urban parents, restricting social distractions and limiting media exposure helps children to stay focused on studies. Close-knit community ties and personalized attention in schools are ways rural parents can find leverage in their child's learning experience.
- In instances in which private school pupils experience increased levels of stress and a tendency to procrastinate, parents must be in close collaboration with academics to set realistic expectations and ease the pressure placed on children. On the other hand, parents of students enrolled in government-run schools should demand better infrastructure and teaching methods to compete with private institutions.
- Lastly, parents must acknowledge the strong but weak correlation between school climate, scientific reasoning, and parental support with academic performance. Parents providing their children with the necessary skills to succeed in school will lead towards improving cognitive and behavioural components (logical thinking, time manageability etc.), including better education-related needs and meeting future challenges.

6.4 Limitations of the Study

- First, the data collection method relied on self-reports from students, creating potential biases inherent to this method, including social desirability bias, recall bias, and subjectivity in defining terms such as school climate, scientific reasoning, procrastination tendency, and autonomy support parents. These biases

may have affected the results, where participants may have either inflated or deflated their answers based on perceptions and not behaviours or results.

- Another limitation is the cross-sectional nature of the study, where data is collected at one point in time and does not depict changes over time. This design precludes the possibility of exploring within-subject changes in school climate, scientific reasoning, procrastination tendency, and parent autonomy support over time, or the potential for long-term influences of these constructs on physics achievement. A longitudinal study would offer a dynamic understanding of how these variables interact and change over time, especially during the pivotal years of senior secondary schooling.
- Thirdly, the research overlooks qualitative insights that would contribute to context for the findings. Quantitative measures may tap into correlations found between parent autonomy support and academic achievement, but these approaches do not unpack the nature or quality of parental interactions associated with support for autonomy (Soenens et al., 2019). Similarly, the ways in which teachers and school leaders affect school climate are not well-studied. These additional qualitative methodologies, such as interviews, focus groups, or case studies, could have provided a deeper understanding of the findings, helping to contextualise and explain the quantitative results.
- Lastly, though, this study does provide useful insights on the relationship between school climate and students' scientific reasoning, procrastination tendencies, parent autonomy support, and physics achievement; future studies may build on the results here by addressing the limitations identified in the current research. Future studies should also adopt longitudinal designs, larger and more diverse samples, qualitative methodologies, and a wider range of contextual and external factors in order to offer a more complete and nuanced understanding of these key educational trends.

6.5 Suggestions for Future Research

- The subjects of this study were the senior secondary school students, that is, class 12. However, respect from primary to tertiary students' developmental perspective is reminiscent of the research that needs to be done. A longitudinal approach like this would help show how school climate and parent autonomy

support are related to scientific reasoning, procrastination tendency, and academic achievement over time.

- Likewise, future studies may include students from other branches and disciplines than physics. Including subjects such as chemistry and biology, mathematics, as well as social sciences could facilitate comparative studies on domain differences in scientific reasoning and procrastination tendencies. This might leave room for such research to signal whether particular cognitive and behavioural traits might become more visible, valuable, or rewarded in concrete disciplines.
- Due to increasing diversity in educational settings, it would be very beneficial to conduct cross-cultural studies. Comparative studies can also shed light on cross-cultural differences in school climate (e.g., violence, bullying, and social exclusion) and the differential impact of parental support across cultures and their differential impact on academic achievement, thus allowing for a better understanding of which are the universal and culture-specific factors that influence learning outcomes. Such work could focus on nationality-bound comparative studies between students and education around the world or within a country but with special attention to multicultural classes.
- Future studies could take a mixed-methods approach, combining qualitative and quantitative data collection methods. While quantitative data can provide statistical information regarding the relationships between variables, qualitative data, such as interviews or focus groups, can help uncover deeper insights into students' lived experiences and perceptions. Such triangulation could pull together the data to highlight the nuanced factors affecting academic performance.
- Experimental studies may be performed to intervene to promote scientific reasoning and reduce procrastination. In other words, insert them with the implementation of all science modules or specific workshops focused on time management, critical thinking, and scientific problem solving across varying educational settings to assess their impact.
- Future research will need to examine the interaction effects of multiple cognitive and behavioural factors, including metacognition, emotional intelligence, spatial reasoning, etc., on academic achievement. A comprehensive understanding of

how these variables relate to and impact one another can facilitate the creation of design interventions that promote whole learning processes.

- Future research might also include teachers as participants, looking at the way they teach and how their methods may impact students' scientific reasoning and procrastination tendencies. Some insight can also come from teachers' reflections on the school climate and their own contribution to a supportive learning environment.
- Longitudinal studies are especially useful for understanding how, if at all, procrastination tendencies and scientific reasoning change over time. Such studies could follow students over multiple years, studying how these traits evolve and their effects on long-term academic achievement.
- Future research could also include study on other psychological and environmental issues such as mental health, emotional intelligence, and peer relationships. Exploring how these dynamics relate to school climate and parental involvement will provide a broader perspective of some of the social determinants impacting academic success.
- Finally, when we are living in an era of technology, looking at how technology plays a role in the school climate or scientific reasoning would be very relevant. Future research may investigate the role that technology and virtual learning spaces play in shaping procrastination behaviours and academic performance, particularly in physics.
- These suggestions reflect the complexity of the topic and the enormous potential for future inquiry. By exploring these pathways, researchers can help to build a solid base for evidence-guided practices to optimise academic success and overall educational excellence.