Harmonizing Team Dynamics and Personality Strengths in Effectively Managing a Large Educational STEM Program

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Abstract

It has been argued that technical competence and leadership alone are not keys to project success outcomes; team dynamics and personality composition are other indicators that synergistically affect project outcomes. This paper explores the effective management of a large educational STEM program that includes multi-departmental projects by harmonizing team dynamics and personality strengths. In this study, the team members' personalities were assessed using an impartial personality evaluation tool that employs the Myers-Briggs Type Indicator (MBTI). This study further examines the team's dynamics under the spectrum of the members' perspectives, exploring how the team utilizes personality traits and team dynamics to effectively administer a sizable STEM program. The team effectiveness was evaluated by adopting a tested and validated team effectiveness survey. All instruments were sent to participants electronically. The retrieved data was cleaned and analyzed using the Statistical Package of Social Scientists (IBM SPSS 25.0). The study found that the team had six (6) unique personalities which were predominantly assertive and less turbulent. The findings show that employing team personalities dynamics in workload distribution and assignments led to successful program outcomes during the past four years, especially in achieving an overall team effectiveness rating of 87% and a strong team culture and cohesion. The study shows that blending team dynamics and personalities enhances teamwork in large STEM programs, achieving high effectiveness and fosters the achievement of set goals.

Introduction

Efficiently managing large educational STEM programs, particularly interdisciplinary projects, requires a harmonious blend of team dynamics and individual personality strengths [1]. These projects bring together experts from divergent disciplines to collaborate towards common goals, making the team set up a critical determinant of success. While much attention has been given to factors like team composition, size, and tenure, the impact of team members' personality traits on overall team effectiveness remains unexplored.

Interdisciplinary Science, Technology, Engineering, and Mathematics (STEM) projects involve collaboration across multiple disciplines to address complex problems. They integrate knowledge from various fields, including biology, physics, computer science, and engineering. These projects often lead to innovative solutions and breakthrough discoveries that are applicable to real-world issues like engineering education and environmental sustainability. However, challenges include communication barriers, integrating methods and theories, building team dynamics, and assessing the interdisciplinary nature of these projects.

Individual personality strengths are crucial in shaping team dynamics and influencing how team members interact, collaborate, and perform. Gabriel [2] conducted studies that illuminated how personality traits define team members' roles within a group. For instance, extraversion is associated with the "Driving Onward" function, while intuition contradicts sensing in this role. Similarly, the "Planning Ahead" role aligns with the judging function, while the perceiving function opposes it. However, introversion, feeling, and thinking do not exhibit explicit associations with specific roles, suggesting the complexity of team personality dynamics. Despite these insights, there remains a lack of understanding of the direct influence of team personality on effectiveness and success.

This study attempts to provide evidence by investigating the relationship between team personalities and performance within an interdisciplinary research group at a historically black college and university (HBCU). This group, operational for over four years, focuses on hands-on teaching interventions to enhance African American students' motivation and academic achievement across seven STEM disciplines. With approximately 200 tasks and 40 personnel, the program is a fitting backdrop to explore the intricate interplay between leadership, team dynamics, and personality strengths in achieving educational goals.

Conceptual Framework

A management function termed leadership is the burden of exerting influence, motivation, and guidance over individuals or groups to accomplish shared goals or objectives [3]. Leadership plays a significant role in enhancing the efficiency and achievements of a team [4]. Central to leadership is the "personality" of both the team leader and the team members. Effective collaboration among individuals with different personalities is essential for achieving large-scale educational initiatives, particularly in STEM [5]. A robust framework is necessary to manage large multi-departmental STEM projects effectively, enabling the leader to harmonize team dynamics and leverage individual strengths.

The Myers-Briggs Type Indicator (MBTI) theory categorizes individuals into four distinct dichotomies based on their preferences in attitude, perceiving function, decision-making, and lifestyle [6]. These dichotomies are mutually exclusive, meaning a person in one bracket cannot belong to another. The theory identifies 16 personality types with dominant, auxiliary, tertiary, and inferior functions. It suggests archetypes, suitable careers for each type, and strategies for understanding team members' preferences and tailoring communication and collaboration strategies. This model offers users insights into their personality preferences and psychological type and incorporates an additional letter to accommodate five scales instead of four [12]. The model evaluates five personality dimensions, each representing opposite ends of a spectrum: (1) Energy: the interaction with the surrounding environment (Extraverted(E)/Introverted(I)); (2) Mind: the perception and processing of the world (Intuitive(N)/Observant(S)); (3) The process of making decisions and reacting to emotions (Thinking(T)/Feeling(F)); (4) Tactics: the approach to work, planning, and decision-making (Judging(J)/Prospecting(P)); and (5) Identity: the level of confidence in abilities and decisions (Assertive(A)/Turbulent(T)).

This paper explores a conceptual framework (Figure 1) that aims to achieve essential coordination among heterogeneous personalities by examining the Myers-Briggs Type Indicator (MBTI) theory and essential leadership skills and experiences. Effective leadership in this context involves implementing transformational leadership styles while remaining adaptable to varying circumstances. Leaders must understand team dynamics and individual personality strengths to facilitate goal setting and task allocation. By leveraging each team member's unique assets, leaders can enhance team performance and foster a culture of collaboration, candid feedback, and open communication.

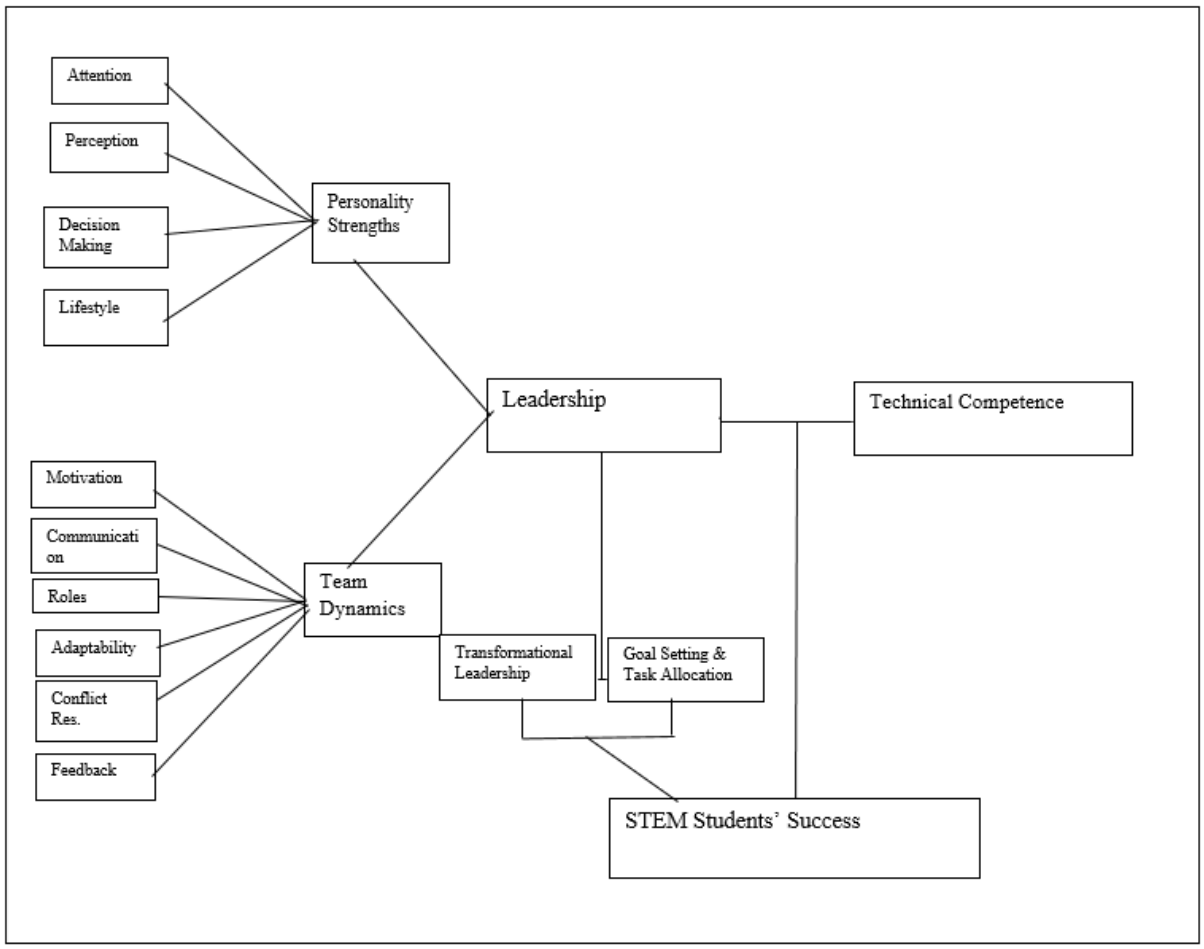

Figure 1: Conceptual framework

Team Dynamics Components

Communication Styles: Within a team, personality factors can greatly impact communication. Extraverted people, for instance, are typically more outgoing and assertive; they often take the initiative in group conversations and speak honestly about their opinions [7]. On the other hand, introverted people would rather listen intently and participate more slowly, which could result in quieter but equally important contributions to group conversations [8].

Leadership Roles: Effective leadership is associated with personality traits such as extraversion, conscientiousness, and emotional stability [9]. Individuals with these qualities might evolve into team leaders by default, influencing decision-making, giving guidance, and creating a supportive atmosphere.

Each member's unique personality strengths can influence conflict resolution within a team. According to [10], those with a high level of agreeableness would emphasize upholding harmony and actively seek compromise when faced with conflicts. On the other hand, people who rate lower agreeableness levels could be more outspoken in promoting their own opinions, which could result in more heated but constructive discussions.

Task Allocation: A team's task distribution strategy may consider members' individual skills. For instance, strong organizational abilities and an eye for detail can help someone succeed at tasks requiring accuracy and diligence. In contrast, innovative and creative thinking may help someone contribute more successfully to brainstorming and problem-solving tasks [10].

Team Cohesion: The combined effect of the individual strengths in a team may influence the team's cohesiveness. When properly managed, teams with various personality traits can gain from complementary abilities and perspectives, improving team performance, creativity, and innovation [11].

Motivation: This encompasses intrinsic and extrinsic factors that drive individual team members to achieve their goals, exert effort, and persist in facing challenges. Teams with high motivation typically exhibit greater performance, productivity, and cohesion, functioning as unified entities.

Effective feedback mechanisms enable the reciprocal exchange of constructive observations and insights to improve individual and group performance. Timely, specific, and candid feedback enhances competencies, behaviors, and outcomes.

Methodology

The present study adopted a quantitative design to investigate the team's personality dynamics as well as the team effectiveness. Adopting a tested and modified National Evaluation Research Institute Scale (NERIS) model, an online assessment instrument and platform that employs the Myers-Briggs Type Indicator (MBTI), the team personality characteristics were evaluated as a framework for understanding the personality traits of team members.

Figure 2 (with Figures 2a, and 2b decomposing the left and right arm of Figure 2), presents these categories, descriptions, and spectrum identity labels. Moreover, each personality type is further classified into one of four role layers, namely Analysts (Intuitive and Thinking [NT]), Diplomats (Intuitive and Feeling [NF]), Sentinels (Observant and Judging [S_J]), and Explorers (Observant and Prospecting [S_P]), based on their dominant preferences and characteristics. A total of 93 7-point Likert scaled questions ranging from agree to disagree were used to evaluate the

personalities of the team. To avoid scoring bias, the test was conducted via the web-portal which is graded to define the category each test takers belongs. The present study adopted the team effectiveness instrument developed by Sharif and Nahas [13] to evaluate the multi-disciplinary team effectiveness. The present study focused on six (6) constructs that measure team's effectiveness, which are: (1) clear purpose, (2) distinct roles, (3) suitable leadership, (4) cohesion and trust, (5) communication, (6) decision making, and (6) social relationships, The data collection tool was distributed electronically, the team effectiveness audit tool, and follow-up emails were also sent to improve response rates. Data collection took place during the project's final year. The quantitative data analysis was done using IBM SPSS Statistics (25.0), Results were presented using simple percentages and frequency. Bar chart and pie charts were also employed to visualize the distribution of the data collected.

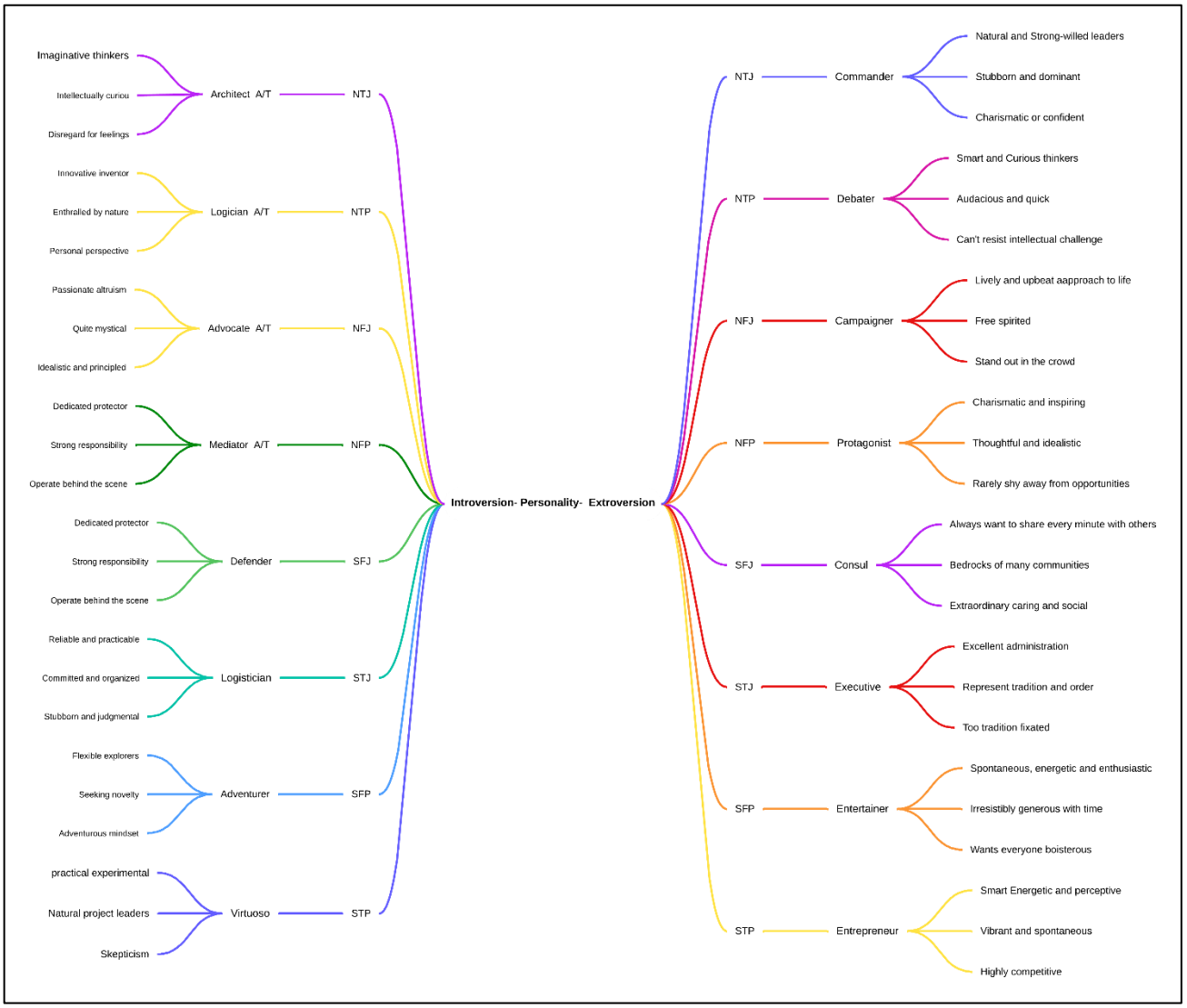

Figure 2: The broad spectrum of personality traits (introversion and extraversion), their roles and characteristics.

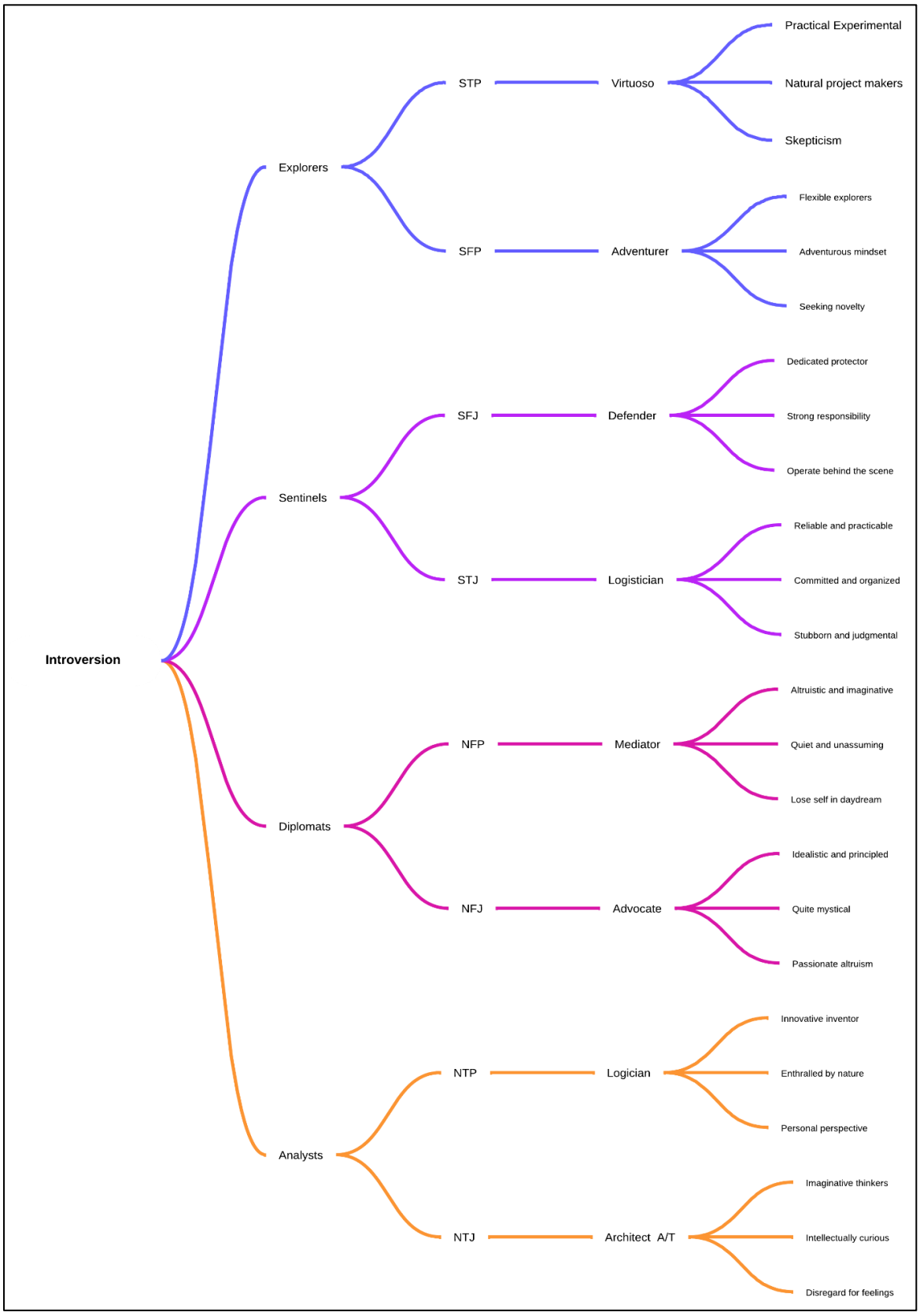

Figure 2a: Showing the broad Introversion spectrum of personality traits, their roles, and characteristics.

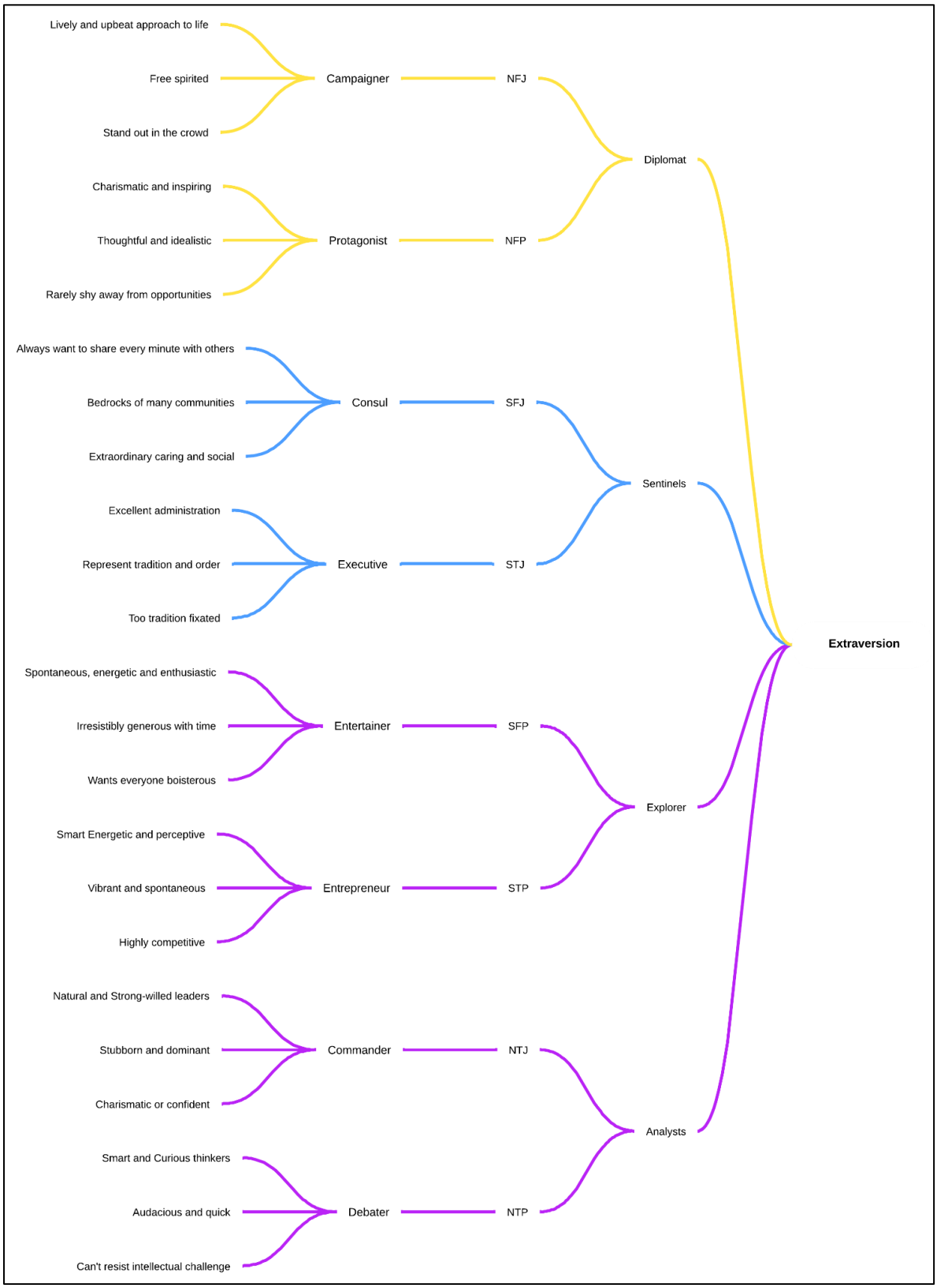

Figure 2b: The broad Extraversion spectrum of personality traits, their roles and characteristics

Results

This study revealed informative results that shed light on the nuanced connection between individual personalities and collective team dynamics.

Our first finding, depicted in Figure 3, demonstrate the varying dynamics of personalities among team members, as outlined by [14]. Out of 16 possible outcomes, this highlights the presence of six unique personalities within the team. The team's largest group, comprising 38.46%, are protagonists, followed by advocates at 23.07%, while logisticians accounted for 15.38%. Lastly, 7.69% of the team is represented by architects, consuls, and entertainers, respectively.

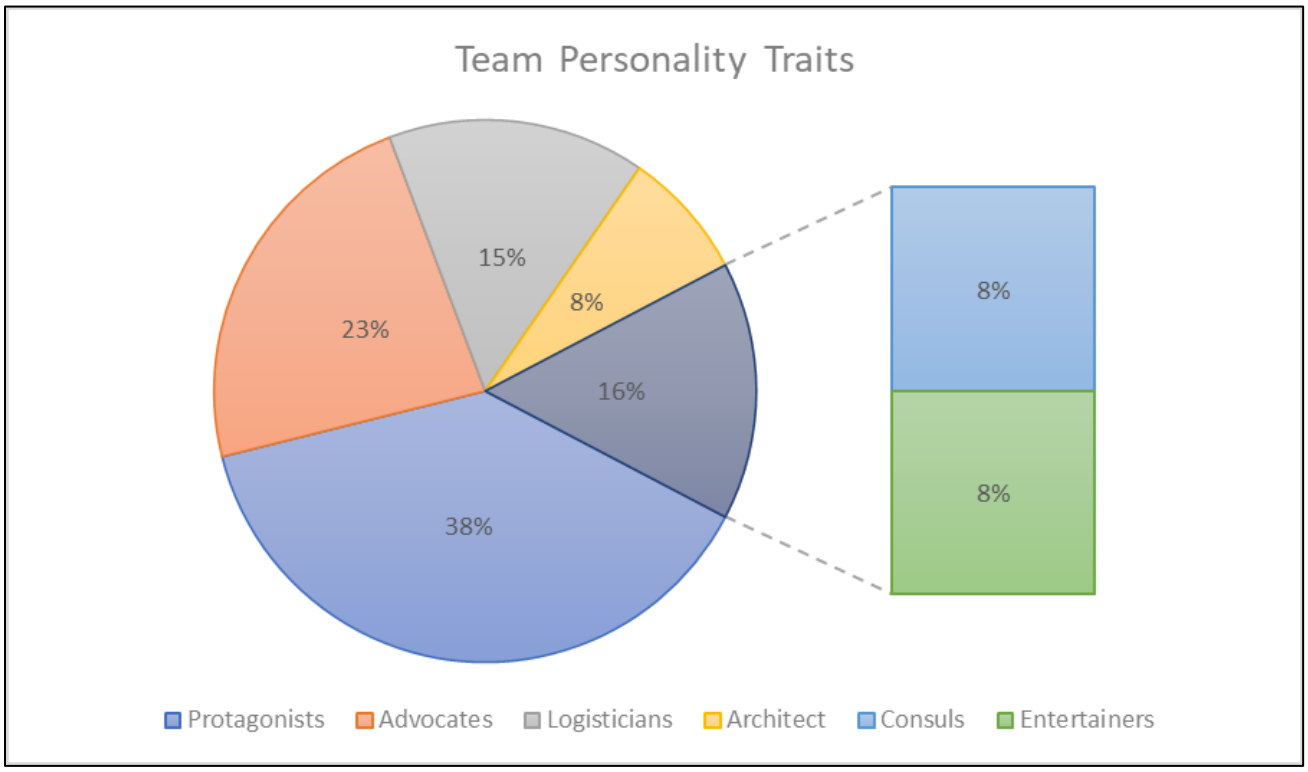

Figure 3: Team Personality Traits

The second finding indicated a distribution of 9 for turbulence and 27 for assertiveness out of a total probability of 36. This suggests that the team was comprised predominantly of assertive individuals. According to [14], this high level of assertiveness contributes significantly to the team's effectiveness. Assertive traits, such as confidence, decisiveness, and assertive communication, were prevalent among team members, fostering proactive problem-solving and decision-making [15]. Conversely, a diminished turbulence score indicates a reduced level of discord and disturbance among team members, facilitating more seamless cooperation and the completion of assignments [16]. This is because assertive

individuals are known for their propensity to foster constructive dialogue and win-win resolutions.

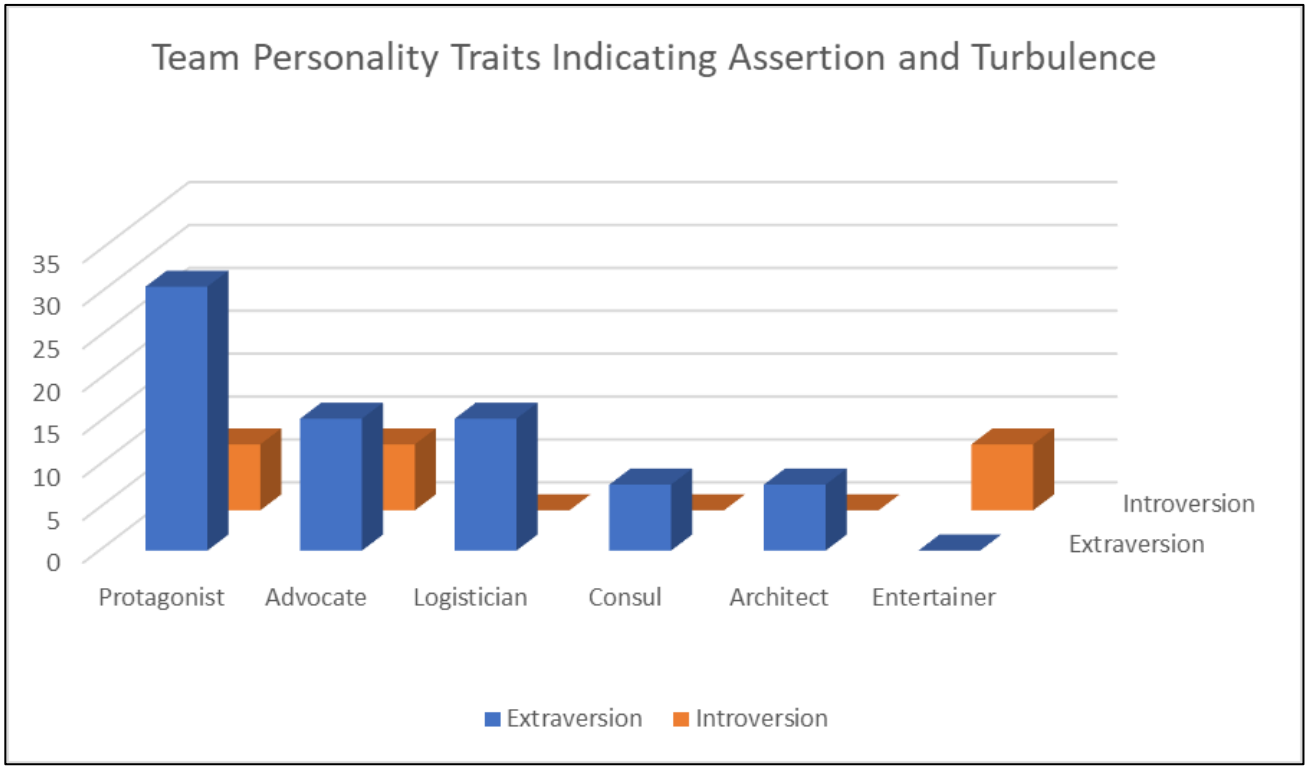

Figure 4: Team Personality Traits Indicating Assertion and Turbulence

Thirdly, our finding indicates that team effectiveness and success were assessed based on five key constructs of team success, the findings of which are outlined in Figure 5. The results show a strong consensus among team members, with over 95.0% agreeing that the team maintains an appropriate culture. Furthermore, 92.0% of respondents acknowledge the team's active involvement in setting task objectives, reflecting a proactive approach to goal setting that aligns with the principles of strengths-based leadership theory [17]. The leadership's adeptness at harmonizing team dynamics and individual personality profiles is evident, as evidenced by the high cohesion and trust reported by about 94% of respondents, along with 92% indicating high team morale. The nurturing of social relationships within the team has fostered improved collaboration, with over 96% of respondents expressing pride in their team membership.

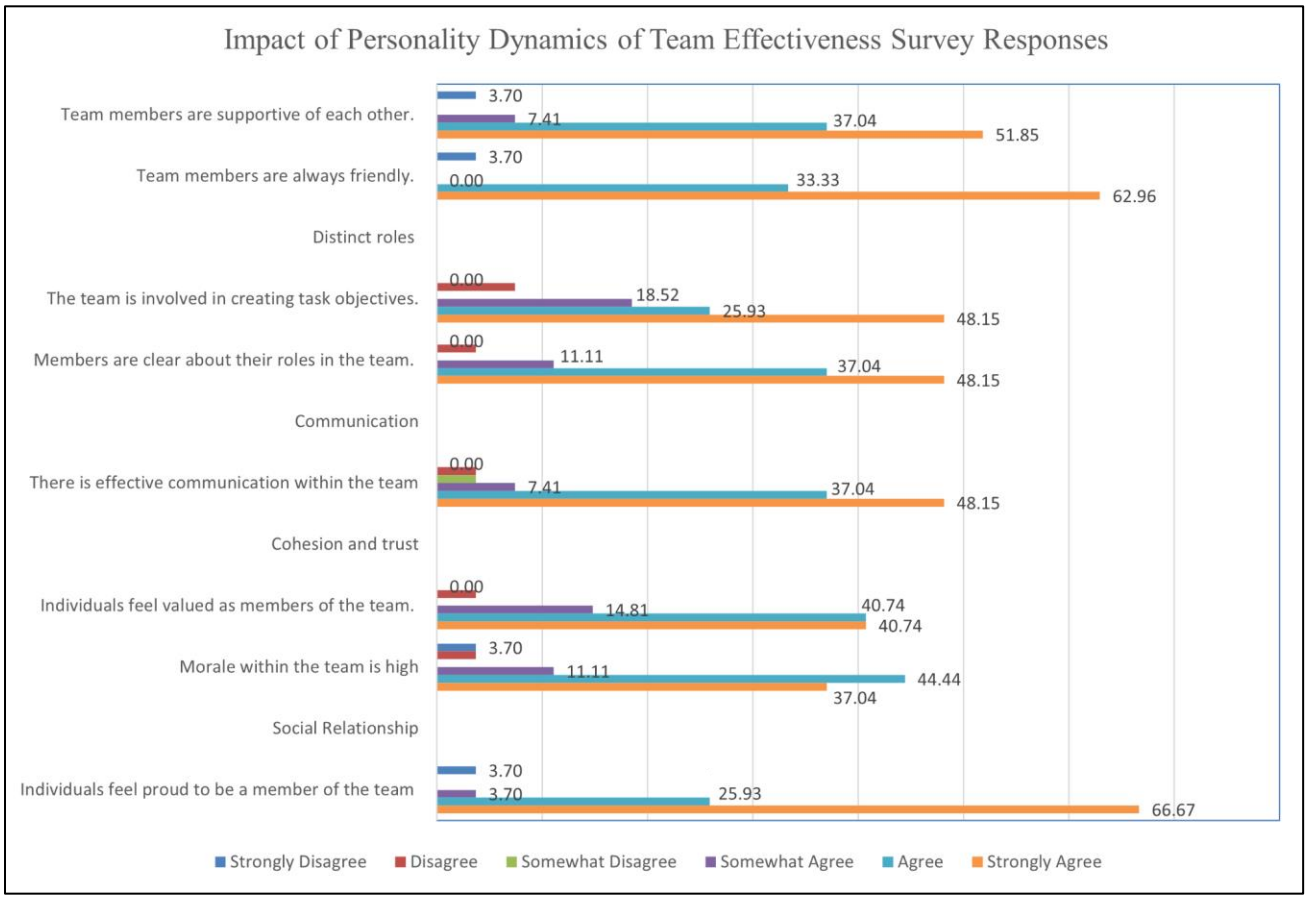

Figure 5: Impact of Personality Dynamics on Team Effectiveness Survey Responses

Discussion

The study's findings provide significant insights for optimizing team effectiveness by emphasizing the intricate connection between individual personalities and team dynamics. First off, the team consists of people with different personality types. The team, dominated by protagonists, advocates, and logisticians, suggests that several leadership and influencer roles can significantly impact how the team interacts and performs. Secondly, team members' high assertiveness and low turbulence scores demonstrate the prevalence of assertive traits, which promote proactive problem-solving, decisive decision-making, and a harmonious team environment favorable to collaboration and task completion.

The evaluation of the team's performance also reveals a high degree of collaboration among members on preserving appropriate team culture, active participation in goal-setting, and high levels of cohesiveness, trust, morale, and pride in team membership. These elevated ratings for cohesion, trust, and morale are noteworthy. These align with research by [18], who argue that a positive emotional climate and strong unity foster collaboration. Fostering a cohesive team culture and maximizing team potential is also made possible by effective leadership that can identify and leverage the talents of different personalities as well as the dynamics of the team.

By applying such knowledge, institutions can attain improved performance results and success by proactively harmonizing team dynamics, leadership tactics, and collaborative methods. The high rating for-role clarity echoes findings emphasizing the importance of well-defined roles and responsibilities in boosting team effectiveness [19]. Clearly, delineated roles help prevent confusion and duplication of efforts. Effective communication, another essential aspect, was observed, aligning with research by [20], who highlights communication as pivotal in shaping team performance. Transparent communication streamlines coordination and manages interdependencies among team members. Understanding individual personalities and how they affect team dynamics provides valuable guidance for building successful teams in various work environments.

Conclusion

This study demonstrates how the leader of a sizable educational program involving forty personnel and 200 tasks across multiple departments of STEM projects utilized personality composition and team dynamics synergistically to foster social relationships, improve communication, and cultivate harmony. The study unveiled the diverse range of personalities present on the team, alongside a significant proportion of assertive members who promoted team cohesion and connection instead of personality conflicts. The team received an 87% rating for efficacy, with approximately 94% of team members attributing assertiveness-related qualities (confidence, decisiveness, and open communication) to the team's success, as opposed to personality conflicts and incompatibility. The implementation of the conceptual framework of this study will be beneficial when supervising other extensive STEM educational initiatives.

Acknowledgement

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References

[1] L.M, Bennett, H. Gadlin, "Collaboration and team science: from theory to practice". *J Investig Med. 2012 Jun;60(5):768-75. Doi: 10.2310/JIM.0b013e318250871d. PMID: 22525233; PMCID: PMC3652225.*

[2] M. P. Gabriel, "Personality types as predictor of team roles," *PhD Thesis, University of South Africa, 2000*

[3] P. G. Northouse, "Leadership: Theory and practice (8th ed.)". *Sage Publications, Inc. (2018).*
[4] R. J. House, P. J. Hanges, M. Javidan, P. W. Dorfman, and V. Gupta, Culture, leadership, and organizations*: The GLOBE study of 62 societies. Sage Publications, Inc. (1999).*
[5] T. Kitchel, "Psychosocial Differences by CTE Discipline and Personality Type in Student Teachers", (2010).
[6] I. B. Myers, M. H., McCaulley, N. L. Quenk, and A. L. Hammer, MBTI manual: A guide to the development and use of the Myers-Briggs Type Indicator (3rd ed.*). CPP, Inc.. Li, K. Wang, Y. Xiao, J. E. Froyd, and S. B. Nite, (2009).* "Research and trends in STEM education: A systematic analysis of publicly funded projects," *International Journal of STEM Education*, vol. 7, pp. 1–17, 2020.
[7] M. R. Barrick, and M. K. Mount, "The Big Five personality dimensions and job performance: A meta-analysis. Personnel Psychology", 44(1), 1-26, (1991).
[8] R. R. McCrae, and P. T. Costa, A Five-Factor Theory of personality. Handbook of personality: Theory and research, 2(3), 139-153, (1999).
[9] T. A. Judge, J. E., Bono, R. Ilies, and M. W. Gerhardt, Personality and leadership: A qualitative and quantitative review. *Journal of Applied Psychology, 87(4), 765-780, (2002).*
[10] M. R. Barrick, G. L. Stewart, M. J. Neubert, and M. K. Mount, "Relating member ability and personality to work-team processes and team effectiveness," *Journal of Applied Psychology, 86(2), 377-389, (1998).*
[11] A. E. Vianen, "Person-organization fit: The match between newcomers' and recruiters' preferences for organizational cultures". *Personnel Psychology, 53(1), 113-149, (2000).*
[12] 16personalities.com Accessed February 15, 2024.
[13] T. Sharif and R. Nahas, "Team effectiveness: A case study of a fast-growing private educational organization in the UAE," *J Educ Pract*, vol. 4, pp. 141–144, 2013.
[14] M. R. Barrick and M. K. Mount, "The Big Five Personality Dimensions and Job Performance: A Meta-Analysis," Personnel Psychology, vol. 44, no. 1, pp. 1-26, 1991.
[15] M. R. Barrick, G. L. Stewart, M. J. Neubert, and M. K. Mount, "Relating member ability and personality to work-team processes and team effectiveness," *Journal of Applied Psychology, 86(2), 377-389, (1998).*
[16] D. Virga, P. L. Curseu, L. Maricutoiu, F. A. Sava, I. Macsinga, and S. Magurean, "Personality, relationship conflict and Teamwork-Related Mental Models," *National Library of Medicine, (2014).* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4220921/
[17] H. Ding and E. Yu, "Follower strengths-based leadership and follower innovative behavior: The roles of core self-evaluations and psychological well-being," *Revista de Psicología del Trabajo y de las Organizaciones*, vol. 36, no. 2, pp. 103–110, 2020.

[18] S. G. Barsade and A. P. Knight, “Group affect,” *Annu. Rev. Organ. Psychol. Organ. Behav.*, vol. 2, no. 1, pp. 21–46, 2015.

[19] É. Lapointe, C. Vandenberghe, and J.-S. Boudrias, “Organizational socialization tactics and newcomer adjustment: The mediating role of role clarity and affect-based trust relationships,” *Journal of Occupational and Organizational Psychology*, vol. 87, no. 3, pp.599–624, 2014.

[20] S. L. Marlow, C. N. Lacerenza, J. Paoletti, C. S. Burke, and E. Salas, “Does team communication represent a one-size-fits-all approach?: A meta-analysis of team communication and performance,” *Organizational behavior and human decision processes*, vol. 144, pp. 145–170, 2018.