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Effect of strategic memory advanced reasoning training (SMART) therapy for enhancing final-year high school students career choices

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Abstract

The SMART program improves students' memory, reasoning, and strategic thinking skills, crucial for academic success and career planning. This study explored the effect of Strategic Memory Advanced Reasoning Training (SMART) for final-year high school students, aiming to enhance their decision-making abilities and prepare them for University. Based on the literature, nine hypotheses were developed with SMART program implementation therapy as an independent variable with four sub-variables: cognitive skills, professional development, social skills, and academic skills, and their impact on the dependent variable, such as career decision-making. Using a smart partial least square-structural equation modeling (PLS-SEM) on 284 high school students, confirmatory factor analysis (CFA) and structural equation modeling (SEM) was implemented to confirm the measurement model. Path analysis was conducted to determine the relationship between independent and dependent variables. Results of the study revealed that SMART therapy significantly enhances cognitive abilities, academic performance, personal development, and social skills, collectively contributing to better career decision-making among final-year high school students. However, the direct impact of SMART on career decision-making was not supported, indicating that additional factors, such as social and emotional influences, play a role. These findings suggest that integrating SMART therapy into high school curricula can better prepare students for future challenges and career opportunities, aligning with Sustainable Development Goal 4 (Quality Education). A collaborative approach among stakeholders, policy support, and innovative practices are recommended to overcome potential obstacles and ensure the successful implementation of SMART therapy in educational settings.

Keywords Strategic memory, Advanced reasoning training (SMART), Career choices, Cognitive skills, Personal development, Social skills

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Introduction

High school students need advice and counseling to pursue post-graduation ambitions efficiently [1]. As they approach graduation, they face critical decisions about their future academic and career paths, which can be challenging as they must align their career aspirations with their skills and interests [2]. The modern school environment necessitates that educators provide instruction while managing various developmental and social challenges, meeting safety and health standards, and adhering to state-mandated learning requirements [3]. Although high school educators are state-licensed and capable, the added requirements and complexities within the school environment leave them with little time or ability to guide students effectively toward their chosen ambitions [4]. In Pakistani high schools, this situation is further exacerbated by inadequate guidance from teachers and mentors, leading to confusion and uncertainty about choosing the right major or discipline [5]. Consequently, students often struggle to make informed decisions about their future [6].

In such situations, students face problems regarding their future careers [7]. For example, students with exemplary academic achievements often aim for engineering and medical fields, but average and below-average students are usually unaware of their aptitudes and interests [8]. They tend to follow their friends' choices; if their friends get admitted to a business program, they do the same. Some students listen to their parents or family members, while others go to low-budget colleges and feel stuck, leading to poor decisions about their future. As a result, they may not succeed in their careers and lose interest in their studies [9]. In these cases, students need guidance to listen to their inner voices, consider their interests, aptitudes, and skills, and make informed decisions. Therefore, they need help from their teachers and mentors.

The timeliness of decisions is crucial due to the globalized impact of decisions and actions across various settings [10]. Unfortunately, high school students often do not work with vast amounts of data and may be unprepared for life beyond high school [11]. Teachers must understand that besides teaching or transferring knowledge, their duty also includes mentoring and guiding students [12, 13]. It involves using visualization tools to help students identify professional, personal, and financial goals to enable student-centered growth as they create and pursue their ambitions [14]. Expanded duties and responsibilities have shifted educators' focus towards more measurable school outcomes, reducing their ability and available time to mentor students and prepare them for adult life beyond high school graduation [15]. Several strategies and approaches have been adopted to facilitate students in such situations [16]. Therapies such as Cognitive Behavioral Therapy (CBT), Mindfulness-Based Stress Reduction (MBSR), Motivational Interviewing (MI), and Career Counseling assist students in analyzing the significance of their researched information, synchronizing their actions and understanding how their ambitions impact other aspects of their lives [1]. Through these therapies, students can become more active in articulating a personal vision statement and focusing on their destiny. Additionally, these programs are designed to enhance cognitive skills and support career decision-making [17].

While these methods provide valuable support in managing stress, improving mental health, and guiding career choices [18], the Strategic Memory Advanced Reasoning Training (SMART) program offers unique advantages [19]. Unlike traditional therapies, SMART focuses on enhancing memory, reasoning, and strategic thinking skills, which are critical for effective learning and decision-making [1]. This structured approach not only aids students in making informed career choices but also equips them with advanced cognitive abilities essential for academic success and personal growth [11]. This study aims to evaluate the effectiveness of the Strategic Memory Advanced Reasoning Training (SMART) program in helping final-year high school students in Pakistan make informed career choices and improve their readiness for University. Specifically, this study will assess the impact of SMART on several vital areas: Cognitive Abilities, Academic Performance, Career Decision-Making, Personal Development, and Social Skills. These skills are crucial for students' future careers, as they enhance their ability to think strategically, perform academically, make well-informed career decisions, develop personally, and interact socially. The study will provide comprehensive insights into how SMART can support students transitioning from high school to higher education and beyond by focusing on these areas. Although studies on SMART for career choices in high school students are lacking, the evidence of its benefits on cognitive, executive functions, and psychological health suggests that it could indirectly support better career decision-making processes in this population. The present study would be beneficial in confirming this application.

Overview of previous studies

Although children can develop executive function skills over time, the home learning environment plays a crucial role in shaping the development of these abilities, even in challenging circumstances [20]. However, selective focus and impulse control, while essential for learning, are not sufficient on their own to support overall academic success [21]. As students progress, higher-order cognitive abilities like reasoning, problem-solving, and flexibility become essential for academic and social success, which

can be fostered through structured learning activities [22]. Introducing executive function training into educational settings improves goal-directed behaviors and real-world academic outcomes [8]. Schools and educators have a significant opportunity to enhance executive functions among students, as these abilities are trainable and directly linked to future success [23]. Additionally, improving executive functions correlates with greater cognitive and emotional regulation, which in turn supports academic confidence and social skills development [24].

Several studies have explored the efficacy of Strategic Memory Advanced Reasoning Training (SMART) therapy in various educational and cognitive contexts, demonstrating its broad applicability in enhancing executive functions such as reasoning, memory, and problem-solving. For example, Vas et al. examined the effects of reasoning training (SMART) on adults with traumatic brain injury (TBI), focusing on both veterans and civilians with persistent mild impairments [25]. This study demonstrated that SMART can improve essential cognitive skills necessary for daily functioning and rehabilitation in individuals with cognitive impairments, a finding that underscores its potential for enhancing strategic thinking and reasoning.

Another noteworthy study by Gamino et al. explored the impact of SMART (Strategic Memory Advanced Reasoning Training) on higher-order executive functions in middle school students. The study, which focused on training teachers to enhance cognitive development, found that students who participated in SMART showed significant improvements in strategic thinking, reasoning, and problem-solving skills [1]. The study revealed that students who participated in SMART showed significant improvements in these areas, along with increased self-efficacy and reduced anxiety about future academic transitions. While this study did not directly address career readiness, it provides valuable insight into the cognitive benefits that can be leveraged in supporting career decision-making [26].

Research by Chapman et al. aimed to explore how SMART training could influence cognitive functions, particularly reasoning and memory [4]. The study found that participants who underwent SMART training showed significant improvements in both memory and reasoning abilities, with these cognitive gains being sustained over time, suggesting lasting neural changes. These results support the effectiveness of SMART in enhancing cognitive functions such as executive function, attention, and problem-solving skills, which in turn help participants perform better in everyday life. Building on this, Chapman and Mudar examined the neural mechanisms underlying SMART training, with a focus on neuroplasticity and cognitive adaptability [5]. Their findings indicated that participants not only performed better on cognitive tasks but also exhibited increased activation in the prefrontal cortex, a region crucial for executive functions. This suggested that SMART training could induce neural gains, strengthening cognitive pathways related to memory and reasoning, particularly in ageing populations. Such results align with the theory that SMART training improves cognition and induces neuroplastic changes that may mitigate cognitive decline.

In line with these findings, Vas et al. studied the long-term effects of SMART training on elderly individuals [6, 7]. Their research revealed that SMART training significantly slowed cognitive decline, improving working memory, processing speed, and reasoning. These cognitive improvements were associated with changes in brain structure, particularly an increase in cortical thickness in memory-related areas. The studies emphasized that sustained participation in cognitive training led to the most significant benefits, reinforcing the idea of neuroplasticity through regular cognitive engagement. Furthermore, Zientz et al. explored the broader impacts of SMART training, particularly its effect on neural efficiency [9]. The study found that SMART participants showed enhanced connectivity in the brain's default mode network, which is involved in spontaneous cognitive activity and higher-order reasoning. This effect was particularly notable in older adults, who also experienced improvements in attention span and cognitive flexibility.

These findings reinforce the importance of incorporating cognitive training programs like SMART into high school curricula to better prepare students for future challenges. While prior studies have focused on cognitive outcomes in adults or general educational contexts, this study adapts SMART to specifically target career decision-making among high school students in Kashmir. This application of SMART in the context of career readiness has not been fully explored in previous research, and we hope to provide new insights into how these cognitive skills can be harnessed to improve career decision-making and academic outcomes for adolescents in this region.

Theoretical framework

The theoretical framework for this study on implementing Strategic Memory Advanced Reasoning Training (SMART) for final-year high school students is grounded in cognitive and educational psychology. This framework integrates cognitive abilities, academic performance, personal development, social skills, and career decision-making theories to evaluate how the SMART program can enhance students' readiness for university and career choices [19, 25, 27, 28]. The SMART program is designed to improve cognitive functions such as memory, reasoning, and strategic thinking, which are

critical for academic success and career planning [29]. Cognitive abilities form the foundation of learning and problem-solving skills, which students need to process information, make informed decisions, and adapt to new situations [30]. The processing speed theory [31, 32] and the intelligence and education framework [33] support the importance of enhancing cognitive abilities to achieve better educational outcomes.

Improved cognitive abilities are expected to lead to better academic performance [19]. Educational research indicates the relationship between cognitive skills and academic achievements [34]. High academic performance is often associated with effective learning strategies, time management, and applying knowledge to practical scenarios [35]. Research by Yan emphasizes the role of self-regulated learning and its impact on academic success [36, 37]. The SMART program incorporates activities that foster self-regulation, improving students' educational outcomes [38].

As students develop their cognitive and academic skills, they become better equipped to make informed career choices [39]. Career decision-making involves evaluating interests, strengths, and market opportunities to select an appropriate career path [40]. Lent et al. 's social cognitive career theory and Super's Life-span, life-space approach to career development highlight the importance of cognitive and academic skills in making career decisions [41, 42].

The SMART program also aims to foster personal growth by enhancing self-awareness, goal-setting, and self-efficacy. Personal development is crucial for students to manage stress, stay motivated, and pursue lifelong learning [43]. Theories of self-determination [44] and self-efficacy provide a basis for understanding how personal development can influence students' career readiness and overall well-being [45].

Effective communication, teamwork, and empathy are essential social skills that contribute to academic and career success [46]. The SMART program includes activities designed to improve social interactions, which can help students build strong professional networks and navigate social challenges in their academic and career journeys. Deary et al. social intelligence theory and Riggio et al.'s assessment of social skills underscore the significance of these abilities in personal and professional contexts [47, 48].

Conceptual framework

Globally, teachers are encouraged to adopt theory-driven and research-supported strategies and instructional practices to improve the academic performance of high school students because they have to move to universities where they continually offer courses, resources, and tidbits to refine and enhance skills. Strategic Memory Advanced Reasoning Training (SMART) is a cognitive training program developed by scientists and researchers at the Center for Brain Health, University of Texas at Dallas. The SMART program teaches strategies to improve critical thinking abilities [19, 25, 29]. Multiple randomized trials, including in healthy adults and clinical populations, demonstrated neural, cognitive, and functional gains following SMART [49]. The manualized higher-order executive function training program consisted of 10 45-minute classroom sessions delivered over a 1.5-month. The program instructed students in metacognitive strategies and practice that fostered top-down processing via abstracting meanings from information [1]. SMART therapy program engaged students in classroom-wide discussions encouraging verbal and written expression of ideas and thought processes facilitated by the instructor's presentation of the program's open-ended questions [26].

SMART therapy and cognitive abilities

The SMART program aims to enhance cognitive abilities essential for effective learning and problem-solving [19]. Cognitive skills such as memory, reasoning, and strategic thinking are foundational for academic success and career planning. Research by Salthouse posits that faster cognitive processing speeds lead to more efficient learning and better academic outcomes [32]. Similarly, Deary et al. highlighted the importance of intelligence and education, suggesting that enhanced cognitive abilities contribute to higher educational achievements [50]. Vas et al. found significant improvements in working memory and problem-solving skills among high school students who underwent SMART training [25]. These findings support the hypothesis that SMART therapy positively influences cognitive abilities (see Fig. 1).

H1 SMART positively influences cognitive abilities.

Cognitive abilities and career decision-making

Cognitive abilities play a crucial role in career decision-making. Lent et al.'s social cognitive career theory and Super's life-span, life-space approach to career development provide a framework for understanding how enhanced cognitive and academic skills aid in making informed career choices [42, 51]. Gamino et al. demonstrated that students who received SMART training exhibited superior strategic thinking and planning skills, leading to more confident and informed career decisions [1]. These studies suggest that improved cognitive abilities directly impact students' ability to make well-informed career decisions.

H2 Cognitive abilities positively influence career decision-making.

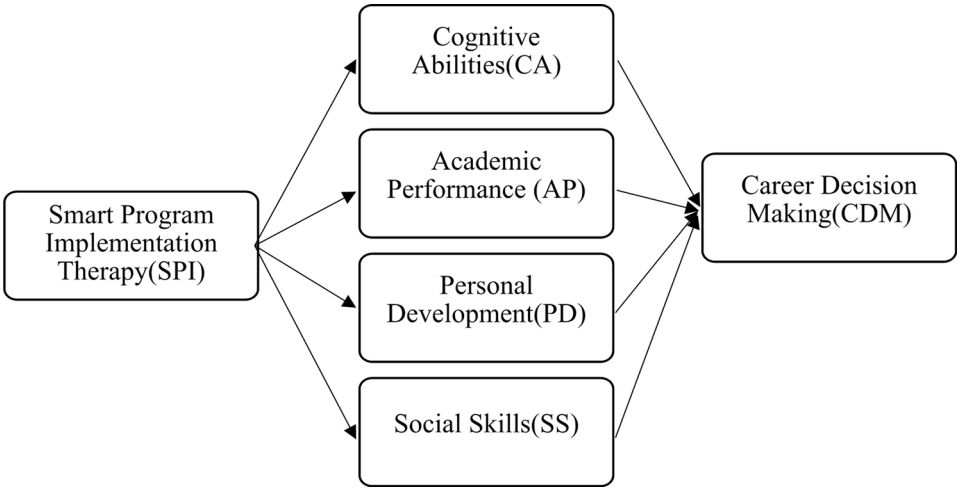

Fig. 1 Conceptual framework: The framework shows how SPI influences four key areas: Cognitive Abilities (CA), Academic Performance (AP), Personal Development (PD), and Social Skills (SS). These areas collectively contribute to enhanced Career Decision Making (CDM)

Academic performance and career decision-making

Academic performance is another critical factor influencing career decision-making. Kuh et al. and Fokkens-Bruinsma et al. emphasized the role of self-regulated learning and academic self-efficacy in achieving academic success [52, 53]. These skills help students manage their study time effectively, understand and apply lecture materials, and perform well in exams and assignments, enhancing their ability to make informed career choices. The positive correlation between academic performance and career decision-making is well-supported by empirical evidence [52].

H3 Academic performance positively influences career decision-making.

SMART therapy and academic performance

The SMART program's focus on enhancing cognitive abilities naturally extends to improving academic performance [35]. By fostering skills such as memory, reasoning, and strategic thinking, SMART therapy helps students manage their academic tasks more effectively [25, 54]. Vas et al. found that students who participated in SMART training outperformed their peers in standardized tests and critical thinking assessments [25]. It supports the hypothesis that SMART therapy positively impacts academic performance.

H4 SMART positively influences academic performance.

SMART therapy and personal development

Personal development involves stress management, goal setting, and self-motivation, which are crucial for academic and career success. Ryan and Deci's self-determination theory and Bandura's self-efficacy theory highlight the importance of these aspects in personal growth [44, 45]. SMART therapy includes activities designed to enhance these skills, helping students reflect on their strengths and weaknesses, take responsibility for their development, and pursue lifelong learning [25]. These theories provide a solid foundation for the hypothesis that SMART therapy positively influences personal development.

H5 SMART positively influences personal development.

SMART therapy and social skills

Effective communication and teamwork are essential for academic and career success. Goleman's (2006) social intelligence theory and Riggio et al. 's assessment of social skills underscore the significance of these skills [48, 55]. SMART therapy includes components that enhance social skills, such as group activities and discussions. By improving students' ability to communicate and work with others, SMART therapy supports their overall personal and professional development [56].

H6 SMART positively influences social skills.

Social skills and career decision-making

Social skills are critical in career decision-making, facilitating better networking, communication, and collaboration [38]. Improved social skills help students seek career advice, participate in group projects, and perform well in interviews, which are all important for making informed career choices [57]. The positive impact of social skills on career decision-making is supported by theories of social and emotional learning (SEL) [51, 58].

H7 Social skills positively influence career decision-making.

Personal development and career decision-making

Personal development, including self-awareness, goal setting, and stress management, is crucial for effective career planning. Ryan, Deci, and Bandura's theories suggest that proactive individuals are better equipped to make well-informed career decisions in their personal development. SMART therapy enhances these aspects, supporting students in career planning and decision-making [44, 45].

H8 Personal development positively influences career decision-making.

By integrating findings from recent studies and theoretical frameworks, this study hypothesizes that the SMART program positively influences cognitive abilities, academic performance, personal development, and social skills, enhancing career decision-making. This framework provides a comprehensive understanding of how the SMART program can enhance students' growth, ultimately leading to better career choices and preparedness for University life.

SMART therapy and career decision-making

The combined influence of enhanced cognitive abilities, improved academic performance, personal development, and social skills facilitated by SMART therapy leads to better career decision-making [25, 49, 59]. The strategic memory and reasoning skills developed through SMART therapy enable students to make more informed and confident career choices. This holistic approach aligns with the findings of Gamino et al. and Vas et al., who demonstrated the comprehensive benefits of SMART training in preparing students for higher education and career pathways [1, 25].

H9 SMART positively influences career decision-making.

By integrating findings from recent studies and theoretical frameworks, this study hypothesizes that the SMART program positively influences cognitive abilities, academic performance, personal development, and social skills, enhancing career decision-making [60].

Methodology

This study employed a quantitative approach using a survey design, with data analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM). PLS-SEM is a statistical method that allows for the examination of complex relationships between multiple variables within a theoretical framework, combining confirmatory factor analysis (CFA) with multiple linear regression [61, 62]. PLS-SEM was chosen due to its ability to handle complex models involving both reflective and formative constructs. It allows for the simultaneous use of measurement and structural models, which enhances the interpretability of data [63]. To assess these models rigorously, SmartPLS software was used, a specialized tool for PLS-SEM analysis. The choice of PLS-SEM was based on its proven effectiveness in examining complex models in educational psychology and career development research [64]. When compared to traditional statistical methods, SEM improves the precision and validity of statistical results, making it especially useful for investigating the relationships between cognitive training and career decision-making outcomes in this study.

Sample, inclusion/exclusion criteria, and sampling rationale

The study was conducted in two government high schools in the MZF district of Kashmir, purposefully selected due to their active participation in the Strategic Memory Advanced Reasoning Training (SMART) program. These schools provided an appropriate and accessible population for evaluating the program's impact on students' career decision-making. Participants were eligible if they were (a) enrolled in one of the two selected schools and (b) had completed SMART therapy training during the study period. Students who did not participate in the SMART program were absent during survey administration, or submitted incomplete responses were excluded. Of the 300 students invited, 284 returned fully completed questionnaires, yielding a 94.67% response rate. To minimize potential bias associated with purposive sampling, all students who met the inclusion criteria were invited to participate, regardless of academic stream, gender, or age. This inclusive strategy ensured diversity across demographics. The sample comprised four class sections (two from a girls' school and two from a boys' school), including students from both science and arts backgrounds, as detailed in Table 1. The final sample size aligns with methodological guidelines for structural equation modeling, which recommend 30–500 participants [65, 66]. This diversity ensures that the findings are robust and applicable across different student groups.

Table 1 Profile of respondents

Demographic	Age	Group	Therapy duration	Frequency ($n = 284$)	Percentage (%)
Girls' high school A MZF district	15–19	Arts Group	Eight weeks	35	12.32%
Girls High School B MZF district	16–20	Science Group	Eight weeks	36	12.68%
Boys' high school A MZF district	15–19	Arts Group	Eight weeks	32	11.27%
Boys' High School B MZF district	16–20	Science Group	Eight weeks	39	13.73%

Questionnaire development

To develop the questionnaire to see the impact of SMART therapy on students' career choice development and preparation for university life, the researcher conducted a thorough literature review and utilized validated constructs from existing research. The questionnaire was designed to measure six key variables: Cognitive Abilities (CA), Academic Performance (AP), Personal Development (PD), Social Skills (SS), Career Decision Making (CDM), and the implementation of the SMART program. Each variable's items were adapted from well-established sources to ensure reliability and validity. The items for Cognitive Abilities were derived from research by Salthouse focused on various cognitive processes such as understanding, retention, application, concentration, problem-solving, and critical analysis [31, 50]. Items for Academic Performance were adapted from studies by Kuh et al. and Bandura and covered aspects such as assignment completion, understanding of lecture materials, exam performance, class participation, and effective study management [53, 58, 67]. The items measuring Personal Development were based on the works of Ryan and Deci, which addressed goal setting, stress management, motivation, personal growth, and proactive learning [44]. For Social Skills, items from Goleman and Riggio focused on making friends, effective communication, social participation, conflict resolution, empathy, and maintaining long-term relationships [48, 56]. Career Decision-making items were sourced from Lent et al. and Super, which assessed career interests, research, informed choices, goal setting, seeking advice, and confidence in decision-making [40, 42]. The SMART therapy component was informed by Chapman et al., Gamino et al., Cook et al., Cook et al., and Vas et al. [1, 19, 25, 26]. The questionnaire comprised 40 statements, with each variable represented by five statements (See supplementary file). A 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was used to evaluate participants' responses. Two statistical tools, SPSS and SmartPLS (PLS-SEM), were used for data analysis. A dataset review was conducted to ensure it met measurement model specifications. Indicator loadings were examined as the first step in the evaluation process. Confirmatory factor analysis (CFA) validated the measurement model, assessing various types of validity [62]. Partial least squares structural equation modeling (PLS-SEM) was used to evaluate the proposed model, which was effective with small sample sizes and complex models [61]. Multivariate statistical analysis using PLS-SEM was conducted in two stages: first, evaluating the measurement model, and then the structural model through SmartPLS 4.0, with 10,000 bootstrap samples to ensure accuracy [68].

Therapy implementation

The Strategic Memory Advanced Reasoning Training (SMART) program was implemented over 14 weeks in two government high schools in the Kashmir district to enhance students' career choices. The therapy involved 284 high school students (both girls and boys), with sessions designed to improve cognitive abilities, academic performance, personal development, social skills, and career decision-making. The program focused on developing cognitive flexibility, strategic thinking, and reasoning skills, rather than traditional memory techniques or mnemonic devices. Key techniques used in SMART included visualization, conceptual mapping, and mental imagery, which have been shown to enhance memory retention and cognitive performance by strengthening the brain's ability to process and apply information effectively (Kosslyn, 2005). These methods were aimed at improving students' decision-making skills and their ability to think critically about their future careers. Data for the present study was collected two months after the completion of the training program, right before the University examinations, to assess the impact of the training program. The details of the therapy implementation are provided in the table below (see Table 2).

Findings of the study

A Confirmatory Factor Analysis (CFA) is the first step to test the reliability and validity of the measurement variables, laying the foundation for subsequent structural analysis. The PLS-SEM is applied to test the hypothesis after proposing the hypothesis or exploring the causal relationships between latent constructs. Internal consistency reliability was assessed using Cronbach's Alpha (CA) and Composite Reliability (CR), as previous studies indicated that CR estimates tend to produce more accurate reliability coefficients (Kalkbrenner, 2023). According to empirical evidence, CA and CR coefficients should always be greater than 0.7 for a good and reliable instrument. For the analysis of the measurement model, Hair and Alamer suggested evaluating the convergent validity, composite reliability, and the Average Variance Extracted (AVE) value [69].

Based on the analysis of Table 3; Fig. 2 provided, the results indicate strong reliability and validity of the constructs used in this study. The table shows that all Cronbach's Alpha (CA) and Composite Reliability (CR) coefficients exceed the recommended threshold of 0.70, demonstrating high internal consistency reliability [70]. Specifically, the CA coefficients range from 0.888 to 0.930, and the CR coefficients range from 0.914 to 0.942, indicating reliable measurements across all constructs. The Average Variance Extracted (AVE) values for each construct also meet the minimum acceptable threshold of 0.50, confirming convergent validity [70]. The AVE

Table 2 Weekly session plan for the SMART program

Week	Focus Area	Activities and Goals	Description
Week 1	Introduction and Memory Techniques	Introduction to the SMART program, its benefits, and objectives. - Teaching memory techniques such as mnemonic strategies (e.g., chunking, visualization) and mental imagery. - Interactive memory games to practice these techniques.	Students were introduced to the SMART program and its objectives. The focus was on enhancing cognitive abilities through visualization, conceptual mapping, and mental imagery. Along with that memory techniques like mnemonics (e.g., chunking, association) and visualization were also taught. Strategies such as making connections, mnemonics, chunking and so on are widely used in educational practices (Koeckeritz, Hopkins, & Alison, 2004). These techniques have been shown to improve cognitive performance by enhancing working memory and learning efficiency (Bellezza, 1981). Additionally, students participated in interactive memory games to practice these methods.
Week 2	Enhancing Working Memory	Working memory exercises and group activities. - Introducing career exploration tools and resources.	Exercises aimed at enhancing working memory were conducted. Students practiced techniques such as visualization (Kosslyn, 2005) to reinforce their memory and reasoning abilities. These activities were supplemented by career exploration tools and resources, which facilitated students' career decision-making processes.
Week 3	Developing Reasoning Skills	Introduction to reasoning (deductive and inductive). - Logic puzzles and brainteasers conducted. - Group discussions on problem-solving strategies.	Students were taught reasoning techniques, including deductive and inductive reasoning, and engaged in logic puzzles and brainteasers. These exercises are designed to improve cognitive flexibility and problem-solving abilities (Bellezza, 1981), facilitating better decision-making and strategic thinking.
Week 4	Critical Thinking	**Critical Thinking Exercises** - Conducting critical thinking exercises, debates, case studies, and career aptitude tests.	Critical thinking exercises were introduced, alongside debates and case studies to stimulate problem-solving and analytical thinking. Career aptitude tests and interest inventories were administered to aid students in understanding their career paths.
Week 5	Strategic Planning	Goal-setting workshops, teaching planning and organizational skills. - Conducting decision-making simulations related to career choices.Goal-setting workshops, teaching planning and organizational skills. - Conducting decision-making simulations related to career choices.	Goal-setting and **decision-making simulations** were conducted. Through this approach, students practiced **strategic planning** and **organization** skills, which are essential for making informed career decisions. This reinforced their cognitive and strategic thinking.
Week 6	Integration and Application	Applying learned skills to real-world scenarios. - Conducting mock career counseling sessions and providing individual coaching.	Students applied learned skills to real-world scenarios, participated in mock career counseling sessions, and received individual coaching. This helped to reinforce the integration of **critical thinking** and **career decision-making** skills.
Week 7	Review and Practice	Reviewing key concepts and conducting practice sessions with feedback. - Preparing for final assessments.	Key concepts were reviewed, and students participated in practice sessions with feedback. This process helped reinforce the techniques and knowledge acquired throughout the program.
Week 8	Final Assessment and Feedback	Conducting post-training assessments to evaluate the program's impact. - Feedback session and discussion on next steps for students.	Post-training assessments evaluated the program's impact, followed by a feedback session where students discussed their progress and next steps for career planning.

values in this study range from 0.620 to 0.643. Additionally, the Variance Inflation Factor (VIF) values used to assess multicollinearity were below the critical value of 5, with the highest VIF value being 2.780. It indicates no significant multicollinearity problem in the model [71].

The path analysis model shows that all measurement items have factor loadings higher than 0.50, which is the acceptable threshold for retaining measurement items in the model [72]. The factor loadings for the constructs range as follows: Academic Performance (AP) from 0.783 to 0.807, Cognitive Abilities (CA) from 0.701 to 0.758, Career Decision Making (CDM) from 0.761 to 0.840, Personal Development (PD) from 0.760 to 0.835, Smart Program Implementation (SPI) from 0.777 to 0.816, and Social Skills (SS) from 0.759 to 0.798. These loadings indicate strong correlations between the indicators and their respective constructs.

The Heterotrait-Monotrait (HTMT) technique was employed to assess the discriminant validity of the constructs in the model. According to Henseler et al., an HTMT ratio of less than 0.85 (strict) or less than 0.90 (acceptable) indicates adequate discriminant validity [73]. Table 4 displays the HTMT values for the constructs:

All HTMT values are below the acceptable threshold of 0.90, confirming that discriminant validity is established for all constructs. The Fornell-Larcker criterion was also used to assess discriminant validity. This criterion requires that each construct's square root of the Average Variance Extracted (AVE) be greater than its highest

Table 3 Factors loading and assessment of the indicators

Indicators	Factor Loading	VIF	Cronbach's Alpha	CR	AVE	Source
AP.2	0.807	2.075	0.888	0.914	0.641	Kuh et al. (2006) and Zimmerman & Schunk (2013)
AP.3	0.783	1.915				
AP.4	0.819	2.122				
AP.5	0.800	1.950				
AP.6	0.803	2.063				
AP.7	0.790	1.881				
CA.1	0.710	1.994	0.900	0.915	0.620	Salthouse (1996) and Deary (2020)
CA.10	0.719	2.415				
CA.2	0.732	1.963				
CA.3	0.686	1.896				
CA.4	0.758	2.397				
CA.5	0.718	2.404				
CA.6	0.701	2.020				
CA.7	0.737	2.136				
CA.8	0.720	2.125				
CA.9	0.719	1.971				
CDM.1	0.797	2.270	0.930	0.942	0.643	Lent and Brown (2020) and Super (2020)
CDM.2	0.761	1.970				
CDM.3	0.799	2.317				
CDM.4	0.821	2.528				
CDM.5	0.840	2.780				
CDM.6	0.783	2.152				
CDM.7	0.791	2.155				
CDM.8	0.831	2.622				
CDM.9	0.788	2.170				
PD.1	0.781	1.927	0.885	0.913	0.636	Ryan and Deci (2022) and Bandura et al. (2023)
PD.2	0.835	2.308				
PD.3	0.788	1.958				
PD.4	0.823	2.303				
PD.5	0.760	1.857				
PD.6	0.795	1.955				
SP1.1	0.777	2.177	0.942	0.950	0.635	Chapman et al. 2015; Gamino et al. 2022; Cook et al. 2014; Cook et al. 2020; Vas et al. 2015
SPI.10	0.797	2.376				
SPI.11	0.786	2.362				
SPI.2	0.778	2.368				
SPI.3	0.790	2.445				
SPI.4	0.794	2.375				
SPI.5	0.806	2.567				
SPI.6	0.816	2.698				
SPI.7	0.813	2.772				
SPI.8	0.801	2.513				
SPI.9	0.801	2.520				
SS.1	0.781	2.127	0.923	0.936	0.618	Goleman (2006) and Riggio (1986)
SS.2	0.798	2.389				
SS.3	0.791	2.123				
SS.4	0.799	2.256				
SS.5	0.759	1.972				
SS.6	0.796	2.308				
SS.7	0.787	2.180				

Table 3 (continued)

Indicators	Factor Loading	VIF	Cronbach's Alpha	CR	AVE	Source
SS.8	0.785	2.130				
SS.9	0.776	2.083				

Note AP: Academic Performance, CA: Cognitive Abilities: Career Decision Making: Personal Developments: Smart Program Implementation Therapy, SS: Social Skills
VIF variance inflation factor, CA Cronbachs alpha, CR composite reliability, AVE average variance extracted

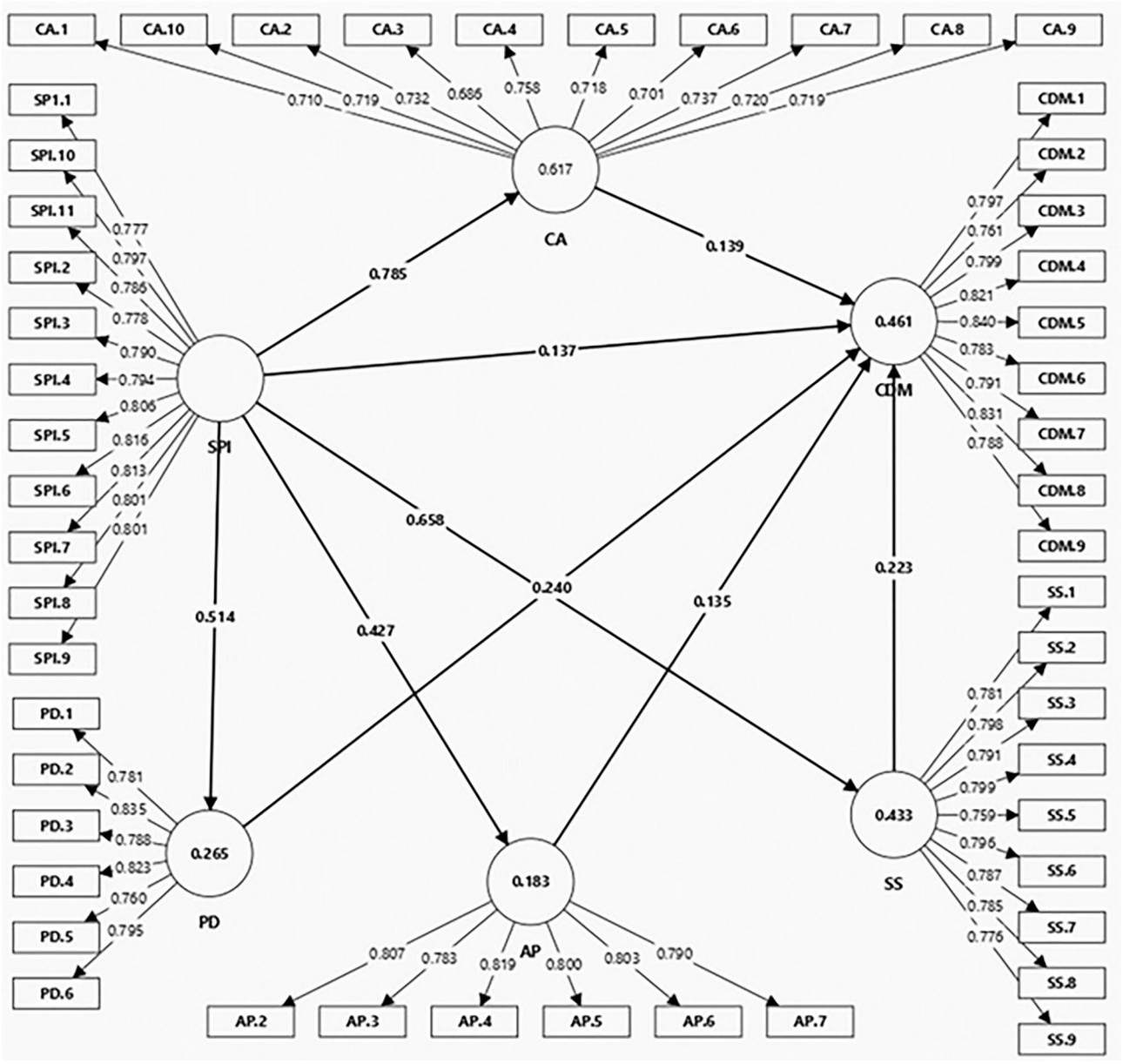

Fig. 2 Measurement (path analysis) model

correlation with any other construct. Table 5 presents the Fornell-Larcker criterion values:

The diagonal values in Table 4 represent each construct's square root of the AVE. These values are more significant than the corresponding off-diagonal correlations, further supporting the discriminant validity of the constructs.

After confirming the validity and reliability of the measurement model through the HTMT ratio and Fornell-Larcker criterion, the next stage involved developing the structural model, exploring possible relationships, and

Table 4 Discriminant validity assessment through Heterotrait-Monotrait (HTMT) ratio

	AP	CA	CDM	PD	SPI	SS
AP						
CA	0.450					
CDM	0.454	0.574				
PD	0.357	0.540	0.575			
SPI	0.466	0.787	0.609	0.561		
SS	0.422	0.598	0.600	0.517	0.702	

Note AP: Academic Performance, CA: Cognitive Abilities: Career Decision Making: Personal Developments: Smart Program Implementation Therapy, SS: Social Skills

Table 5 Discriminant validity through Fornell-Larcker criterion

	AP	CA	CDM	PD	SPI	SS
AP	0.800					
CA	0.418	0.787				
CDM	0.414	0.551	0.802			
PD	0.319	0.495	0.526	0.797		
SPI	0.427	0.785	0.574	0.514	0.797	
SS	0.383	0.578	0.557	0.469	0.658	0.786

Note The diagonal values represent the square root of AVE for each construct; off-diagonal values are inter-construct correlations. Discriminant validity is confirmed when the √AVE is greater than corresponding inter-construct correlations. AP: Academic Performance, CA: Cognitive Abilities: Career Decision Making: Personal Developments: Smart Program Implementation Therapy, SS: Social Skills

testing the hypotheses. By ensuring that both HTMT values and Fornell-Larcker criteria meet the necessary thresholds, the discriminant validity of the constructs in the model is confirmed. This validation process is crucial before proceeding to the structural model analysis, which investigates the causal relationships among the constructs.

Structural model

Table 6 presents the results of the hypothesis testing through path analysis, including path coefficients (β), T values, P values, effect sizes (f2), and confidence intervals (2.5% CI and 97.5% CI). Each hypothesis was evaluated to determine the impact of various factors on Career Decision Making (CDM) and other related constructs. For H1, it was found that Academic Performance (AP) positively impacts Career Decision Making (CDM) with a significant path coefficient (β = 0.135, t = 4.664, $p < 0.000$) and a small effect size (f2 = 0.026). The confidence interval (CI) ranges from 0.078 to 0.190, leading to the acceptance of H1. H2 hypothesized that Cognitive Abilities (CA) would positively impact CDM. However, the path coefficient (β = 0.139, t = 1.920, $p = 0.055$) was not significant, and the effect size (f2 = 0.013) was small, with a confidence interval that included zero (-0.002 to 0.282), resulting in the rejection of H2. For H3, Personal Development (PD) was found to have a significant positive impact on CDM (β = 0.240, t = 4.523, $p < 0.000$) with a moderate effect size (f2 = 0.073) and a CI ranging from 0.137 to 0.343, leading to the acceptance of H3. H4 posited that Smart Program Implementation Therapy (SPI) would positively impact Academic Performance (AP). It was supported by a significant path coefficient (β = 0.427, t = 12.150, $p < 0.000$), a large effect size (f2 = 0.224), and a CI from 0.360 to 0.496, leading to the acceptance of H4. For H5, SPI was also found to have a significant positive impact on Cognitive Abilities (CA) with a very strong path coefficient (β = 0.785, t = 44.231, $p < 0.000$), a large effect size (f2 = 1.609), and a CI from 0.752 to 0.821, resulting in the acceptance of H5. H6 hypothesized that SPI would positively impact CDM. However, the path coefficient (β = 0.137, t = 1.946, $p = 0.052$) was not significant, and the effect size (f2 = 0.011) was small, with a CI including zero (-0.005 to 0.270), leading to the rejection of H6. H7 found that SPI positively impacts Personal Development (PD) with a significant path coefficient (β = 0.514, t = 11.902, $p < 0.000$), a large effect size (f2 = 0.360), and a CI from 0.431 to 0.598, leading to the acceptance of H7. H8 showed that SPI positively impacts Social Skills (SS) with a significant path coefficient (β = 0.658, t = 19.313, $p < 0.000$), a large effect size (f2 = 0.763), and a CI from 0.589 to 0.725, leading to the acceptance of H8. Lastly, H9 hypothesized that SS would positively impact CDM. It was supported by a significant path coefficient (β = 0.223, t = 3.820, $p < 0.000$), a small effect size (f2 = 0.049), and a CI from 0.111 to 0.341, resulting in the acceptance of H9.

Table 6 Hypothesis testing through path analysis

Hypotheses	Parameter	Path Coefficients (β)	T Values	*P* values	Effect Size (f2)	2.5% CI	97.5% CI	Decision
H1	AP > CDM	0.135	4.664	0.000	0.026	0.078	0.190	Accepted
H2	CA > CDM	0.139	1.920	0.055	0.013	-0.002	0.282	Rejected
H3	PD > CDM	0.240	4.523	0.000	0.073	0.137	0.343	Accepted
H4	SPI > AP	0.427	12.150	0.000	0.224	0.360	0.496	Accepted
H5	SPI > CA	0.785	44.231	0.000	1.609	0.752	0.821	Accepted
H6	SPI > CDM	0.137	1.946	0.052	0.011	-0.005	0.270	Rejected
H7	SPI > PD	0.514	11.902	0.000	0.360	0.431	0.598	Accepted
H8	SPI > SS	0.658	19.313	0.000	0.763	0.589	0.725	Accepted
H9	SS > CDM	0.223	3.820	0.000	0.049	0.111	0.341	Accepted

Note AP: Academic Performance, CA: Cognitive Abilities: Career Decision Making: Personal Developments: Smart Program Implementation Therapy, SS: Social Skills

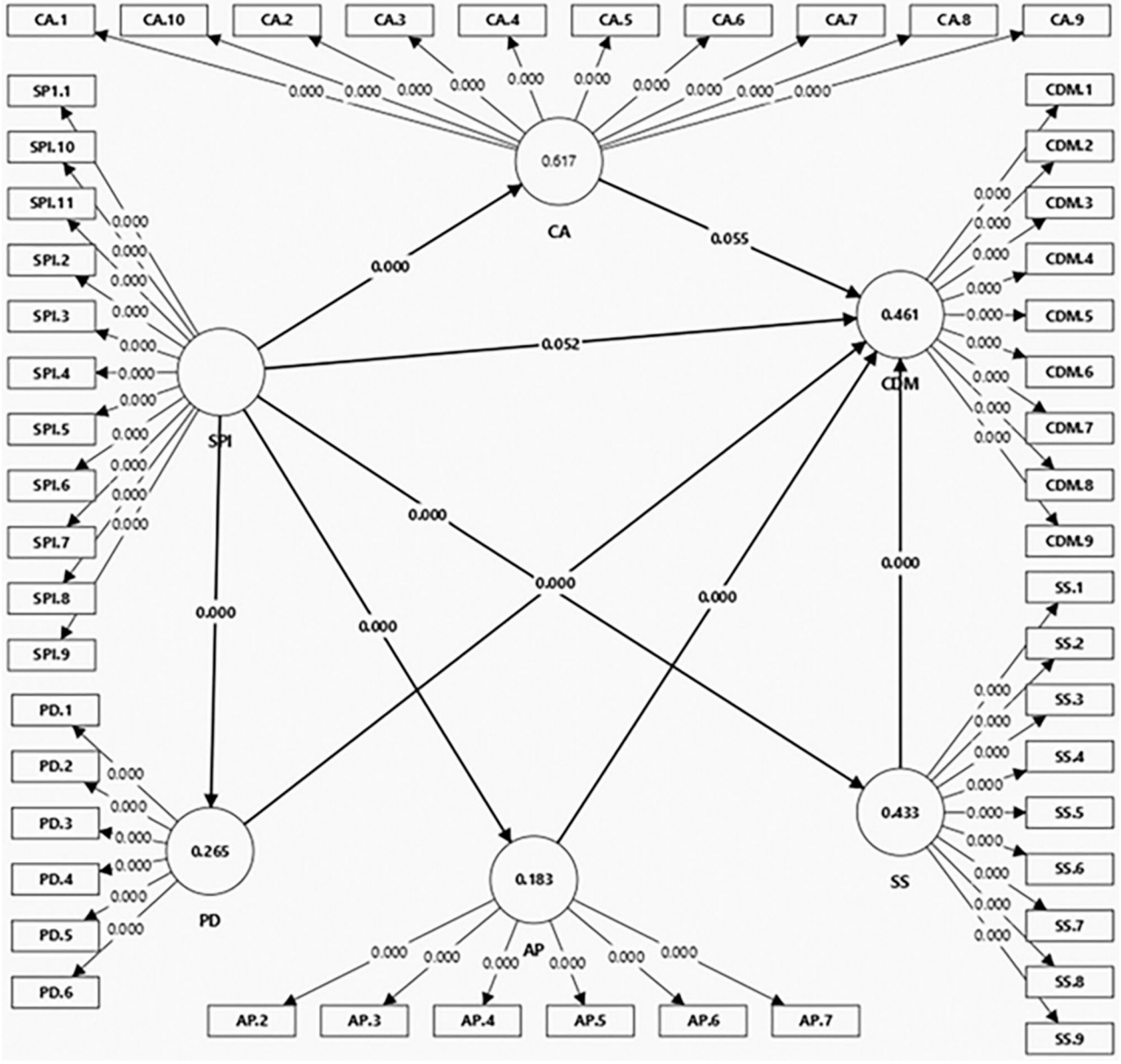

Fig. 3 Bootstrap image for path analysis

Table 7 Goodness of fit indices

Fit Indices	Estimated Model
SRMR	0.069
X^2 (Chi-square)	3478.314
NFI	0.915

Note SRMR standardized root mean square residual, X2 chi-square, NFI Normed Fit Index, EM estimated. Model

The path analysis and model fit assessment for this study are illustrated in Fig. 3; Table 7, respectively. The structural relationships between the constructs are depicted, showcasing the significance of each hypothesized path. The constructs include Academic Performance (AP), Cognitive Abilities (CA), Career Decision Making (CDM), Personal Development (PD), Smart Program Implementation Therapy (SPI), and Social Skills (SS). The path analysis revealed that AP positively impacts CDM ($\beta = 0.135$, $t = 4.664$, $p < 0.000$), PD positively impacts CDM ($\beta = 0.240$, $t = 4.523$, $p < 0.000$), SPI positively impacts AP ($\beta = 0.427$, $t = 12.150$, $p < 0.000$), CA ($\beta = 0.785$, $t = 44.231$, $p < 0.000$), PD ($\beta = 0.514$, $t = 11.902$, $p < 0.000$), and SS ($\beta = 0.658$, $t = 19.313$, $p < 0.000$), and SS positively impacts CDM ($\beta = 0.223$, $t = 3.820$, $p < 0.000$). However, CA does not significantly impact CDM ($\beta = 0.139$, $t = 1.920$, $p = 0.055$), and SPI does not significantly impact CDM ($\beta = 0.137$, $t = 1.946$, $p = 0.052$). The model's fit was evaluated using several

goodness-of-fit indices: Standardized Root Mean Square Residual (SRMR), Chi-square (X^2), and Normed Fit Index (NFI). The results showed SRMR = 0.069, X^2 (Chi-square) = 3478.314, and NFI = 0.915. These indices indicate a good fit of the model, with the SRMR value below the recommended threshold of 0.08 and the NFI value exceeding 0.90. Although the Chi-square value is significant, this is expected with large sample sizes. The model demonstrates adequate fit, supporting most hypotheses, except for the non-significant paths from CA to CDM and SPI to CDM. It suggests that while cognitive abilities and SPI directly affect several constructs, their impact on career decision-making may be mediated by other factors.

Discussion

The present study explored the effectiveness of Strategic Memory Advanced Reasoning Training (SMART) therapy for high school students and its potential to support their transition to university. Nine hypotheses were developed to examine the impact of SMART therapy on enhancing final-year high school students' career choices. The findings revealed significant insights into the benefits of SMART therapy in various educational contexts while highlighting areas where the expected outcomes were not fully realized. SMART therapy has extensively trained teachers and students in diverse scenarios. Previous research has demonstrated that SMART significantly improves gist reasoning, working memory, and executive functions in adults with traumatic brain injury (TBI), highlighting its potential benefits for cognitive control and decision-making processes [25].

Additionally, SMART has shown improvements in executive function, memory, and daily functioning, indicating a broad impact on higher-order cognitive skills [25]. These findings align with our study, where SMART therapy positively influenced cognitive abilities and academic performance. The hypothesis that SMART therapy would positively impact cognitive abilities and career decision-making was supported. The results indicated a strong positive impact of SMART on cognitive abilities, consistent with the processing speed theory and the intelligence and education framework, emphasizing the importance of cognitive enhancements for better educational outcomes [32, 50]. However, the hypothesis that cognitive abilities would directly influence career decision-making was not supported. It suggests that while SMART therapy enhances cognitive abilities, these improvements alone may not be sufficient to impact career decision-making directly. This outcome could be attributed to the complexity of career decision-making involving cognitive skills and emotional and social factors, as highlighted by Lent et al.s' social cognitive career theory and Super's life-span, life-space approach to career development [41, 42]. The hypothesis that SMART therapy would positively influence career decision-making through its impact on academic performance was supported, demonstrating that improved academic performance provides a solid foundation for making better career decisions. This finding aligns with research indicating that enhanced academic performance through improved cognitive functions is crucial for effective learning and problem-solving [74]. Kuh et al. and Zimmerman & Schunk also support the idea that self-regulated learning and academic achievements are interlinked, providing a basis for informed career choices [53, 67]. Personal development was another area hypothesized to be positively influenced by SMART therapy, which would enhance career decision-making. The results supported the positive impact of SMART on personal development and the subsequent positive effect of personal development on career decision-making. These findings are consistent with theories of self-determination and self-efficacy, which emphasize the importance of personal growth and self-awareness in managing stress, staying motivated, and making informed career choices [44, 45].

The hypothesis that SMART therapy would positively impact social skills was also supported. Improved social skills are crucial for networking, interviewing, and career advancement [75]. The subsequent hypothesis was confirmed that enhanced social skills would positively influence career decision-making. These results underscore the significance of effective communication, teamwork, and empathy in academic and professional contexts, aligning with Goleman's social intelligence theory and Riggio's social skills assessment [48, 56, 76]. However, the hypothesis that SMART therapy would directly influence career decision-making was not supported. This finding suggests that while SMART therapy enhances several critical skills, the direct pathway from SMART to career decision-making might be mediated by other factors such as cognitive abilities, academic performance, personal development, and social skills. In the Pakistani context, the cultural and educational environment may play a role in this outcome. Students often face external pressures and expectations from family and society regarding their career choices, which can overshadow their cognitive and personal development gains from SMART therapy [8].

By incorporating the findings of this study into the broader context of cognitive and educational psychology, it becomes evident that the SMART therapy program is highly beneficial in enhancing the cognitive and social skills necessary for students' academic and career success. However, the direct impact on career decision-making may require additional support mechanisms, especially in contexts where external pressures significantly influence student choices. The findings of this

study show that SMART therapy significantly enhances cognitive abilities, academic performance, personal development, and social skills. These improvements collectively contribute to better career decision-making among final-year high school students. However, further exploration is needed to understand the direct impact of SMART on career decision-making within Pakistan's cultural and educational context. Integrating cognitive training programs like SMART into high school curricula is essential for preparing students for future challenges and career opportunities. When high school students are well-prepared for their career choices, they are more likely to flourish and be productive in their desired fields at University [77]. This preparedness enhances individual success and contributes to the broader educational and professional landscape. Career development is a crucial focus of the Sustainable Development Goals (SDGs), particularly Goal 4: Quality Education. Goal 4 ensures inclusive and equitable education and promotes lifelong learning opportunities. By aligning with this goal, SMART therapy supports the development of essential skills that enable students to make informed career choices, ultimately contributing to sustainable economic growth and personal fulfilment. The emphasis on career readiness within the educational framework helps students transition smoothly from high school to University, fostering an environment where they can achieve their full potential and contribute meaningfully to society.

Conclusion

This study demonstrates the effectiveness of Strategic Memory Advanced Reasoning Training (SMART) in preparing final-year high school students for University and future careers. The findings reveal that SMART therapy significantly enhances cognitive abilities, academic performance, personal development, and social skills, collectively contributing to better career decision-making. By improving these critical areas, SMART therapy helps students make informed career choices and succeed academically. The positive impact of SMART therapy on cognitive abilities aligns with the processing speed theory of Salthouse, 1996 and the intelligence and education framework of Deary & Johnson, emphasizing the importance of cognitive enhancement for educational success [32, 50]. Improved cognitive abilities lead to better academic performance, as Kuh et al. and Zimmerman & Schunk documented [53, 67]. Enhanced academic performance provides a solid foundation for making better career decisions, aligning with the social cognitive career theory and Super's life-span, life-space approach to career development. Personal development, supported by self-determination theories and self-efficacy, is crucial for managing stress, staying motivated, and making informed career choices. SMART therapy's positive impact on social skills, essential for networking, interviewing, and career advancement, aligns with Goleman's social intelligence theory and Riggio's social skills assessment. These findings underscore the multifaceted benefits of SMART therapy in preparing students for future challenges [48, 55]. However, the direct influence of cognitive abilities and SMART therapy on career decision-making was not supported, suggesting that social and emotional factors play a significant role in career decision-making. In the Pakistani context, external pressures and expectations from family and society regarding career choices may overshadow the cognitive and personal development gains from SMART therapy [8]. It highlights the need for a more holistic approach considering these social factors. To address these findings, it is recommended that educational institutions in Pakistan and similar contexts incorporate SMART therapy into their curricula to better prepare students for future challenges and career opportunities. It aligns with Sustainable Development Goal 4: Quality Education, which promotes lifelong learning opportunities. Integrating cognitive training programs like SMART can help students flourish in their chosen fields at University and become more productive members of society.

The present study has several limitations. One major limitation is the exclusive use of self-reported questionnaires, which can introduce response bias, social desirability effects, and limited objectivity. Participants may have responded in ways they perceived as favourable rather than providing entirely accurate reflections of their experiences, particularly in areas such as personal development and social skills. Moreover, self-reported responses rely heavily on memory recall and introspective accuracy, both of which may vary among participants and affect the precision of the data collected. Future research should address this limitation by using mixed methods, such as qualitative interviews, classroom observations, or performance assessments to triangulate the data and improve the validity of the findings. Additionally, the study was conducted in only two schools within the MZF district of Kashmir, which limits its generalizability to other regions. Broader sampling across multiple districts and school types would strengthen external validity. The study also does not explore in depth the emotional and social dynamics that may influence students' decision-making. Including such variables could provide a more holistic understanding of how SMART therapy contributes to student outcomes.

Supplementary Information

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Supplementary Material 1

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Author contributions
NR: made significant contributions to the conception and design of the study, writing, data collection, analysis, and interpretation. XH: provided valuable insights into the theoretical framework conceptualization, resources, supervision, validation, and proofreading AM: Data collection and analysis, writing, review, and editing 4- NZ review and editing. All authors read and approved the final manuscript.

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Data availability
The data supporting this study's findings are not publicly available due to confidentiality and privacy concerns. The data contain information that could compromise the privacy of research participants. For inquiries about the study, please contact the corresponding author.

Declarations

Ethics approval and consent to participate
This study received ethics approval (Approval No: ZSRT2024203) from the Human Experiment Ethics Committee at Zhejiang Normal University. This study was conducted in accordance with the principles outlined in the Declaration of Helsinki. All participants were informed about the purpose of the study and the confidentiality of their personal information. Written informed consent was obtained from each participant before their involvement in the research. Participants were assured that their participation was voluntary and that they had the right to withdraw from the study at any time without any consequences. All data collected for this study were anonymized and securely stored to protect participants' privacy. The research team adhered to the ethical guidelines and principles set forth by Zhejiang Normal University throughout the study to ensure the responsible and respectful treatment of all participants involved.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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