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Determining Effective Reinforcement Activities for Addressing Adolescent Self-Concept with Disciplinary Issues: A Fuzzy Delphi method approach

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Abstract
This study employs the Fuzzy Delphi Method to identify effective reinforcement activities for enhancing self-concept in adolescents with disciplinary issues. A panel of five experts evaluated ten items, achieving strong consensus across all criteria. Defuzzification values ranged from 0.88 to 0.98, indicating high agreement. The findings provide a reliable framework for developing strategies to address adolescents' self-concept in disciplinary contexts. The study highlights the potential of targeted interventions in improving both self-perception and behavior among adolescents. Future research directions include practical implementation, longitudinal studies, and exploration of cultural variations in the applicability of these reinforcement activities.

Keywords: Adolescent Self-Concept, Disciplinary Interventions, Fuzzy Delphi Method, Reinforcement Activities

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1.0 Introduction

The development of self-concept during adolescence represents a critical phase in human development that significantly influences behavioural outcomes and academic achievement (van der Cruijsen et al., 2023). Recent studies indicate that adolescents with disciplinary issues often struggle with poor self-concept (Douma et al., 2022; and Lichner et al., 2021). This is particularly concerning given the Ministry of Education Malaysia's report of a 15% increase in serious disciplinary incidents between 2018 and 2023 (Ministry of Education Malaysia, 2023). Research has shown that adolescents with low self-concept are more likely to engage in disruptive behaviours and face disciplinary actions in school settings (Zhao et al., 2024). A comprehensive study of Spanish secondary school students revealed that those with school refusal behaviours scored significantly lower in multiple dimensions of self-concept compared to their peers (Gonzálvez et al., 2019). In Malaysia, Junaidi et al. (2021) found that disciplinary actions significantly influence students' self-perception and confidence levels, often leading to feelings of alienation and diminished self-worth.

The timing of interventions is crucial, as early adolescence (ages 13-15) represents the most critical period for self-concept development (van der Cruijsen et al., 2023). Research by Zakaria et al. (2021) highlights the connection between weak self-concept and higher rates of misconduct among at-risk students in Selangor, Malaysia. The persistence of these issues presents severe consequences, as studies suggest that unresolved self-concept issues can lead to negative mental health outcomes (Hu et al., 2024). Notably, Caspi et al. (2020) revealed that 34% of mental disorder cases arise before age 15 and 59% before age 18, creating a

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compounding effect on healthcare systems, families, and societal well-being. Therefore, this study aims to investigate effective reinforcement strategies for enhancing the self-concept and overall well-being of adolescents with disciplinary problems. The research employs the Fuzzy Delphi Method (FDM), which is particularly suitable for complex cultural and social contexts such as Malaysia's educational environment (Zulkifli et al., 2022), ensuring the selected activities are contextually sensitive and more likely to succeed.

2.0 Objectives of the study

The primary objective of this study is to identify which reinforcement activities are most successful in improving the self-concept of adolescents with disciplinary problems based on expert consensus.

3.0 Literature Review

Existing research has identified a range of evidence-based reinforcement activities that have shown promise in improving self-concept among youth with disciplinary problems. Adolescent's self-concept is deeply influenced by their environment. Research conducted by Badriyah (2023) and Luo et al. (2021) suggests receiving praise and words of encouragement from parents and educators can lead towards healthy self-concept. For example, adolescents with supportive parenting style tend to develop a positive self-concept, while those exposed to coercive parenting styles often have a negative self-concept. This is further supported by Luo et al. (2021) who found that strong student-teacher relationships can mitigate the adverse effects of parental punishment on adolescent's self-concept and make them feel that they are still accepted within the school. Therefore, a social support-based interventions focuses on rebuilding trust, mutual understanding and creating a conducive home environment can foster the development of adolescent's self-concept. Zukovic & Stojadinovic (2021) also proven that the Support for Positive Behaviour in Schools (SPBSC) framework, which combines behaviour management systems with Social-Emotional Learning (SEL) initiatives are one of the effective strategies. This structured-based intervention not only help managing adolescent behaviours, but can also improve their competencies.

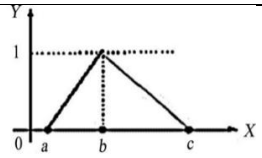
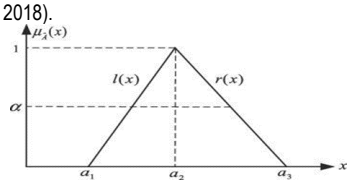
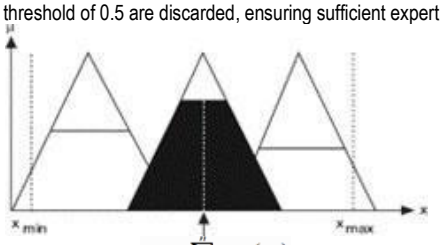
Besides that, a structured counselling session and health education have been shown to improve self-concept among adolescents, especially those engaged in online gaming or facing social pressures (Nurmagandi et al., 2022; Yu, 2023). These approaches emphasize the importance of understanding and reshaping their self-perception. By creating a safe and nonjudgmental space, adolescent can explore their emotions, thoughts, behavioural patterns, and even identify the root causes behind their struggles. Another reinforcement that can lead to improvement in self-concept, are adolescent's participation in physical activities. For instance, studies by Gonzalez-Valero et al. (2020) and Garn et al. (2020) indicate that engaging in physical activities not only enhance self-concept, but can also mitigate their engagement in disciplinary issues. It is clear that such findings underscore the importance of creating supportive environments, both at home and in schools, to bolster adolescent self-concept and reduce disciplinary issues. Despite the existing evidence of the effectiveness of reinforcement activities, there are still a lack of consensus on which particular activities are most beneficial for improving self-concept among Malaysian adolescent with disciplinary issues. Therefore, this paper aims to fill the knowledge gap by implementing a Fuzzy Delphi Method (FDM) to determine which past reinforcement activities are most effective in enhancing adolescent self-concept, especially among those with disciplinary issues as it allows for nuanced evaluations, making it suitable for cultural and social contexts like Malaysia's educational environment.

4.0 Methodology

The Fuzzy Delphi Method combines traditional Delphi techniques with fuzzy set theory for achieving expert consensus on ambiguous topics. Originally developed by Dalkey and Helmer (1963), this method has evolved to better address complex decision-making through the integration of fuzzy set theory. This approach facilitates agreement on unclear concepts (Jani et al., 2018), reduces consultation rounds, and captures honest responses while minimizing distortion. Unlike traditional probability-based approaches, FDM employs mathematical tools to capture judgment uncertainty, particularly suited for subjective assessments. The method's development progressed from foundational work in forecasting accuracy (Murray, Pipino, & van Gigch, 1985; Kaufmann & Gupta, 1988) to recent algorithmic integrations (Mustapha & Darussalam, 2018). FDM incorporates weighted expertise and fuzzy statistics for stable opinion capture (Chang, Hsu, & Chang, 2011), making it an effective tool when direct interviews are impractical. These steps are outlined as follows:

Table 1: Fuzzy Step

Criteria	Step
1. Experts' selection	This study employed a panel of five experts to evaluate language variables and assessment criteria using triangular fuzzy numbers. These numbers represent linguistic variables through three values: minimum (m1), median (m2), and maximum (m3), providing a structured approach to quantify expert opinions in the decision-making process.
2. Determining linguistic scale	Fuzzy numbers transform linguistic variables into standardized values, enabling nuanced interpretation of language-based inputs. This approach provides a structured framework for analysing expert opinions through a standardized fuzzy scale.

<table>
<tr><td></td><td>$$\mu_A(x)=\begin{cases}0, & x\le a\\ \frac{x-a}{b-a}, & a<x\le b\\ 1, & x=b\\ \frac{c-x}{c-b}, & b<x\le c\\ 0, & x\ge c.\end{cases}$$  </td></tr>
<tr><td>3. The Determination of Linguistic Variables and Average Responses</td><td>Expert responses are converted from Likert scale data into fuzzy scales to determine the "average reaction" of each fuzzy number. This translation process enables a more refined interpretation of expert feedback (Benitez, Martin & Roman, 2007).
<table>
<tr><th>Response</th><th>Triangular fuzzy</th><th>Likert Scale</th></tr>
<tr><td>Strongly disagree</td><td>0.00, 0.00, 0.20</td><td>1</td></tr>
<tr><td>Disagree</td><td>0.00, 0.20, 0.40</td><td>2</td></tr>
<tr><td>Moderate Agree</td><td>0.20, 0.40, 0.60</td><td>3</td></tr>
<tr><td>Agree</td><td>0.40, 0.60, 0.80</td><td>4</td></tr>
<tr><td>Strongly agree</td><td>0.60, 0.80, 1.00</td><td>5</td></tr>
</table></td></tr>
<tr><td>4. The determination of threshold value “d”</td><td>The threshold value "d" measures consensus among experts by calculating the distance between fuzzy numbers. This benchmark determines the degree of alignment in expert opinions, providing a structured approach to consensus measurement.
$$d(\bar{m},\bar{n})=\sqrt{\frac{1}{2}\left[(m1-n1)^2+(m2-n2)^2+(m3-n3)^2\right]}$$</td></tr>
<tr><td>5. Identify the alpha cut the aggregate level of fuzzy assessment</td><td>The maximum area for fuzzy assessments is calculated using the formula 4m1 + (2m2) m3), which quantifies expert consensus on approximate ratings (Mustapha & Darussalam, 2018).

</td></tr>
<tr><td>6. Defuzzification</td><td>The defuzzification process uses three formulas with scores ranging from 0 to 1:
1. A = 1/3 (m1 + m2 + m3)
2. A = 1/4 (m1 + 2m2 + m3)
3. A = 1/6 (m1 + 4m2 + m3)
Items with an A value below the alpha-cut threshold of 0.5 are discarded, ensuring sufficient expert agreement.


$$x^*=\frac{\sum_{i=1}^{n}x_i\mu(x_i)}{\sum_{i=1}^{n}\mu(x_i)}$$</td></tr>
<tr><td>7. Ranking</td><td>Elements are ranked based on their defuzzification values, with higher values indicating greater expert consensus (Fortemps & Roubens, 1996).</td></tr>
</table>

4.2 Sampling

Purposive sampling was employed, aligning with the Fuzzy Delphi Method's (FDM) targeted approach. While Hsu and Sandford (2007) recommend panels of 10-15 experts, other researchers suggest that smaller panels of 5-10 highly knowledgeable experts can be sufficient (Rosnaini, 2006; Mohd Ridhuan, 2016). Given this, and considering practical constraints, the study proceeded with a panel of five experts to gather insights and reach consensus.

Table 2: List of experts

No	Experts	No of experts	Field of expertise	Institution
1	Counsellor	3	Islamic Counselling	Institute of Teacher Training
2	Lecturer	1	Counselling	Private University
3	Teachers and School Administrators	1	Counselling	National Secondary School

4.3 Expert criteria

Experts in Fuzzy Delphi studies must possess both comprehensive qualifications and practical experience (Booker & McNamara, 2004). True expertise encompasses formal education, specialized training, and peer recognition (Nikolopoulos, 2004; Perera et al., 2012). This expertise directly impacts study credibility and validity (Mustapha & Darussalam, 2018). For this study, selected experts met strict criteria including a minimum of three years of experience, ensuring their ability to contribute meaningful insights.

4.4 Instrumentation

The Fuzzy Delphi methodology was developed through established research practices, incorporating literature reviews and pilot studies as recommended by Skulmoski et al. (2007) and Okoli and Pawlowski (2004). The study employed a seven-point fuzzy scale, chosen for its proven accuracy in capturing expert opinions. Complex fuzzy values were simplified to a 1-7 scale (shown in Table 3) to enhance accessibility while maintaining precision.

Table 3: Fuzzy scale

Item	Fuzzy Scale
Strongly disagree	(0.0, 0.0, 0.1)
Disagree	(0.0, 0.1, 0.3)
Somewhat Disagree	(0.1, 0.3, 0.5)
Neutral	(0,3, 0.5, 0.7)
Somewhat agree	(0.5, 0.7, 0.9)
Agree	(0.7, 0.9, 1.0)
Strongly agree	(0.9, 1.0, 1.0)

4.5 Data Analysis

The data analysis was conducted using FUDELO 1.0 (Fuzzy Delphi Logic Software), selected for its specialized capabilities in processing Fuzzy Delphi Method data.

5.0 Findings

This section presents the Fuzzy Delphi Method (FDM) analysis of factors influencing student disciplinary issues, based on expert consensus and questionnaire responses.

Table 4: Defuzzification Report

Results	Item1	Item2	Item3	Item4	Item5	Item6	Item7	Item8	Item9	Item10
Expert1	0.01155	0.01155	0.03464	0.01155	0.03464	0.02309	0.02309	0.02309	0.03464	0.06928
Expert2	0.01155	0.01155	0.03464	0.01155	0.03464	0.02309	0.02309	0.03464	0.02309	0.10392
Expert3	0.04619	0.04619	0.13856	0.04619	0.13856	0.03464	0.03464	0.03464	0.02309	0.10392
Expert4	0.01155	0.01155	0.03464	0.01155	0.03464	0.03464	0.03464	0.02309	0.02309	0.06928
Expert5	0.01155	0.01155	0.03464	0.01155	0.03464	0.02309	0.02309	0.02309	0.03464	0.06928
Statistics	**Item1**	**Item2**	**Item3**	**Item4**	**Item5**	**Item6**	**Item7**	**Item8**	**Item9**	**Item10**
Value of the item	0.01848	0.01848	0.05542	0.01848	0.05542	0.02771	0.02771	0.02771	0.02771	0.08314
Value of the construct										0.03603
Item < 0.2	5	5	5	5	5	5	5	5	5	5
% of item < 0.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Average of % consensus										100
Defuzzification	0.98	0.98	0.94	0.98	0.94	0.96	0.96	0.96	0.94	0.88
Ranking	1	1	3	1	3	2	2	2	3	4
Status	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept

The analysis involved evaluating 10 items across a panel of 5 experts. The defuzzification results show that all items achieved a high level of consensus among the experts. The defuzzification values range from 0.88 to 0.98, with all items falling well below the typical threshold of 0.2, indicating strong agreement. This is further evidenced by the 100% consensus rate across all items, suggesting that the experts were in unanimous agreement on the importance or relevance of each item under consideration. The ranking of items based on their defuzzification values reveals a hierarchy of consensus. Items 1, 2, and 4 share the top rank with the highest defuzzification value of 0.98, indicating the strongest agreement among experts. These are followed by items 6, 7, and 8 in the second rank (0.96), then items 3, 5, and 9 in the third rank (0.94), and finally item 10 in the fourth rank (0.88).

Despite the slight variations in ranking, all items were accepted as they met the consensus criteria. The "Value of the construct" reported as 0.03603 represents an overall measure of the construct being evaluated, which is relatively low, indicating a high level of agreement across all items. The uniformity in the number of experts (5) rating each item below 0.2 further supports the robustness of the consensus. In conclusion, the FDM analysis demonstrates a strong and consistent agreement among the expert panel across all evaluated items, with subtle distinctions in the strength of consensus reflected in the rankings. This suggests that all proposed items or criteria are considered valid and relevant by the expert panel, with those ranked higher potentially carrying more weight or importance in the context of the study.

6.0 Discussion

The findings from this Fuzzy Delphi study not only provide consensus on effective interventions but also validate key theoretical frameworks of adolescent development in the Malaysian context. The highest-rated interventions - social skills training and emotional control techniques (both 0.98) - align with both Zukovic and Stojadinovic's (2021) SPBSC framework and broader social learning theories that emphasize the role of modelling and reinforcement in behaviour modification. This alignment suggests that these fundamental skill-building approaches transcend cultural boundaries while addressing the core issue of limited evidence-based interventions in Malaysian schools. Active parental involvement's high rating (0.98) supports Bronfenbrenner's ecological systems theory, highlighting how microsystem interactions critically influence adolescent development. This finding bridges Badriyah (2023) and Luo et al.'s (2021) research on supportive parenting with practical implementation strategies, particularly relevant in Malaysia's family-oriented cultural context. The strong expert consensus challenges current school-based intervention models that often overlook parental engagement components. The substantial support for positive reinforcement techniques and peer support groups (both 0.96) extends beyond simple behavioural modification, reflecting self-determination theory's emphasis on competence and relatedness needs.

These interventions, alongside goal-setting workshops (0.96), create comprehensive support systems that address both immediate behavioural issues and longer-term developmental needs, as identified by Nurmagandi et al. (2022) and Yu (2023). The lower ranking of extracurricular activities (0.88), despite strong literature support from Gonzalez-Valero et al. (2020) and Garn et al. (2020), reveals a critical gap between theoretical benefits and practical implementation challenges in the Malaysian context. This divergence suggests a need to reevaluate how physical and extracurricular activities are integrated into intervention programs for students with disciplinary issues. The implications of these findings reach well beyond immediate intervention strategies. Schools should reevaluate resource allocation at the institutional level to ensure more effective use of available funds. This may include reallocating funds from conventional disciplinary measures to social-emotional learning programs and parent engagement initiatives (Stephens, 2021). This shift highlights the need for teacher training programs to focus on improving preparation in facilitating social-emotional learning and implementing effective family engagement strategies (Soutter, 2023). Thus, rather than relying on punitive measures such as detention or suspension, schools should implement developmental support systems aimed at fostering student growth and improvement.

These systems could include interventions like counselling, mentoring, and social-emotional learning programs, which address the underlying causes of behavioural issues and promote holistic student development. The economic implications involve the upfront costs of teacher training and program development, which should be considered against the potential long-term savings from fewer disciplinary problems and improved student outcomes (Roca et al., 2021). Experts strongly agree on the need for these changes, but there are concerns about their ability to be scaled and sustained, particularly in schools with limited resources. Implementing these changes may face challenges, such as resistance from schools that rely on traditional teaching methods, the need to adapt intervention strategies to local cultures, and disparities in resource availability across different regions (Newbury et al., 2022). These findings suggest future research directions, especially regarding the effective implementation of interventions across various socioeconomic contexts in Malaysia. Longitudinal studies are necessary to evaluate the long-term effects of these interventions on individual student outcomes and overall school climate measures (Grazia & Molinari, 2020). The consensus regarding social-emotional interventions underscores the necessity for the development of culturally sensitive assessment tools to evaluate intervention effectiveness within the Malaysian context. Abd Hadi et al. (2023) found that cultural factors significantly influence the perception and development of social-emotional skills, highlighting the necessity for tools that are valid and culturally relevant.

7.0 Conclusion & Recommendations

7.1 Conclusion

The study provides a nuanced and expert-validated framework for understanding and addressing adolescent self-concept in the context of disciplinary challenges. By employing the Fuzzy Delphi Method, the research systematically identified and validated ten key reinforcement activities that can potentially improve adolescents' self-perception and behavioural outcomes. The findings underscore the critical importance of a holistic, multi-dimensional approach that integrates social skills training, emotional regulation techniques, parental involvement, positive reinforcement, and community engagement. The high level of expert consensus, reflected in defuzzification values ranging from 0.88 to 0.98, demonstrates the robustness of these intervention strategies. These insights offer valuable guidance for educators, counsellors, and policymakers in developing targeted, evidence-based interventions that can effectively support adolescents struggling with disciplinary issues. By recognizing self-concept as a complex psychological construct shaped by diverse social, emotional, and personal experiences, the study contributes to a more comprehensive understanding of adolescent development and provides a practical roadmap for fostering positive behavioural and psychological outcomes.

7.2 Recommendations for Further Research

While this study offers valuable insights, several limitations should be acknowledged. The primary limitation lies in the relatively small expert panel size (n=5), which, although meeting the minimum requirements for the Fuzzy Delphi Method, may not capture the full spectrum of professional perspectives. Additionally, while the expert panel members represented diverse institutions, their shared background in counselling and guidance, though valuable for this study's focus, potentially limits the interdisciplinary scope of the findings. A more diverse panel including experts from related fields such as child psychology, psychiatry, social work, or educational psychology might have provided additional insights into adolescent self-concept development. Building upon these limitations, several important research avenues warrant further investigation. Future investigations should prioritize longitudinal studies that track the long-term effectiveness of these interventions, examining how these strategies impact adolescents' psychological development and

behavioural patterns over extended periods. Additionally, researchers should conduct comparative analyses to assess the cultural nuances and potential variations in intervention effectiveness across different demographic groups, particularly within Malaysia's diverse social landscape. A critical area for further exploration involves developing detailed implementation frameworks for each proposed reinforcement activity, moving beyond theoretical recommendations to provide practical, actionable guidelines for schools, counsellors, and parents. Moreover, researchers could benefit from investigating the potential intersectionality of these interventions, exploring how factors such as socioeconomic background, family structure, and individual psychological profiles might influence the efficacy of self-concept improvement strategies. Quantitative studies with larger sample sizes could also help validate and generalize the current findings, potentially developing more sophisticated predictive models for understanding the complex relationship between reinforcement activities and adolescent self-concept development. By addressing these research gaps, future studies can build upon this foundational work and provide more comprehensive, nuanced approaches to supporting adolescents with disciplinary challenges.

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Paper Contribution to Related Field of Study

This paper contributes to related studies by offering a validated framework for reinforcement activities to enhance adolescent self-concept and address disciplinary issues. Using the Fuzzy Delphi Method, it provides culturally relevant insights, bridging gaps in behavioural intervention research and guiding educators, counsellors, and policymakers in implementing evidence-based strategies tailored to adolescents' psychological and social needs.

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