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Crafting a blueprint for enhancing emotional well-being in special education post-pandemic: A fuzzy Delphi approach

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ABSTRACT

The well-being of a person includes different parts of life, such as mental and emotional health, physical health, and social relationships. Emotional well-being is especially important and refers to how people feel psychologically, including finding meaning in life, feeling positive emotions, and being satisfied with life. For students with special educational needs, focusing on emotional well-being is especially important after the COVID-19 pandemic to help them grow and succeed. This study aimed to create a plan for supporting the emotional well-being of these students in special education after the pandemic. The study had two main goals: (i) to find out if experts agree on the key components needed to create a model for emotional well-being for students with special needs after COVID-19, and (ii) to identify if there is agreement among experts on the important factors needed to build such a model. The Fuzzy Delphi Method (FDM) was used, gathering input from nine experts through questionnaires. The data were analyzed using triangular fuzzy numbers and the defuzzification process to rank each variable. The study found more than 75% agreement among experts, threshold values (d) below 0.2, and α-cut values above 0.5. The FDM analysis identified six main elements for an emotional well-being model for students with special educational needs after COVID-19. These results offer important guidance for developing emotional well-being models for these students, providing key support for both teachers and students in managing emotions in the post-pandemic period.

1. Introduction

The special education field in Malaysia is facing remarkable challenges due to the COVID-19 pandemic. The disruptions caused by COVID-19 have drastically altered the educational landscape, bringing to the forefront the emotional hurdles that students with diverse needs often face. In this article, we employ the fuzzy Delphi approach to examine emotional well-being within the context of sustainable development goals (SDGs) (UN, 2015). In the wake of the pandemic, Malaysia's educators, parents, and policymakers must urgently improve emotional support systems for students with special needs. It is crucial to understand the unique challenges faced by individuals with developmental disabilities during pandemics to develop effective strategies for supporting their emotional well-being post-pandemic (Sheppard-Jones et al., 2021). The emotional well-being of these individuals, often ignored in mainstream conversations, has become a focal point as educators strive to develop effective strategies that promote resilience, inclusivity, and a conducive learning environment.

The fuzzy Delphi approach is a valuable tool for addressing uncertainty and ambiguity in promoting emotional well-being for special education students during the post-pandemic era (Arsad et al., 2019; Fazel et al., 2016; Hsu and Yang, 2000). This approach involves gathering insights from a diverse group of experts, synthesizing their knowledge, reconciling differing viewpoints, and creating a strategic framework (Rahman et al., 2021) for designing personalized plans that cater to the unique

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needs of special education students in an ever-changing educational landscape.

Using the fuzzy Delphi approach, our aim in this article is to support the UN' (2015) Sustainable Development Goals (SDGs) of Quality Education (SDG 4) and Good Health and Well-Being (SDG 3), outlined in 2015. We promote inclusive and quality education for every special education student, ensuring access to an environment that fosters emotional well-being and resilience. This aligns with the emphasis on mental health within SDG 3, as emotional well-being is a crucial aspect of overall health. Our aim is to contribute meaningfully to the sustainable development agenda by creating a blueprint for a more empathetic, resilient, and inclusive educational environment in Malaysia and other regions. This research study focuses on two key inquiries:

1. Is there a consensus among the experts on the fundamental components for developing an emotional well-being model for students with special needs post-COVID-19?
2. Is there a consensus among the experts on the elements needed to develop an emotional well-being model for students with special needs post-COVID-19?

2. Literature review

2.1. Emotional well-being

"Well-being" encompasses various aspects of life, including health, social relationships, academics, and resilience. However, it is important to define it more clearly. The World Health Organization (Bourne, 2010) defines well-being as complete physical, mental, and social well-being, which is considered a critical goal for maintaining good health. Measuring well-being can be subjective, so scales and questionnaires focus on self-reported views and psychological and objective factors. Subjective well-being refers to an individual's ability to experience happiness and respond positively and adaptively to life, thereby indicating a sense of overall well-being, as Lyubomirsky (2001) defined. Similarly, Seligman (2011) identified five key components of personal growth (flourishing): experiencing positive emotions and satisfaction, engaging in activities that evoke positive feelings, cultivating supportive and meaningful relationships, discovering purpose, and achieving personal goals.

Emotional well-being (EWB), a critical facet of our psychological health and overall wellness, revolves around recognizing and managing diverse emotions, closely intertwining with our social and emotional welfare. It assumes a pivotal role in regulating our emotional responses. Contemporary research by Kalokerinos et al. (2019) underscores the significance of emotional well-being in emotional regulation, revealing that individuals who experience high levels of emotional well-being usually possess better emotional regulation abilities. On the other hand, individuals who are experiencing a decline in their emotional well-being may resort to using fewer effective strategies to regulate their emotions (Barrett, 2003; Kalokerinos et al., 2019).

Furthermore, emotional well-being (EWB) extends beyond the balance between pleasant and unpleasant emotions, as articulated by Keyes (2003). EWB, a multifaceted construct, encompasses dimensions such as an individual's positivity and life sentiments, experiential factors, the emotional quality of daily experiences, and cognitive aspects like judgments about life satisfaction, a sense of meaning, and the ability to pursue goals that extend beyond the self (Park et al., 2023). Recognizing and fostering emotional well-being, as highlighted by contemporary research, contributes to emotional regulation and a holistic sense of fulfillment and life satisfaction.

EWB and mental health are common concerns that impact persons in various settings, including schools (Hanley et al., 2020) and different populations, such as children, adolescents, and women (Ross et al., 2020). EWB is a crucial component of mental health, and studies have demonstrated a correlation between EWB and physical health. Positive affect and emotions, essential for physical health, are physiological manifestations of mental well-being (Fredrickson, 2004; Lindfors, 2012). Hence, it is crucial to endorse EWB to advance general health and well-being.

The importance of well-being has been increasingly recognized in the education sector, especially due to the significant impact of the COVID-19 pandemic. According to Rees and Tissot (2023), the Department for Education in the United Kingdom (DfE) has funded state-funded schools that meet certain criteria to support students' and staff's mental health and well-being. This funding is intended to train a staff member to become a senior mental health lead responsible for developing and implementing a comprehensive mental health and well-being strategy across the school. The DfE has set a goal for all schools to participate in this program by 2025.

The pandemic has affected Malaysia physically and socially, spanning the economic, health, and education sectors. During the lockdowns, Malaysia has significantly impacted social well-being, leading to heightened anxiety and depression. Economic uncertainty and the potential return of the Movement Control Order (MCO) contribute to chronic anxiety (Shanmugam et al., 2020). Concerns about business closures and job losses add to overall distress. Social restrictions disrupt routines, fostering loneliness. Isolation for COVID-19 patients can lead to negative psychological effects, including post-traumatic stress disorder (PTSD). Frontline workers, like hospital staff, face prolonged stress. Students, especially those transitioning to online learning, experience increased stress. Special needs students are particularly affected and confined at home, impacting their social and emotional health. Parents of special needs children express constant

concern about their future, facing emotional and mental strain from prolonged home confinement.

2.2. Special education in Malaysian landscape

The special education sector in Malaysia is experiencing significant transformations due to the COVID-19 pandemic. Today's worldwide crisis has substantially affected education and societal conventions, highlighting the significance of resilience, flexibility, and inclusiveness in education, especially for pupils with diverse needs. The epidemic has underscored the crucial significance of mental health and emotional well-being in school, specifically for pupils in special education. As a result, Malaysia's special education system after COVID-19 prioritizes providing mental health support services, counseling, and comprehensive well-being efforts for kids with various needs.

In Malaysia, the Ministry of Education categorizes special education students into six main groups according to their disabilities. These categories are Visual Impairment (BL), Hearing Impairment (DE), Speech Impairment (SD), Physical Disability (PH), Learning Disability (LD), and Multiple Disabilities (MD). The special education department of the Malaysian Ministry of Education has recently released statistics on the number of special education students in Malaysia. The data shows an upward trend in the number of students with special needs enrolling each year. This trend highlights the need for the education system in Malaysia to prioritize the emotional well-being of students affected by COVID-19.

Emotional well-being plays a crucial role in shaping these students' learning experiences and growth. However, the COVID-19 pandemic has presented several obstacles that hinder their learning and daily functioning. The lack of contact with the school environment has limited their social engagement, and the uncertainty surrounding schooling might harm their emotional welfare.

3. Research design

This study proposes a group decision method to confirm the adjustments made to the main components and elements of the emotional well-being model for special needs post-COVID-19. The Delphi Method is one of the most used group decision methods, which involves surveying experts' opinions in specific fields with questionnaires. If there is no consensus among experts, the negotiator integrates the opinions and selects the average or 50% of the result as the collective opinion.

However, the traditional Delphi Method has its shortcomings. It is based on expert opinions and may only sometimes satisfy the convergence standard. As a result, the survey may need to be repeated several times, resulting in high time and capital expenses. To overcome these limitations, this study adopts the reformed Fuzzy Delphi Method (FDM) based on triangular fuzzy numbers (Zadeh, 1965). Zadeh et al. (1977) reported that the theory of fuzzy sets has substantially developed in the past decade. This theory has proven useful in various areas: taxonomy, topology, linguistics, automata theory, logic, control theory, game theory, information theory, psychology, pattern recognition, medicine, law, decision analysis, system theory, and information retrieval (Banno et al., 2019; Huang et al., 2021; Mengistu and Panizzolo, 2021; Tsai et al., 2020; Yusoff et al., 2021).

3.1. Data collection and analysis

This research study utilizes a systematic and rigorous quantitative approach known as the Fuzzy Delphi method, originally developed by Murray et al. (1985). This method involves collecting data through questionnaires and expert ideas to reach a consensus on a particular topic. The Fuzzy Delphi method is a well-established and effective research method for decision-making in various fields, including business (Chen, 2014), economics (Alharbi and Khalifa, 2021), healthcare (de Meyrick, 2003), and engineering (Ameyaw et al., 2016).

The FDM method was applied to select the model elements because it solved the disadvantages of the conventional Delphi Method and because extreme conditions would not easily affect its results. The process of collecting and analyzing data for the Fuzzy Delphi Method in this study is illustrated in Fig. 1.

Step 1: First, we created a questionnaire to help us get expert opinions through the Fuzzy Delphi Method (FDM). This questionnaire is a tool that will help us gather insights from the experts in the field. We will use many sources to create it, including reviewing literature and contacting experts for qualitative perspectives and experiences. Multiple sources are utilized to create the FDM questionnaire, including a thorough literature review that provides a foundation for understanding existing perspectives and relevant dimensions of the targeted domain. Not only does the questionnaire draw insights from the literature, but it is also enriched through expert interviews. These interviews provide valuable qualitative insights, perspectives, and experiences related to the subject under consideration.

Furthermore, the questionnaire development process incorporates insights from focus group discussions, leveraging a group of specialists' collective expertise and diverse viewpoints. This collaborative approach ensures that the questionnaire is comprehensive, well-rounded, and reflective of expert opinions. According to Powell's (2003) insights, the Delphi method, including its Fuzzy variant, is an exceptionally flexible approach for obtaining expert consensus. Powell (2003) suggested that the initial round of the Delphi method typically involves expert interviews to identify specific issues, which aligns with the questionnaire development phase in FDM. Importantly, Powell (2003) highlighted the versatility of identifying issues through open-ended questions, emphasizing the method's adaptability. We can identify these

issues through open-ended questions, making the method adaptable. Another approach, as Duffield (1993) proposed, involves using a survey form borrowed from existing literature. This approach gives a structured foundation for the questionnaire, which can streamline the development process while benefiting from established frameworks.

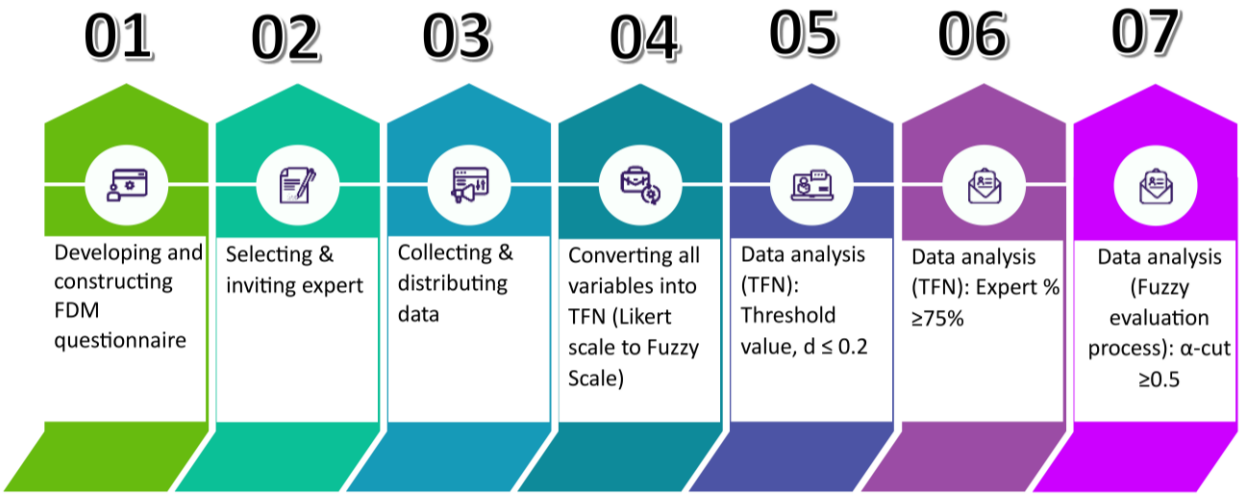

Fig. 1: Fuzzy Delphi data collection and data analysis

Step 2: We cordially invite experts to participate in a collaborative workshop where they can share their insights. According to Jones and Twiss (1978), research studies require a range of 10 to 50 experts. Experts recommend that a model should be validated by a group of 10 to 18 individuals (Okoli and Pawlowski, 2004). For more comprehensive and reliable findings, a larger panel of 15 to 35 experts should be selected. However, Ocampo et al. (2018) have presented a different perspective, suggesting that a research study can be conducted with fewer experts. This is because the quality of results obtained from group discussions is not solely dependent on the number of experts involved. There is no strong relationship between the number of experts and the quality of results that can be produced from group discussions. After careful consideration, we have followed Adler and Ziglio's (1996) recommendation to ensure a manageable yet robust expert panel. A group of 12 professionals with expertise in special education, curriculum, and emotional well-being were carefully selected for a research project, which followed a rigorous and thoughtful process.

The selection criteria were strict, primarily emphasizing extensive professional experience. Each expert in the study possesses more than five years of practical experience in their respective fields (Berliner, 2004). The expert panel was carefully chosen to ensure a wide range of perspectives and insights from experienced individuals in the field of special education. These experts were selected based on their extensive experience and were invited to participate in the study by signing a consent letter agreement to provide feedback on the proposed emotional well-being model.

The study aims to use the fuzzy Delphi approach to reach a comprehensive consensus and enhance the framework for modeling emotional well-being in Malaysian special education post-pandemic. Table 1 describes each expert.

Table 1: Demographic data of the expert

Expert	Gender	Academic qualification	Field of expertise	Years of experience
E1	Male	PhD	Special education	30
E2	Male	PhD	Psychology	5
E3	Male	PhD	Curriculum	10
E4	Male	PhD	Pedagogy	7
E5	Male	PhD	Technology	6
E6	Male	PhD	Curriculum	9
E7	Male	PhD	Psychology	10
E8	Male	PhD	Special education	15
E9	Male	Master	Special education	20
E10	Female	PhD	Curriculum	10
E11	Female	Master	Special education	12
E12	Female	Master	Special education	10

According to the information provided in Table 1, 12 specialists completed the verification questionnaire. Of these experts, nine are male, and three are female. Of the 12 participants, nine hold a PhD degree, and the remaining three have a master's degree. All 12 specialists boast over five years of experience in their respective fields of expertise. Various experts focus on the emotional well-being of special needs students across different sectors. This is in line with De Saá-Pérez et al. (2017), who suggested that a mix of academic knowledge, professional experience, and sector diversity can strengthen research findings by encouraging the exchange of knowledge, fresh combinations, and

improved citation impact. The input and feedback from these experts played a crucial role in developing a relevant and practical emotional well-being model for special needs students in the post-COVID-19 context.

Step 3: Next, collecting and distributing relevant data to the expert panel is a key phase in the research process. It is crucial to collect and distribute relevant data to the expert panel, enabling them to offer well-informed insights and opinions. The collected data may include previous research findings, statistical data, and other materials to assist the experts in their evaluation and decision-making processes. Once the data was compiled, our team shared it with the expert panel in a clear and organized manner, allowing them to review and analyze the information thoroughly. The purpose of this step is to help the experts thoroughly understand the research topic and develop a well-informed consensus using the fuzzy Delphi approach. By ensuring that all experts have access to the same information, this phase also helps to reduce bias and increase the validity and reliability of our research findings.

Step 4: Converting variables to Triangular Fuzzy Numbers involves transforming data from a Likert scale to a Fuzzy scale. This method represents uncertainties and imprecisions associated with human responses in a nuanced way. Discrete values on the Likert scale are assigned a triangular fuzzy set, representing the degree of uncertainty or imprecision. Adopting Triangular Fuzzy Numbers acknowledges the vagueness inherent in human perceptions, resulting in a more realistic representation of data.

Zadeh et al. (1977) introduced the concept of fuzzy sets in 1965 as a formal framework for representing and modeling ambiguity and imprecision associated with linguistic terms. These terms are linked to linguistic variables such as temperature, age, and speed and convey uncertainties that cannot be precisely captured by conventional set theory. Fuzzy numbers, a specialized category of fuzzy sets, were also introduced to encapsulate imprecision within quantities, in contrast to the precise nature of real numbers. Further research by Dubois and Prade (1978) and Wang and Wang (2014) explored the arithmetic operations applicable to fuzzy numbers and elucidated their inherent properties. A subclass of fuzzy numbers is characterized by a triangular shape called Triangular Fuzzy Numbers (TFN). Fig. 2 illustrates the value of the Triangular fuzzy number.

Triangular Fuzzy Numbers (TFN) provide a means of gauging attitude or consensus, much like the Likert scale. The greater the fuzziness of the scale, the more precise the data becomes. Additionally, TFN can transform an expert's Likert scale rating into a fuzzy score. It is crucial to remember that TFNs must comprise odd numbers, such as 3, 5, or 7. Each response contains three values: the lowest possible value (n1), the most probable value (n2), and the highest possible value (n3).

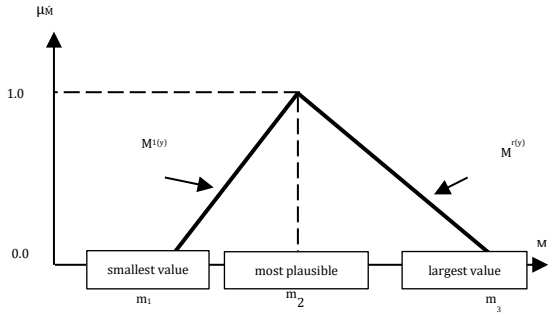

Fig. 2: Triangular fuzzy number

The TFN aims to identify any uncertainty or inaccuracy in the expert's opinion. Due to their fixed nature, certain income components cannot be measured effectively using a Likert scale. For instance, if experts give "Emotional health examination and evaluation" a score of 5, indicating strong agreement, the scores will be transformed into three values: a minimum value of 0.6, a most reasonable value of 0.8, and a maximum value of 1.0, representing blur scores. For the corresponding items, an expert agrees with 60%, 80%, and 100% percentages. The fuzzy scores are then averaged based on m1, m2, and m3 values for the subsequent Defuzzification procedure. Table 2 explains the TFN for the 5 and 7 Likert scales.

Table 2: The difference between Likert scale scoring and fuzzy scoring for a five-point scale and seven-point scale

Scale	Level	Likert scale	Fuzzy scale		
7	Strongly agree	7	0.90	1.00	1.00
	Very agree	6	0.70	0.90	1.00
	Agree	5	0.50	0.70	0.90
	Moderately agree	4	0.30	0.50	0.70
	Disagree	3	0.10	0.30	0.50
	Very disagree	2	0.00	0.10	0.30
	Strongly disagree	1	0.00	0.00	0.10
5	Strongly agree	5	0.75	1.00	1.00
	Agree	4	0.50	0.75	1.00
	Moderately agree	3	0.25	0.50	0.75
	Disagree	2	0.00	0.25	0.50
	Strongly disagree	1	0.00	0.00	0.25

To conduct the analysis, we utilized the Fuzzy Delphi technique, which involved presenting a set of items to experts for evaluation using a Likert scale. These experts could also provide feedback and suggestions on the instruments via blank spaces. The data gathered from the Likert scales was then processed using Microsoft Excel and transformed into a triangular fuzzy number. Our study employed a seven-point Fuzzy scale.

Step 5: The next step, calculating the distance between two fuzzy numbers, is critical in determining the threshold value, referred to as 'd.' and calculated using the formula as follows:

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]} \quad (1)$$

After obtaining the value, a threshold (d-construct) was calculated using the formula below:

$$Threshold\ value\ (d-construct)= \frac{\sum Average\ threshold\ value,(d)\ for\ each\ item}{Total\ experts \times Total\ items\ in\ constructs} \quad (2)$$

This parameter, influenced by the work of Hansen (2000) and Cheng and Lin (2002), plays a crucial role in achieving expert consensus in the study. According to the set condition, if the calculated Threshold value (d) ≤ 0.2, all experts have reached a consensus. This threshold value indicates an acceptable range of variation in opinions and perspectives. However, if the calculated (d-Construct) exceeds 0.2, it implies a divergence of expert opinions. In such cases, the consensus-building process may require a second round of discussions or a review of items, allowing experts to revisit and refine their assessments. Alternatively, removing certain items could streamline the consensus-building process.

Step 6: Next, we evaluate the expert consensus, a critical threshold of 75%. If the overall agreement for the entire construct is 75% or more, it indicates a significant consensus among specialists. The 75% threshold for individual items ensures that each component achieves at least 75% agreement (Chu and Hwang, 2008; Murry Jr and Hammons, 1995).

Step 7: The final step is the fuzzy evaluation process, determining the ranking for each variable or sub-variable in a study. Three formulas are used to calculate the aggregated measure of importance associated with multiple evaluations assigned to a given variable or sub-variable.

$$A = \sqrt{\frac{1}{3}} \times (m_1 + m_2 + m_3) \quad (3)$$

$$A = \sqrt{\frac{1}{4}} \times (m_1 + 2m_2 + m_3) \quad (4)$$

$$A = \sqrt{\frac{1}{6}} \times (m_1 + 4m_2 + m_3) \quad (5)$$

Eq. 3 balances the evaluations by taking the arithmetic mean of the three. This ensures that each assessment is equally important to the overall measure. Eq. 4 gives more weight to the middle evaluation. It is assigned twice the weight of the other evaluations, reflecting the potential significance of this assessment. Eq. 5 gives the middle evaluation even more weight. It is assigned four times the weight of the other evaluations, capturing instances where a moderate evaluation holds particular importance.

The fuzzy evaluation process provides a systematic and flexible method for determining rankings by allowing varied considerations of the importance of each evaluation in the overall assessment of variables or sub-variables. The resulting 'A' value is then compared to the α-cut value. If 'A' is less than 0.5, it signals expert consensus in rejecting the item. Conversely, if 'A' exceeds 0.5, it signifies expert consensus to accept the item in question (Bodjanova, 2006). This α-cut-based decision-making process is a critical determinant in accepting or rejecting items within the study.

In this research, the Fuzzy Delphi Technique was chosen over the traditional Delphi technique due to its potential to save time and resources in survey management. Moreover, this approach enables experts to consistently offer well-rounded perspectives, facilitating an efficient and comprehensive consensus-building process.

4. Result and discussion

The appendix presents the fuzzy number of each appraisal indicator after undergoing the process of fuzzy estimation. Tables 3–9 feature the most significant indicators and appraisal consensuses in terms of the primary component of emotional well-being for special needs students after COVID-19, relying on expert consensus. According to the experts, digital learning support, counseling, emotional well-being services, and parental and community engagement represent the three most crucial components among all six. This result aligns with the findings of Guzzo et al. (2022), Masi et al. (2021), and O'Connor Bones et al. (2022), who highlighted these components' importance towards students' emotional well-being with special educational needs after COVID-19. The remaining three components, i.e., educational adjustment, pandemic-related support, and social relations and emotional support, are also regarded as critical by the experts. For each component, we have specified the elements that must be part of the emotional well-being model for individuals with special needs post-pandemic. Table 3 demonstrates that all components possess a threshold value (d) within 0.124-0.143 ≤ 0.2, expert consensus percentages (%) between 87% and 93%, and a fuzzy score value (A) ≥ 0.5 between 0.762 and 0.780. The components fulfill the conditions for the fuzzy Delphi method.

Table 3: Findings of fundamental main component of the emotional well-being for students with special educational needs post-COVID-19 through expert consensus

No.	Component of model	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Digital learning support	0.143	87%	0.980	0.920	0.780	0.780	Accepted	1
2	Pandemic-related support	0.124	93%	0.990	0.950	0.820	0.762	Accepted	5
3	Counseling and emotional well-being services	0.143	87%	0.910	0.780	0.960	0.780	Accepted	1
4	Parental and community engagement	0.143	87%	0.970	0.800	0.930	0.780	Accepted	1
5	Educational adjustment	0.137	87%	0.990	0.950	0.820	0.769	Accepted	4
6	Social relations and emotional support	0.124	93%	0.950	0.990	0.820	0.762	Accepted	5

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for digital learning support: Providing digital learning support requires five crucial elements, including stable technological infrastructure, digital learning resources, technical support, technology use training, and the support of trained teachers (Yusoff et al., 2020). While all these elements are important, experts consider stable technological infrastructure, technical support, and technology use training to be the most crucial. Guzzo et al. (2022) emphasized the need to prioritize improving network infrastructure and ensuring that all students have access to necessary digital tools. In the long run, it is also essential to train teachers and students in digital skills, revise curricula, and implement new teaching and assessment methods. Technical actions must include developing inclusive tools and interactive platforms. Therefore, providing digital learning support requires long-term efforts from everyone involved. According to Table 4, each component satisfies the FDM criteria. The threshold value (d) falls within 0.124-0.143, which is less than or equal to 0.2. The expert consensus percentages (%) range between 87% and 93%, and the fuzzy score value (A) lies between 0.762 and 0.780, which is greater than or equal to 0.5.

Table 4: Findings of the elements for digital learning support of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for digital learning support	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Stable technological infrastructure	0.143	87%	0.780	0.910	0.960	0.780	Accepted	1
2	Digital learning resources	0.124	93%	0.820	0.950	0.990	0.762	Accepted	5
3	Technical support	0.143	87%	0.800	0.930	0.970	0.780	Accepted	1
4	Technology use training	0.143	87%	0.780	0.920	0.980	0.780	Accepted	1
5	Support of trained teachers	0.137	87%	0.800	0.940	0.990	0.769	Accepted	4

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for pandemic-related support: Five essential elements need to be addressed to ensure pupils with special educational needs are provided with adequate support in the post-COVID-19 era. These elements include teacher and family support for hybrid learning transitions, healthcare and hygiene education, assessment of the impact of online learning, provision of information and effective communication, and support and training for teachers and staff. According to expert consensus, the requirement of information and effective communication are the most critical elements, among others. This aligns with Dalton et al.'s (2020) statement, which suggests that effective communication with children can protect their psychological health. According to Table 5, the threshold value is between 0.076 and 0.132, which is equal to or less than 0.2. The expert consensus percentages range from 90% to 100%, and the fuzzy score value is between 0.883 and 0.920, which is equal to or greater than 0.5.

Table 5: Findings of the elements for Pandemic-Related Support of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for pandemic-related support	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Teacher and family support for hybrid learning transitions	0.076	100%	0.800	0.950	1.000	0.917	Accepted	2
2	Healthcare and hygiene education	0.128	100%	0.760	0.910	0.980	0.883	Accepted	2
3	Assessment of the impact of online learning	0.103	90%	0.800	0.940	0.990	0.910	Accepted	3
4	Provision of information and effective communication	0.098	90%	0.820	0.950	0.990	0.920	Accepted	1
5	Support and training to teachers/staff	0.132	100%	0.800	0.930	0.980	0.903	Accepted	4

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for counseling and emotional well-being services: It is important to consider five key components to provide a comprehensive emotional well-being service. These include emotional health examination and evaluation, counseling and psychotherapy services, online services, stress management skills training, and emotional well-being campaigns for pupils with special educational needs. Among these components, stress management skills training is the most significant and valuable for promoting positive emotional health. During challenging times such as pandemics, it is crucial to offer targeted support and attention to parents of children with developmental disorders. Recent research by Martinsone and Tzivian (2021) highlights the significance of this approach in alleviating difficulties faced by families. The study emphasizes the need to establish a support system

that caters to the unique needs of these parents. Such an initiative would provide them with the necessary resources to cope with the challenges associated with raising a child with developmental disorders during difficult times. Based on the information provided in Table 6, the threshold value falls within the range of 0.064 to 0.132. This value is equal to or less than 0.2. The expert consensus percentages range from 90% to 100%, indicating a high level of agreement among the experts. Additionally, the fuzzy score value falls within the range of 0.883 to 0.937, which is equal to or greater than 0.5.

Table 6: Findings of the elements for counseling and emotional well-being services of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for counseling and emotional well-being services	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Emotional health examination and evaluation	0.098	90.0%	0.820	0.950	0.990	0.920	Accepted	2
2	Counselling and psychotherapy services	0.132	100.0%	0.800	0.930	0.980	0.903	Accepted	4
3	Online services	0.128	100.0%	0.760	0.910	0.980	0.883	Accepted	5
4	Stress management skills training	0.064	100.0%	0.840	0.970	1.000	0.937	Accepted	1
5	Emotional well-being campaigns for pupils with special educational needs	0.103	90.0%	0.800	0.940	0.990	0.910	Accepted	3

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for parental and community engagement: Experts have determined that parental and community engagement can be improved through various methods, including resilience workshops and training, effective communication, psychosocial support, and collaboration in educational planning. Psychosocial support is the most preferred approach among all the measures. This aligns with the findings of the Harrop et al. (2022) study, which recommends strategies to improve communication and allocate adequate resources for bereavement and mental health services in schools and communities. Increasing awareness and providing guidance on available support can also be significantly beneficial. Therefore, resources and initiatives should be developed to foster supportive communication within families and schools, while appropriate resources should be allocated to provide specialist bereavement and mental health services (Sanders et al., 2021). Increasing awareness and guidance on available support can be particularly useful in this context. According to the data provided in Table 7, the threshold value falls within the range of 0.049 to 0.098, which meets the criterion of being equal to or less than 0.2. The expert consensus percentages range from 90% to 100%, which indicates a high level of agreement among the experts. In addition, the fuzzy score value falls within the range of 0.920 to 0.947, which is equal to or greater than 0.5, satisfying the FDM requirements.

Table 7: Findings of the elements for Parental and community engagement of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for parental and community engagement	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Resilience workshop/training	0.098	90.0%	0.820	0.950	0.990	0.920	Accepted	4
2	Effective communication	0.064	100.0%	0.840	0.970	1.000	0.937	Accepted	2
3	Psychosocial support for parents/guardians	0.049	100.0%	0.860	0.950	1.000	0.947	Accepted	1
4	Collaboration in educational planning	0.073	100.0%	0.820	0.960	1.000	0.927	Accepted	3

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for educational adjustment: The educational adjustment construct comprises several elements that are crucial for effective education. These include a flexible, individualized education plan (IEP), a pupil-centered approach, alternative assessment techniques, and collaboration with special education experts. Among these, the IEP is considered the most preferable by experts. During the COVID-19 pandemic, participants worked with parents to adjust individualized education programs to cope with the challenges. A study conducted by Hurwitz et al. (2022) revealed that some students

preferred virtual instruction, which raised concerns about the future of education. However, the participants showed remarkable resilience. The implementation of IEP allows for personalized education that caters to each student's unique strengths, weaknesses, and learning styles (Kouo et al., 2024). A pupil-centered approach ensures that the student's needs, interests, and preferences are considered during the learning process. Alternative assessment techniques provide a more comprehensive evaluation of a student's progress and performance than relying solely on standardized tests. Collaboration with special education experts ensures that the educational program is inclusive and meets the needs of all students. The COVID-19 pandemic posed unprecedented challenges to the field of education. However, the participants demonstrated their adaptability and resilience by collaborating with parents and adjusting individualized education programs. The preference for virtual instruction raises concerns about the future of education and how it may continue to evolve to meet the needs of students. The data provided in Table 8 indicates that the threshold value falls within the acceptable range of 0.073 to 0.140, satisfying the criterion of being less than or equal to 0.2. The expert consensus percentages range between 90% and 100%, indicating a high degree of agreement amongst the experts. Furthermore, the fuzzy score value ranges between 0.880 and 0.927, satisfying the FDM requirements of being greater than or equal to 0.5.

Table 8: Findings of the elements for educational adjustment of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for educational adjustment	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	IEP	0.073	100.0%	0.820	0.960	1.000	0.927	Accepted	1
2	Pupil-centered approach	0.137	90.0%	0.760	0.910	0.970	0.880	Accepted	4
3	Alternative assessment	0.076	100.0%	0.800	0.950	1.000	0.917	Accepted	2
4	Collaboration with special education experts	0.140	90.0%	0.800	0.930	0.970	0.900	Accepted	3

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

Elements for social relations and emotional support: Social relationships and emotional support are crucial for maintaining good mental health, particularly during times of crisis. Emotional reduction of social isolation and peer support groups are two essential components that contribute significantly to achieving this. According to the FDM result, peer support groups have been ranked as a top priority compared to reducing social isolation, as per expert consensus. Encouragingly, a recently conducted study by Suresh et al. (2021) highlighted the effectiveness of peer support groups in improving mental health during the COVID-19 pandemic. This study suggests that peer support groups can be a valuable tool for enhancing emotional well-being and may prove to be vital in future crises. Based on the data presented in Table 9, it can be observed that the threshold value falls within the range of 0.103 and 0.155, which satisfies the stipulation of being less than or equal to 0.2. The expert consensus percentages range from 90% to 100%, signifying a substantial level of consensus among the experts. Additionally, the fuzzy score value falls within the range of 0.867 and 0.910, thus meeting the FDM requirements as it is greater than or equal to 0.5. As illustrated in Fig. 3, the study summarizes the inclusion of six principal components essential for fostering emotional well-being among students with special educational needs in the post-COVID-19 era. All these key components require every unit of element needed to ensure the emotional well-being of students with special education needs post COVID in Malaysia.

5. Implication

The results of this study hold significant academic and practical implications. Firstly, the research highlights crucial components for crafting customized emotional well-being models for students with special educational needs, particularly in the post-COVID-19 era. This recognizes and manages the unique emotional challenges faced by this demographic. Secondly, educators can leverage these findings to inform and improve their strategies for promoting emotional well-being in special education settings. Teachers can create targeted interventions and support systems by understanding the identified elements.

Table 9: Findings of the elements for social relations and emotional support of the emotional well-being model of pupils with special educational needs post-COVID-19 through expert consensus

No.	Elements for social relations and emotional support	Conditions of triangular fuzzy numbers		Conditions of fuzzy evaluation process				Expert consensus	Ranking
		Threshold value, d	Percentage of expert group agreement, %	m_1	m_2	m_3	Fuzzy score (a)		
1	Reduction of social isolation	0.155	100.0%	0.740	0.850	0.970	0.867	Accepted	2
2	Peer support group	0.103	90.0%	0.800	0.940	0.990	0.910	Accepted	1

For triangular fuzzy numbers: threshold value (d) ≤ 0.2 and experts consensus percentages (%) ≥ 75.0%; For fuzzy evaluation process: score fuzzy value (a) ≥ 0.5

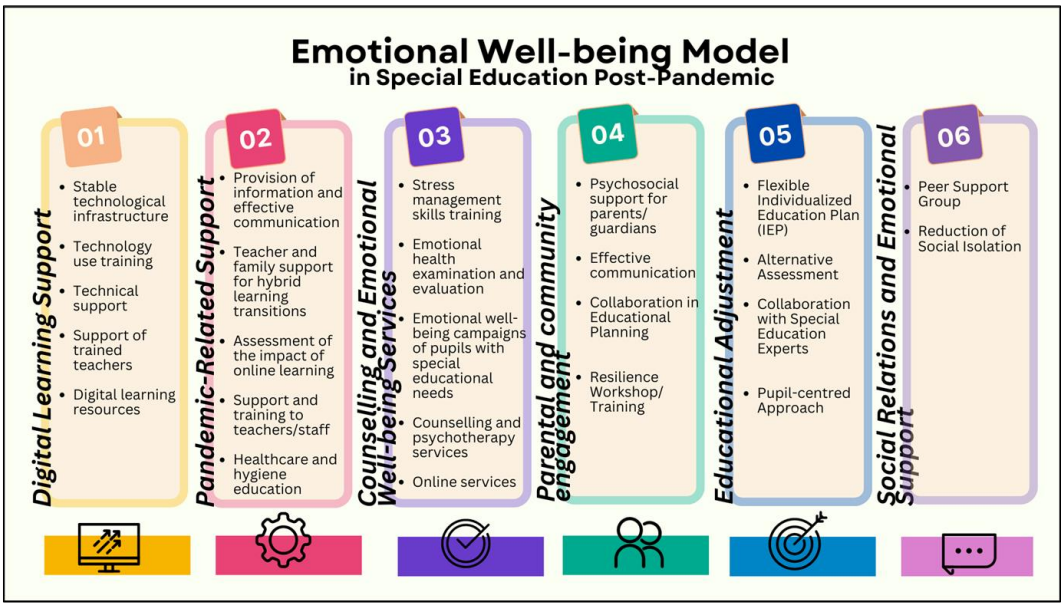

Fig. 3: Emotional well-being model in special education post-pandemic

In addition, the outcomes provide valuable insights into resource allocation for educational institutions and policymakers. By understanding the various factors that impact emotional well-being, decision-makers can effectively prioritize their resources. The study suggests that targeted professional development for educators and professionals working with special education students in areas related to emotional well-being is necessary. Training programs can be designed to improve students' ability to manage their emotions effectively. Furthermore, integrating the identified constructs into educational practices promotes a student-centric approach to addressing the unique emotional needs of special education students. The study emphasizes the importance of educators and parents/caregivers working closely to recognize the significance of emotional well-being for this group. These stakeholders can collaborate to develop a comprehensive support system using the identified constructs. The emotional well-being model outlined in the research can serve as a foundation for promoting long-term resilience in special education students. Strategies developed from the study can contribute to developing coping mechanisms and emotional stability beyond the immediate post-COVID-19 period. These findings offer practical guidance for developing targeted interventions, allocating resources, providing professional development, and fostering collaborative efforts to support the emotional well-being of special education students in the post-COVID-19 educational landscape.

6. Limitations and directions for future research

It is crucial to acknowledge certain limitations that may impact the interpretation of our findings as we progress with our study. To begin with, we used the fuzzy Delphi method to establish expert consensus dynamics, which may introduce subjectivity due to individual perspectives, professional backgrounds, and experiences that can influence consensus. This subjectivity may affect the identified emotional well-being constructs. Since our study focuses on the post-COVID-19 period, we must consider temporal factors regarding the dynamic nature of emotional well-being. Our findings may only partially capture the evolving needs over an extended period. It is essential to remember that the emotional well-being model developed in our study may only be relevant to special education in a post-COVID-19 context and may not be universally applicable to diverse educational settings or future periods. Lastly, we acknowledge the potential bias that our chosen experts' backgrounds and expertise may introduce. This bias could unintentionally overlook certain significant emotional well-being aspects for students with special educational needs.

7. Conclusion

In conclusion, this study employed the Fuzzy Delphi Method to systematically pinpoint and validate essential constructs for a model of emotional well-being tailored to students with special educational needs after COVID-19. This research not only deepens our comprehension of the specific requirements of this vulnerable group but also makes a significant contribution to the special education field. By providing a detailed framework for educational professionals and policymakers, the findings advocate for the implementation of a structured emotional well-being model. This approach promises to significantly bolster resilience, inclusivity, and overall educational outcomes for these students, thereby supporting their academic and personal development in a post-pandemic context.

The research emphasizes the crucial need for strong emotional support systems within educational frameworks to meet the unique

challenges faced by students with special educational needs, particularly in the aftermath of the pandemic. Aligning with the UN's (2015) Sustainable Development Goals on quality education and good health, our study presents a blueprint for global educational systems to create environments that are intellectually stimulating and supportive of mental and emotional health. This integration of findings into educational policies and practices is proposed as a catalyst for fostering a holistic educational approach, wherein emotional well-being is as fundamental as academic success. Looking ahead, it is vital that research continues to explore the evolving needs of students with special educational needs as they navigate the complexities of recovery post-pandemic. Future studies should refine the proposed models based on feedback from real-world applications and expand their applicability to diverse educational and cultural contexts. Longitudinal studies could provide insights into the long-term effectiveness of these models, ensuring they adapt to and meet the changing needs of students throughout their educational and personal journeys. Such ongoing adaptation and evaluation are essential for maintaining the relevance and impact of the emotional well-being frameworks developed through this research.

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Compliance with ethical standards

Ethical considerations

All participating experts provided informed consent, and their anonymity and confidentiality were maintained throughout the study. This research adhered to ethical guidelines for studies involving human participants, ensuring transparent and voluntary participation.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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