

The Fuzzy Delphi Method: Validation of the Personal Qualities and Abilities Elements in Career Readiness Instrument for Students with Disabilities

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Abstract

This study seeks to achieve expert consensus on the items created for personal qualities and abilities elements in the career readiness assessment tool for students with disabilities. The study utilised the Fuzzy Delphi Method (FDM) using a seven-point Likert scale to collect reviews from 13 experts in diverse disciplines such as special education, batik making, textiles, food & beverage, laundry, and cleaning services. The research instrument comprises five items for personal qualities and abilities elements. The data was analysed utilising Triangular Fuzzy Numbers and the Defuzzification Process. The results suggest that expert comments and consensus on the instrument's constructions are satisfactory. The study found that the expert consensus was above 75%, with a Threshold (d) value below 0.2 and a cut value above 0.5. All five items in the personal quality and ability elements for students with disabilities satisfied the Triangular Fuzzy Numbers criteria and were approved. Thus, this indicates that all items have obtained expert consensus and are essential for evaluating the professional preparation of students with exceptional needs. FDM can amalgamate expert perspectives to reach a consensus on item validation, ensuring the reliability and relevance of the built items.

Keywords: Fuzzy Delphi Method, Instrument Validity, Career Readiness, Work Readiness, Students with Disabilities.

Introduction

In the lives of young adults, the shift from education to employment is an essential phase that has long-term ramifications for the individual's ability to obtain financial independence, social integration, and general well-being (Wehman, 2020). It can be especially difficult for students who have disabilities to make this transition since they frequently confront hurdles and impediments that are not experienced by their peers who do not have disabilities (Jahoda et

al., 2008; Lindsay, 2011). Individuals with disabilities continue to face shockingly high rates of unemployment and underemployment even though efforts have been made to promote inclusive education and equitable opportunity (Morwane et al., 2021; Shier et al., 2009). The purpose of ensuring that these students are sufficiently equipped for the workforce is not only an issue of social fairness, but it is also an essential step towards tapping into a valuable pool of ability and potential (Omar et al., 2022).

The concept of career readiness, which may be described as the possession of the required skills, knowledge, and traits to traverse the world of work successfully, is a comprehensive construct that incorporates a variety of cognitive, technical, and interpersonal competencies (National Association of Colleges and Employers, 2023). Attaining career readiness is essential for students with disabilities to obtain favourable outcomes after leaving school and live satisfying lives. Students with disabilities can achieve positive outcomes and excel in general education when they have access to a challenging curriculum and are held to high expectations by both educators and families. Cultivating career preparation skills also fosters inclusivity by enabling students to engage with their non-disabled peers and actively participate in general education programmes, resulting in improved outcomes. Furthermore, professional preparation comprises a broad spectrum of fundamental capabilities, such as core academics, information about college and careers, social-emotional skills, advanced cognitive abilities, employability, and continuous learning throughout one's life. Acquiring these skills is crucial for achieving success.

There are several obstacles that can impede the development of these capabilities for students with disabilities (Ta & Leng, 2013). These problems include limited access to chances for career exploration, a lack of suitable accommodations and support services, and negative attitudes or low expectations from society (Noor et al., 2018; Rosli, 2021). Hiring managers may develop unconscious prejudices that cause them to have a more negative perception of the work capabilities of candidates with disabilities, regardless of their qualifications. Employers may hold the perception that workers with impairments are not able to contribute equally, perform at full capacity, or possess the same level of ability as other workers. In addition, students with disabilities may have limited access to internships and entry-level positions, which can hinder the development of important soft skills such as communication, interpersonal skills, and decision-making ability. Therefore, a significant number of these students feel that they are not adequately prepared to make well-informed decisions on their careers, to create methods that are helpful for job searching, or to succeed in professional environments (Sek-yum Ngai et al., 2023; Shaffeei et al., 2020).

Career Readiness Instrument

A career readiness instrument is a tool created to evaluate persons' readiness, especially students, for the workforce (Dodd et al., 2022). The tests assess many aspects of job preparedness, including career knowledge, skills, attitudes, and behaviours necessary for successful employment (Grosemans et al., 2020). These instruments aim to provide an objective measure of an individual's strengths and areas for improvement in career-related competencies (Blalock et al., 2006). The results can help identify gaps and inform interventions or support services needed to enhance career readiness. There are different types of career readiness tools that serve certain goals in assessing and improving students' readiness for the job market.

a. Surveys and Questionnaires

These are the most common types of career readiness instruments. They use structured questions to gather data on various aspects of career readiness. Examples include the Career Readiness Self-Assessment and the Career Development Competencies Assessment.

b. Performance Assessments

These involve evaluating students' performance in real or simulated work scenarios. For instance, a project-based assessment might require students to complete a task that mirrors workplace activities, allowing evaluators to assess their practical skills and problem-solving abilities.

c. Portfolios

Students compile a collection of work samples, reflective essays, and records of experiential learning. Portfolios provide a comprehensive view of students' abilities and development over time.

d. Interviews and Focus Groups

These qualitative methods allow in-depth exploration of students' career readiness, providing insights into their attitudes, motivations, and perceived barriers. Interviews and focus groups can complement quantitative data, offering a richer understanding of the student's career readiness.

Career Readiness Instruments are valuable tools in the workplace for fostering employee development, enhancing recruitment, supporting career progression, and boosting engagement and productivity. By implementing these tools, organizations can ensure that their workforce is equipped with the necessary skills to succeed, aligning employee capabilities with organizational goals and creating a more dynamic and efficient work environment.

Career Readiness Instruments for Students with Disabilities

Career Readiness Instruments for students with disabilities are specialized tools designed to evaluate and enhance the skills and preparedness of these students for entering the workforce (National Association of United States Colleges and Employers, 2019). These instruments consider the unique challenges and needs of students with disabilities, providing tailored assessments that focus on their strengths, areas for improvement, and specific accommodations they may require (de Castro & Liezel A Vargas, 2017). By doing so, they help ensure that students with disabilities receive the appropriate support and resources to develop the necessary skills for successful career transitions. The instruments developed in this study are based on "Work Readiness Skills for the Commonwealth" and "College and Career Readiness for Transition."

A 25-year study conducted by the University of Virginia shows a high demand for career readiness skills in Commonwealth countries, and one of the important elements in this study is "personal qualities and abilities" (Crespin et al., 2017). "Personal qualities and abilities" refers to the characteristics, attributes, and competencies that define an individual's personal and professional effectiveness. This includes traits such as (i) Creativity & innovation, (ii) critical thinking & problem-solving, (iii) Initiative & self-direction, (iv) integrity and (v) work

ethic. These qualities enable a person to perform effectively in various situations, work well with others, and contribute positively to their environment (Green et al., 2023). Table 1 shows the basic characteristics of each trait in terms of personal quality and ability elements.

Table 1

Basic Characteristics of Each Traits

Traits	Characteristics
Integrity	Complies with laws, procedures, and workplace policies; demonstrates honesty, fairness, and respect.
Work ethic	Consistently works to the best of one's ability and is diligent, dependable, and accountable for one's actions.
Creativity & innovation	Employs originality, inventiveness, and resourcefulness in the workplace.
Initiative & self-direction	Independently looks for ways to improve the workplace and accomplish tasks.
Critical thinking & problem-solving	Uses sound reasoning to analyze problems, evaluate potential solutions, and implement effective courses of action.

(Source: 21st Century Workplace Readiness Skills for the Commonwealth by the Virginia Department of Education's Office of Career, Technical, and Adult Education).

"Personal qualities and abilities" element are crucial for both personal and corporate achievement in the professional environment (Horrillo et al., 2021). Creativity and innovation empower employees to go beyond conventional boundaries, tackle challenges with fresh perspectives, and produce original ideas that foster ongoing enhancement and flexibility (Cousevic, 2022). The ability to think critically and solve problems is extremely valuable for recognising problems, examining situations, and discovering efficient solutions, guaranteeing that obstacles are overcome effectively and efficiently. Initiative and self-direction exemplify ambition and determination, enabling individuals to proactively take action, propose ideas, and handle setbacks with resilience and assurance (Nur Lyana Baharin & Wan Noordiana Wan Hanafi, 2019). Integrity cultivates a workplace atmosphere that is characterised by trust, professionalism, maturity, accountability, and a positive demeanour, resulting in a constructive and respected environment. Finally, possessing a robust work ethic characterised by conscientiousness, effectiveness, and flexibility guarantees a steady level of excellence and the capacity to excel in rapidly changing and dynamic settings (Saadah Abdullah et al., 2020). These attributes collectively enhance the efficiency, creativity, and moral standards of a company.

Methodology

Research Design

This study is quantitative in nature and applies the Fuzzy Delphi Method (FDM) to achieve expert consensus on the constructs for the quality elements and personal abilities required by employers for MBPK based on expert consensus. This method involves the use of fuzzy set theory integrated into the classical Delphi method, where the Likert scale selected by experts is converted to a fuzzy scale using fuzzy numbering, which consists of binary terms (0,1). The integration of fuzzy numbering will yield three values: the minimum value, the most reasonable value, and the maximum value, which will be selected by the experts.

Instrument

This study uses a questionnaire as an instrument to obtain quantitative data regarding the constructs for the quality and personal abilities elements required by employers for MBPK. The questionnaire has undergone expert review and refinement and has received language validation and content validation from subject matter experts and curriculum experts. The questionnaire meets the criteria and requirements for using the Fuzzy Delphi Method (FDM), which involves using mathematical formulas to achieve expert consensus. The instrument used by the researcher is based on the needs of this study.

Data Analysis Procedure

The data collection and analysis process for this study is based on the implementation steps of the Fuzzy Delphi Method (FDM) as follows:

Step 1: Selection of experts

To implement the Fuzzy Delphi Method (FDM) in this study, the researcher identified a group of experts who agreed to contribute their expertise by providing ideas, critiquing, and improving the content of the items determined by the researcher. The experts in this study consist of employers and teachers from Vocational Special Education Schools. The method for selecting the sample of experts was non-probability sampling, specifically purposive sampling, chosen based on the purpose of evaluating their knowledge and experience. The researcher suggests that the criteria for selecting experts should also include the willingness of individuals to be appointed as experts. Willingness is important to ensure that the experts are genuinely willing to assist the researcher and have sufficient time to participate in the study. Initially, 20 experts were identified to validate this survey instrument. However, only 13 agreed to cooperate, take the time, and willingly assist the researcher. According to Clayton (1997), a number of 10 to 15 experts are considered a homogeneous group of experts, which is the small sample size required as experts. Table 2 below shows the expert's profile involved in this study.

Table 2
Experts Profile

Experts	Field	Sex	Age	Experience (Year)
E1	Food & Beverage	Male	42	20
E2	Cleaning Service	Female	40	15
E3	Dress Making	Male	44	10
E4	Laundry	Male	38	12
E5	Bakery	Female	45	12
E6	Hand Craft	Female	46	23
E7	Landscape	Male	38	16
E8	Human Resource	Female	39	10
E9	Education	Female	42	19
E10	Education	Male	40	14
E11	Education	Male	37	11
E12	Education	Female	48	22
E13	Education	Female	42	17

Step 2: Create a questionnaire for experts

In this process, the questionnaire can be constructed through several methods, namely interviews and literature reviews. (Powell, 2003) stated that the Delphi method is a very flexible method for achieving expert consensus. This is because the first round of Delphi is conducted to identify an issue through expert interviews. However, identifying and obtaining an issue can also be done through open-ended questions. There are also other methods for obtaining related issues, such as questionnaires from literature reviews (Duffield, 1993). In the phase of designing and developing the MBPK career readiness skills instrument, the foundation for the study is based on a combination of literature review mapping analysis and expert interviews in needs analysis. A total of 5 items for quality and personal abilities elements have been developed for the questionnaire in the design and development of the MBPK career readiness skills instrument.

Step 3: Distribute the questionnaire form

The researcher met all 13 experts individually face-to-face while distributing the questionnaire to collect data. During these meetings, the researcher and experts discussed each developed item.

Step 4: Linguistic variable transformation

This process involves converting all linguistic variable scales into Triangular Fuzzy Numbers. Triangular Fuzzy Numbers are represented by values m_1 , m_2 , and m_3 . m_1 represents the minimum value, m_2 represents the most reasonable value, and m_3 refers to the maximum value. Next, Triangular Fuzzy Numbers are used to generate a Fuzzy scale that utilizes a Likert scale for translating linguistic variables into Fuzzy numbers. The number of levels for the Fuzzy scale is odd. A higher Fuzzy scale provides more precise data. Figure 1 illustrates the minimum triangle graph against the Triangular value, which includes all three values in the Triangular Fuzzy Number.

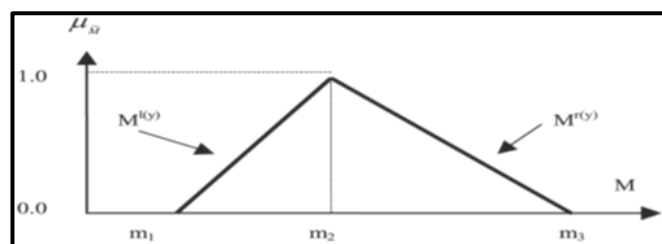


Figure 1: Minimum triangle graph against triangular. Adapted from Mohd Ridhuan Mohd Jamil & Nurulrabihah Mat Noh (2021).

Figure 1 shows the minimum triangle graph against Triangular with $m_1 = \text{nilai minimum}$, $m_2 = \text{nilai sederhana}$, and $m_3 = \text{nilai maksimum}$. The Likert scale data obtained were analyzed using Microsoft Excel software. All data were converted into Triangular Fuzzy Number format. A seven-point Fuzzy scale was used in this study. Table 3 shows the Fuzzy scale comprising linguistic variables indicating a 7-point scale in the Fuzzy Delphi method.

Table 3

Fuzzy Scale

Preferential Scale	7-point Fuzzy Scale	Likert Scale
Strongly disagree	(0.0, 0.0, 0.1)	1
Somewhat disagree	(0.0, 0.1, 0.3)	2
Disagree	(0.1, 0.3, 0.5)	3
Neutral	(0.3, 0.5, 0.7)	4
Agree	(0.5, 0.7, 0.9)	5
Somewhat disagree	(0.7, 0.9, 1.0)	6
Strongly disagree	(0.9, 1.0, 1.0)	7

Step 5: Data analysis

Data analysis is based on the scoring of Triangular Fuzzy Numbers aimed at obtaining Threshold (d) values. According to Thomaidis *et al.* (2006), identifying the Threshold (d) value is crucial for achieving expert consensus. To achieve expert consensus for each item, the first condition must be met is that the Threshold (d) value should not exceed or equal 0.2, indicating expert consensus has been reached (Cheng & Lin, 2002). The vertex method is used to calculate the distance between the average r_{ij} . The distance for each Fuzzy number $m = (m_1, m_2, m_3)$ and $n = (n_1, n_2, n_3)$ is calculated using the following formula:

$$(\tilde{m}, \tilde{n}) = \sqrt{13}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2].$$

Step 6: Determination of expert consensus percentage

The second condition to determine the percentage value of expert consensus is that the overall group consensus must exceed 75% for each item. If not, a second round needs to be conducted (Chu & Hwang, 2008; Murray *et al.*, 1985).

Step 7: Data analysis using the average of Fuzzy numbers or average response (Defuzzification process).

This analysis process aims to obtain a Fuzzy score (A). The third condition to be met to obtain the Fuzzy score (A) is that it must exceed or equal the median value (α -cut value), which is 0.5 (Bodjanova, 2006; Tang & Wu, 2010). This indicates that the element is accepted by expert consensus. Among other functions, the Fuzzy score (A) can be used to determine the position and priority of an element according to expert consensus. The formula involved in obtaining the Fuzzy score (A) is as follows:

- i. $A_{\max} = 1/3 * (a_1 + a_m + a_2)$
- ii. $A_{\max} = 1/4 * (a_1 + 2a_m + a_2)$
- iii. $A_{\max} = 1/6 * (a_1 + 4a_m + a_2)$

Alpha-cut value = median value for '0' and '1'. That is, α -cut = $(0+1)/2 = 0.5$. If the value of A produced is less than the α -cut value = 0.5, the item will be rejected because it does not show expert consensus. According to Bodjanova (2006) and Tang & Wu (2010), the α -cut value needs to exceed 0.5.

Research Findings

The developed Career Readiness consists of three elements, but in this article, the author only focuses on the elements of “personal qualities and abilities.” In this “personal qualities and abilities” element design construct, the items given to the experts are stated in Table 4. The constructs developed in this element are based on interviews with 13 experts.

Table 4

Items for the Element of Personal Quality and Abilities Design Construct

Traits	Items
A1 Creativity & innovation	The ability to understand job expectations regarding authenticity, creativity, and intelligence in the workplace. Students can generate new ideas, seek unique solutions, and think outside the box.
A2 Critical thinking & problem-solving	The ability to analyze situations carefully, identify problems, and find effective ways to overcome them.
A3 Initiative & self-direction	The ability to take responsibility, take initiative to act, and work with minimal supervision.
A4 Integrity	The ability to comply with laws and policies in the workplace demonstrates steadfastness in moral principles such as honesty, integrity, fairness, courage, and respect.
A5 Work ethic	The ability to act professionally in the workplace includes values, principles, and standards of behavior.

The threshold value (d), expert consensus percentage, defuzzification, and item position for the above items are shown in Table 5.

Table 5

Findings of Expert Consensus on Personal Quality and Abilities Element

Item	Condition of Triangular Fuzzy Numbers		Condition of Defuzzification Process		Position	Experts Consensus
	Threshold Value, d	Percentage of Experts Group Consensus, %	Fuzzy Score (A)			
A1	0.205	81.8%	0.788		4	Accepted
A2	0.205	81.8%	0.788		4	Accepted
A3	0.119	100.0%	0.882		3	Accepted
A4	0.071	100.00%	0.903		2	Accepted
A5	0.100	90.91%	0.906		1	Accepted

Condition:

Triangular Fuzzy Numbers

1) Threshold Value (d) ≤ 0.2
= 0.5

2) Percentage of Experts Consensus $> 75\%$

Defuzzification Process

3) Fuzzy Score (A) $\geq \alpha$ – cut value

Based on the findings in Table 5 above, all items recorded a value of Threshold (d) ≤ 0.2 . This result indicates that all of these items have gained an expert consensus (Cheng & Lin, 2002). The expert agreement percentage shows that all items are above 75%, and all defuzzification values for items also exceed the value of α - cut = 0.5. The result shows that the items in quality and personal abilities element have gained consensus from the experts.

Discussion

The results of the FDM analysis in this study have produced a list of constructs for personal qualities and abilities in career readiness instruments. The initial FDM findings show high validity and reliability (Jamelaa Bibi & Siti Ilyana, 2018). The analysis results on expert consensus indicate a good level of agreement, demonstrating that FDM can be used to obtain expert consensus as respondents based on quantitative methods (Marwan & Ali, 2019). The findings from the analysis using the Fuzzy Delphi technique revealed items that were agreed upon and prioritized by the experts for each construct. The results indicate that all these items should be incorporated into the design and development of the career readiness assessment tool for students with disabilities.

Through this FDM analysis, the prioritization of item arrangement begins with the construct (i) work ethics, (ii) integrity, (iii) initiative & self-direction, (iv) critical thinking & problem-solving, and (v) creativity & innovation. All experts agreed that these attributes help students with disabilities build confidence, foster independence, and effectively engage in educational and social environments. Students with disabilities who focus on their personal qualities and abilities are well-positioned to thrive in the workplace (J.francois et al., 2010). Students are able to develop their full potential even further when they are given the opportunity to embrace diversity, receive training, and receive support from employers.

The study findings indicate that the construct of work ethics and integrity is the most important element in personal qualities and abilities. A strong work ethic is a crucial factor in success in the workplace. Employees who possess a robust work ethic exhibit increased productivity, efficiency, and the ability to produce work of superior quality (Panigrahi & Al-Nashash, 2019). By establishing trust, individuals can increase their chances of receiving more opportunities for professional progression, leading to higher levels of job satisfaction and overall success in their careers. On the other hand, integrity is an essential requirement for achieving success in the job. Employees who exhibit integrity establish trust, garner respect, and foster a positive working atmosphere (Shahid & Azhar, 2013). Organisations that are recognised for their integrity tend to achieve superior performance as they inspire trust and dependability among their consumers, clients, and staff. Therefore, developing a culture that esteems and advances a solid work ethic and integrity is essential for both personal and organisational achievement.

The experts highlighted that having initiative and self-direction are crucial characteristics for achieving success in the workplace. Employers appreciate workers who demonstrate initiative and are capable of working independently (Dachner et al., 2021). These folks are catalysts for innovation, enhancing processes, and fostering a great workplace atmosphere. By providing training, defining goals, and creating an enabling environment, people and organisations can cultivate initiative and self-direction, leading to success in the fast-paced modern work environment (Sengupta, 2024). Cultivating initiative and self-direction in schools entails

creating a learning atmosphere that motivates students to actively take the initiative and assume accountability for their learning and behaviour. Fostering self-direction involves teaching students effective time management, work prioritisation, and autonomous resource-seeking.

The findings show that “creativity & innovation” and “critical thinking & problem-solving skills” have the same fuzzy score, which is 0.788. Creativity and innovation refer to the ability to generate original ideas and transform them into new and valuable products, processes, or solutions (Khessina et al., 2018). It enhances workers' ability to solve problems, improve processes, and develop new products, leading to increased job satisfaction, productivity, and a competitive edge for the organisation. Meanwhile, critical thinking and problem-solving involve the ability to analyze information, evaluate options, and develop effective solutions to complex challenges (Razak et al., 2022). Employers need workers with critical thinking and problem-solving skills to navigate complex situations, make informed decisions, and develop innovative solutions that drive organisational success and adaptability.

Conclusion

In preparing students with disabilities for the workplace, it is crucial to focus on specific qualities and personal abilities that enhance their work readiness. These elements encompass a range of skills beyond academic knowledge, emphasizing traits that contribute to professional success and adaptability in diverse work environments (Marwan & Ali, 2019; Sengupta, 2024). Teachers play a crucial role in nurturing students' personal qualities and abilities essential for the workplace. Educators cultivate teamwork and adaptability by fostering environments that encourage communication skills through discussions and presentations, critical thinking via problem-solving tasks, and collaboration through group projects. They also promote creativity and innovation by encouraging students to explore new ideas and develop solutions while emphasising time management and organisational skills through structured assignments. Employers value personal qualities and abilities in employees because they contribute significantly to workplace effectiveness and success. Overall, these elements not only enhance individual performance but also contribute to positive work culture, client satisfaction, and organisational growth, making them indispensable to employers seeking capable and versatile team members.

This research makes a theoretical addition by applying the Fuzzy Delphi Method (FDM) to validate aspects related to personal qualities and abilities in job preparation assessments for students with disabilities. The study enhances the approach of consensus-building in special education research, specifically in the evaluation of job preparation, by utilising FDM. The utilisation of Triangular Fuzzy Numbers and the Defuzzification Process showcases an innovative methodology for managing ambiguity and fluctuation in expert viewpoints, providing a resilient framework for guaranteeing the dependability and pertinence of evaluation instruments. This research is important because it connects the theoretical concepts of personal traits with the practical requirements of students with disabilities in several vocational fields. The study confirms the essential components required for professional preparedness and emphasises the significance of customising assessment instruments to meet the specific requirements of students with exceptionalities, thus promoting more inclusive and efficient educational approaches.

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