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Dynamic Interval Valued Neutrosophic Number for Students' Comprehensive Competencies Evaluation Empowered by Digital Technology

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Abstract: Higher education's quick adoption of digital technology has changed the way that students' overall capabilities are assessed, going beyond traditional academic achievement to include more general abilities like creativity, teamwork, problem-solving, and digital literacy. To analyze student skills holistically, this study investigates a multifaceted evaluation framework that makes use of digital assessment tools, big data analytics, and intelligent learning platforms. With its emphasis on cognitive, practical, social, and emotional aspects, the framework gives teachers a dynamic, data-driven way to document students' development. This study uses Dynamic Interval Valued Neutrosophic Number to overcome uncertainty. We show the comparison analysis between the proposed approach and other methods.

Using digital portfolios, real-time feedback systems, and sophisticated assessment models, the research demonstrates how technology may revolutionize evaluations by making them more transparent, developmental, and individualized. According to the findings, digital technology not only improves the precision and effectiveness of competence evaluations but also cultivates the capacity for lifelong learning, therefore equipping students to meet the needs of the globalized society and digital economy.

Keywords: Dynamic Interval Valued Neutrosophic Number; ents' Comprehensive Competencies; Digital Technology.

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1. Introduction

Indeterminacy information can be handled via a neutrophilic set (NS). NS and its derivatives are now widely used in many fields, including decision-making. However, in certain real-world complicated problems, data may be gathered across several periods or from multiple time periods, necessitating dynamic decision-making[1].

One way to think about the term "dynamic" is in terms of criteria like (a) a set of choices needed to accomplish a goal; (b) path-dependent decisions; and (c) the state of decision-making. This study examines time-constrained "dynamic" decision issues, such as those in patient care and emergency management[2]. Changes in the trend of profit for all goods over time should be used to examine the economic growth level of product series when examining the financial status of a particular firm. Another instance is in medical diagnostics, when doctors must examine patients at various intervals[3].

The main contributions of this study are organized as follows:

1. This study uses the dynamic interval valued neutrosophic number to overcome the uncertainty in the decision matrix.
2. This study proposed a decision-making approach for Students' Comprehensive Competencies Evaluation Empowered by Digital Technology.
3. This study compares the proposed approach by other methods. The results show the proposed approach is effective compared to other methods.

2. Literature Review

With an emphasis on Online Women University, Quraishi et al. [4] explored how digital literacy is incorporated into higher education courses. The significance of digital literacy in equipping pupils for success in the digital age is outlined in the introduction. Their study's goal is to investigate the effects of integrating digital literacy, considering students' opinions, experiences, and usage habits of technology. Convenience sampling was used to gather data from 150 participants, including instructors and students, as part of a cross-sectional study design. To gather information about digital literacy, technology use, and educational experiences, surveys were given out. Frequencies, percentages, ANOVA, chi-square tests, and regression analysis were among the descriptive and inferential methods used to identify trends and correlations.

Both possibilities and problems for student empowerment via classroom teaching have arisen because of the widespread integration of digital technology into education. Research assessing how these reforms affect multifaceted student empowerment is still few, though. To evaluate the effects of digital classroom changes across the five empowerment dimensions of engagement, motivation, autonomy, cooperation, and digital literacy, this mixed methods study set out to provide a thorough assessment methodology. Twenty instructors and 300 college students from three institutions that have adopted technology-driven instructional innovations during the previous two years were included in the sample. To assess the reforms, quantitative survey data and qualitative information gleaned from observations and interviews were combined. Increased student enthusiasm, confidence, self-direction, and collaborative skills were found in the results[5].

The learning environment has undergone significant change because of the incorporation of digital technology into education. Hidayat-Ur-Rehman [6] emphasized how crucial it is to investigate the variables affecting students' engagement (SE) in this rapidly changing digital world, especially in formal online learning settings. Self-determination theory (SDT) serves as the foundation for this study, which offers a thorough model with interrelated components: digital competence (DC), smartphone usage (SPU), perceived autonomy (PA), digital formal learning (DFL), and SE.

3. Definitions Dynamic interval-valued neutrosophic set (DIVNS)

Definition 1[7]

Neutrosophic set (NS) is:

$X = \{y: T_X(y), I_X(y), F_X(y)\}$

$T_X(y), I_X(y), F_X(y) \in [0,1]$

$0 \leq \sup\big(T_X(y)\big) + \sup\big(I_X(y)\big) + \sup\big(F_X(y)\big) \ \leq 3$

Definition 2

Dynamic single valued neutrosophic set (DSVNS) is:

$X = \{y: T_X(y), I_X(y), F_X(y)\}$

$T_X(y), I_X(y), F_X(y): [0, \infty) \rightarrow [0,1]$

$T_X(y), I_X(y), F_X(y)$ are continuous function whose argument is time (t).

Definition 3

Dynamic interval valued neutrosophic set (DIVNS) is:

$X = ([T_X^L(t), T_X^U(t)], [I_X^L(t), I_X^U(t)], [F_X^L(t), F_X^U(t)])$

$[T_X^L(t), T_X^U(t)], [I_X^L(t), I_X^U(t)], [F_X^L(t), F_X^U(t)] \subseteq [0,1]$

4. Set Theoretic Operations of DIVNS

This part shows the set theoretic operations of DIVNS. Let two DIVNS are:

$A(t) = \Big\{\Big(\big(x(t)\big), \big(T_x^A(t_1), I_x^A(t_1), F_x^A(t_1)\big)\Big)\Big\}$

$B(t) = \Big\{\Big(\big(x(t)\big), \big(T_x^B(t_1), I_x^B(t_1), F_x^B(t_1)\big)\Big)\Big\}$

Definition 4

Intersection of DIVNS is:

$A(t) \cap B(t) = \big\{\big(T_x^A(t_1) \wedge T_x^B(t_1), I_x^A(t_1) \vee I_x^B(t_1), F_x^A(t_1) \vee F_x^B(t_1)\big)\big\}$

Definition 5

Union of DIVNS is:

$$A(t) \cup B(t) = \{(T_x^A(t_1) \vee T_x^B(t_1), I_x^A(t_1) \wedge I_x^B(t_1), F_x^A(t_1) \wedge F_x^B(t_1))\}$$

Definition 6

Complement of DIVNS is:

$$A(t)^c = \{(F_x^A(t_1), 1 - I_x^A(t_1), T_x^A(t_1))\}$$

5. Operations of DIVNS

This part shows the operations of DIVNS. Let two DIVNS numbers are:

$$a(t) = \{(T_x^A(t_1), I_x^A(t_1), F_x^A(t_1)), \ldots (T_x^A(t_k), I_x^A(t_k), F_x^A(t_k))\}$$

$$b(t) = \{(T_x^B(t_1), I_x^B(t_1), F_x^B(t_1)), \ldots (T_x^B(t_k), I_x^B(t_k), F_x^B(t_k))\}$$

Definition 7

$$a(t) \oplus b(t) = \left\{ \begin{array}{c} (T_x^A(t_1) + T_x^B(t_1) - T_x^A(t_1)T_x^B(t_1), I_x^A(t_1)I_x^B(t_1), F_x^A(t_1)F_x^B(t_1)), \\ \ldots, \\ (T_x^A(t_k) + T_x^B(t_k) - T_x^A(t_k)T_x^B(t_k), I_x^A(t_k)I_x^B(t_k), F_x^A(t_k)F_x^B(t_k)) \end{array} \right\}$$

Definition 8

$$a(t) \otimes b(t) = \left\{ \begin{array}{c} (T_x^A(t_1)T_x^B(t_1), I_x^A(t_1) + I_x^B(t_1) - I_x^A(t_1)I_x^B(t_1), F_x^A(t_1) + F_x^B(t_1) - F_x^A(t_1)F_x^B(t_1)), \\ \ldots, \\ (T_x^A(t_k)T_x^B(t_k), I_x^A(t_k) + I_x^B(t_k) - I_x^A(t_k)I_x^B(t_k), F_x^A(t_k) + F_x^B(t_k) - F_x^A(t_k)F_x^B(t_k)) \end{array} \right\}$$

Figure 1. Steps of the proposed approach.

6. Comprehensive Framework

This section shows the steps of the proposed approach. Figure 1 shows the steps of the proposed approach.

- Create the decision matrix.

Set of experts and decision makers created the decision matrix using the DIVNS number between the criteria and alternatives.

-Apply the score function.

The score function is applied to obtain crisp values.

- Combine the decision matrix.

The decision matrix is combined into a single matrix.

Rank the alternatives based on the values of score function.

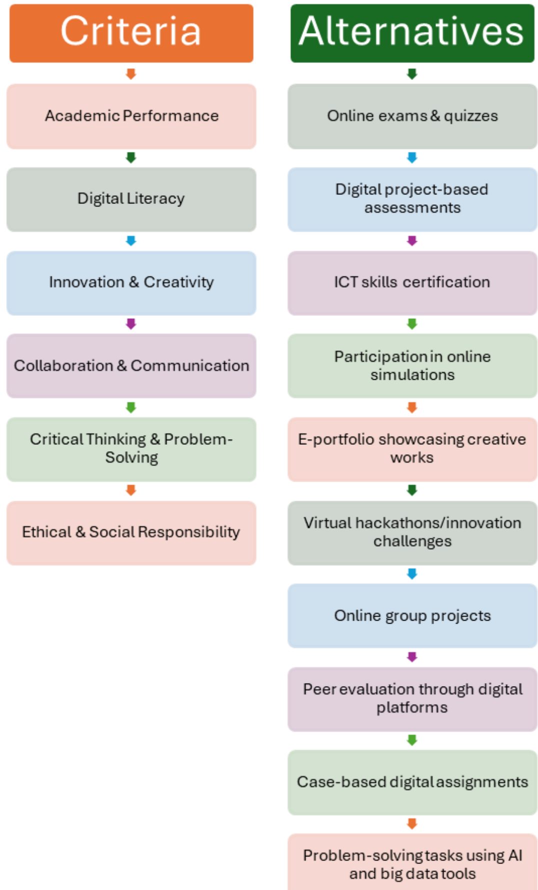

Figure 2. Data of this study.

7. Application

Digital literacy has become a vital skill set in today's higher education, helping students to successfully traverse the intricacies of the digital world. Given the speed at which technology is developing, it is now essential to include digital literacy into the higher education curriculum to empower students and improve their academic performance. Using a thorough case study methodology, this study seeks to examine how digital literacy has been successfully incorporated into higher education. This study aims to give educators and policymakers useful information to maximize digital literacy programs at higher education institutions by evaluating use patterns, efficacy, impact, strategies, best practices, and difficulties. This study uses six criteria and ten alternatives as shown in Figure 2.

Three experts evaluated the criteria and alternatives as shown in Table 1.

Table 1. Values by experts.

	$DIVC_1$	$DIVC_2$	$DIVC_3$	$DIVC_4$	$DIVC_5$	$DIVC_6$
$DIVA_1$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])

DIVA$_2$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])
DIVA$_3$	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])
DIVA$_4$	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])
DIVA$_5$	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.38,0.4], [0.25,0.4], [0.12,0.3])
DIVA$_6$	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])
DIVA$_7$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])
DIVA$_8$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])
DIVA$_9$	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])
DIVA$_{10}$	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])
	DIVC$_1$	DIVC$_2$	DIVC$_3$	DIVC$_4$	DIVC$_5$	DIVC$_6$
DIVA$_1$	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])
DIVA$_2$	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])
DIVA$_3$	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])
DIVA$_4$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])
DIVA$_5$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.38,0.4], [0.25,0.4], [0.12,0.3])
DIVA$_6$	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.7,0.9], [0.33,0.45], [0.59,0.6])
DIVA$_7$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])
DIVA$_8$	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])
DIVA$_9$	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])
DIVA$_{10}$	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])
	DIVC$_1$	DIVC$_2$	DIVC$_3$	DIVC$_4$	DIVC$_5$	DIVC$_6$
DIVA$_1$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])
DIVA$_2$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])

DIVA$_3$	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])
DIVA$_4$	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])
DIVA$_5$	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])
DIVA$_6$	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.38,0.4], [0.25,0.4], [0.12,0.3])
DIVA$_7$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.7,0.9], [0.33,0.45], [0.59,0.6])
DIVA$_8$	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])
DIVA$_9$	([0.38,0.4], [0.25,0.4], [0.12,0.3])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.1, 0.2], [0.6, 0.7], [0.7, 0.8])	([0.2, 0.3], [0.5, 0.6], [0.6, 0.7])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])
DIVA$_{10}$	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.7,0.9], [0.33,0.45], [0.59,0.6])	([0.3, 0.5], [0.4, 0.6], [0.4, 0.5])	([0.5, 0.6], [0.4, 0.5], [0.3, 0.4])	([0.6, 0.7], [0.2, 0.3], [0.2, 0.3])	([0.7,0.9], [0.33,0.45], [0.59,0.6])

We use the score function to obtain crisp values as shown in Table 2.

Table 2. Crisp values.

	DIVC$_1$	DIVC$_2$	DIVC$_3$	DIVC$_4$	DIVC$_5$	DIVC$_6$
DIVA$_1$	2.14	2.72	3.08	3.3	4.46	4.2145
DIVA$_2$	2.14	3.72	4.2145	4.46	3.3	3.08
DIVA$_3$	2.72	3.08	3.3	4.46	4.2145	2.72
DIVA$_4$	3.3	3.08	2.72	2.14	3.72	2.14
DIVA$_5$	4.46	3.3	3.08	2.72	2.14	3.72
DIVA$_6$	4.46	4.46	3.3	4.46	3.72	4.2145
DIVA$_7$	3.72	3.08	3.3	3.72	2.14	2.72
DIVA$_8$	2.14	3.3	4.46	4.2145	3.72	3.08
DIVA$_9$	2.72	4.46	2.14	2.72	4.2145	3.3
DIVA$_{10}$	3.08	4.2145	3.08	3.3	4.46	4.46
	DIVC$_1$	DIVC$_2$	DIVC$_3$	DIVC$_4$	DIVC$_5$	DIVC$_6$
DIVA$_1$	3.3	2.72	3.08	3.3	4.46	4.2145
DIVA$_2$	3.08	3.72	4.2145	3.3	3.3	3.08
DIVA$_3$	2.72	3.08	3.3	3.08	3.3	2.72
DIVA$_4$	2.14	3.08	2.72	2.72	3.08	2.14
DIVA$_5$	3.72	3.3	3.08	2.14	2.72	3.72
DIVA$_6$	3.3	3.3	3.3	3.72	2.14	4.2145
DIVA$_7$	3.72	3.08	2.14	4.46	3.72	4.46
DIVA$_8$	3.3	3.3	3.72	4.2145	2.14	3.3
DIVA$_9$	3.08	4.46	3.3	3.08	2.72	3.08
DIVA$_{10}$	2.72	4.2145	4.2145	3.72	2.14	2.72
	DIVC$_1$	DIVC$_2$	DIVC$_3$	DIVC$_4$	DIVC$_5$	DIVC$_6$
DIVA$_1$	2.14	2.72	3.08	3.3	4.46	4.2145
DIVA$_2$	3.72	3.72	4.2145	4.46	3.3	3.08
DIVA$_3$	4.2145	2.14	3.3	4.46	4.2145	2.72
DIVA$_4$	4.46	3.72	2.14	2.14	2.14	2.14
DIVA$_5$	3.3	4.2145	3.72	2.14	3.72	2.14
DIVA$_6$	3.08	4.46	4.2145	3.72	4.2145	3.72

DIVA7	3.72	3.08	4.46	3.72	2.14	4.2145
DIVA8	2.14	3.3	3.3	4.2145	2.72	4.46
DIVA9	3.72	4.46	2.14	2.72	3.08	3.3
DIVA10	4.2145	4.2145	3.08	3.3	4.46	4.2145

We combine the decision matrix into a single matrix as shown in Table 3.

Table 3. Combine the decision matrix.

	DIVC1	DIVC2	DIVC3	DIVC4	DIVC5	DIVC6
DIVA1	2.526667	2.72	3.08	3.3	4.46	4.2145
DIVA2	2.98	3.72	4.2145	4.07333	3.3	3.08
DIVA3	3.218167	2.766667	3.3	4	3.9097	2.72
DIVA4	3.3	3.293333	2.52667	2.33333	2.98	2.14
DIVA5	3.826667	3.604833	3.29333	2.33333	2.86	3.19333
DIVA6	3.613333	4.073333	3.60483	3.96667	3.3582	4.04967
DIVA7	3.72	3.08	3.3	3.96667	2.6667	3.79817
DIVA8	2.526667	3.3	3.82667	4.2145	2.86	3.61333
DIVA9	3.173333	4.46	2.52667	2.84	3.3382	3.22667
DIVA10	3.338167	4.2145	3.45817	3.44	3.6867	3.79817

We rank the alternatives as shown in Figure 3.

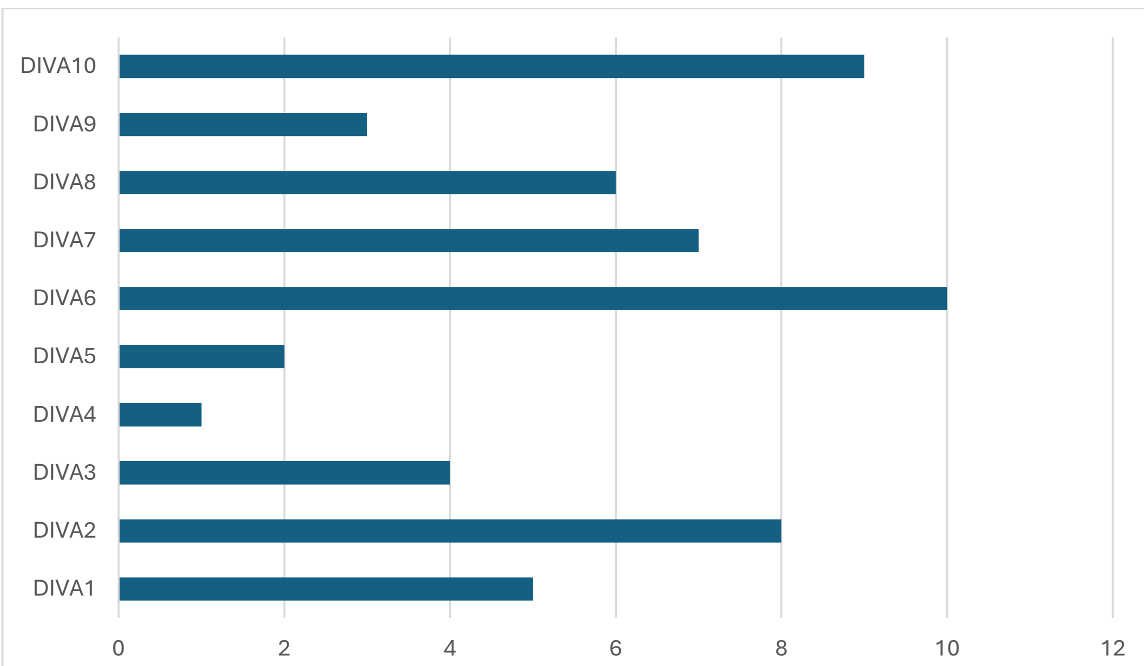

Figure 3. Ranks of alternatives.

8. Comparison

This section shows the comparative analysis results. We compare the proposed approach by different methods such as accuracy function and Certainty function. Results of the comparison analysis are shown in Figure 4.

- ✓ Alternative DIVA6 consistently achieved the highest rank across all three functions, making it the most reliable and dominant option.
- ✓ This suggests that DIVA6 performs exceptionally well in terms of outcomes (score), dependability (accuracy), and confidence (certainty).
- ✓ It could represent a benchmark or best practice among all alternatives.
- ✓ DIVA10 stands out as the second-best, showing strong and balanced performance across all measures, very close to A6.
- ✓ DIVA2 also performs at a high level, though slightly weaker in certainty (7), indicating it is effective but with minor stability concerns.
- ✓ Both alternatives are highly valuable and could be prioritized for implementation alongside **DIV**A6.
- ✓ DIVA7 is strong in certainty (8) but slightly lower in accuracy (6), meaning it is a dependable choice though performance may vary.
- ✓ DIVA8 balances accuracy and certainty well, placing it as a solid middle-tier performer.
- ✓ DIVA1 shows average performance across the board (5,5,5), indicating a baseline alternative with moderate outcomes but lacking excellence.
- ✓ These four alternatives fall at the bottom, with DIVA4 being the weakest overall.
- ✓ DIVA3 and DIVA9 show only slightly better performance, while DIVA5 still remains weak.
- ✓ These options may require significant improvement or reconsideration before being used in practice.

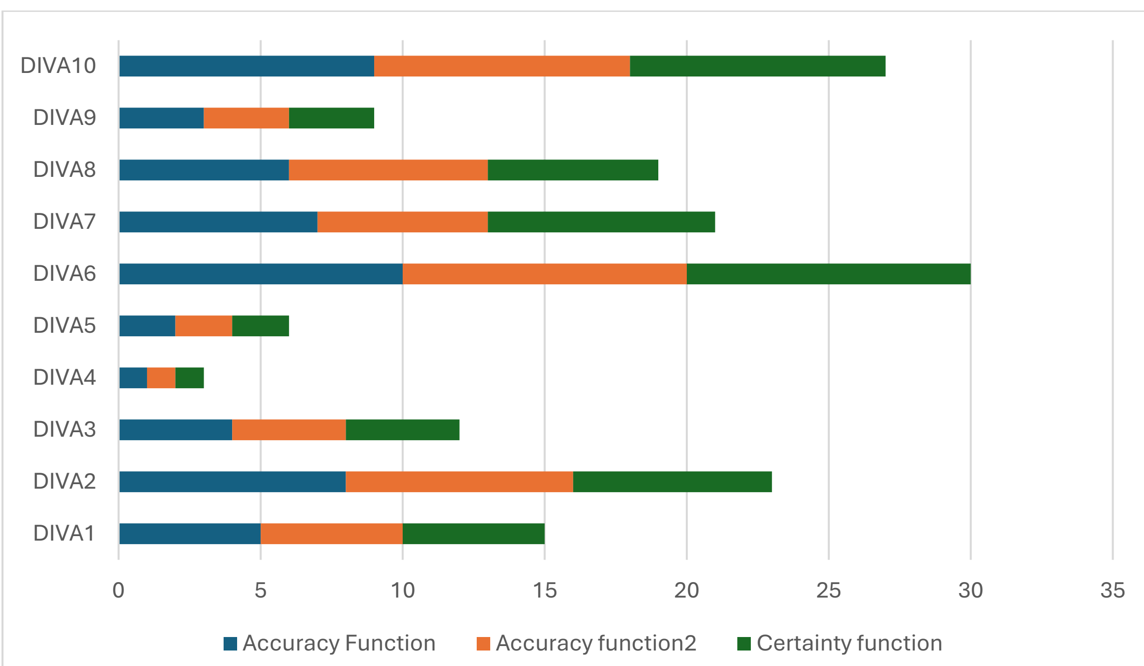

Figure 4. Comparison results.

9. Conclusions

Digital technology-enabled assessments of students' overall skills mark a substantial improvement in teaching methods. The results demonstrate that, in comparison to conventional techniques, digital tools and data-driven methodologies may offer a more continuous, multifaceted, and objective evaluation. We used the dynamic interval valued neutrosophic number to solve vague information. The comparison analysis was made between the proposed approach and other methods. The results showed that proposed approach is effective compared to other methods.

This change makes it possible for teachers to more accurately pinpoint each student's abilities, monitor their progress, and provide focused interventions to promote learning. Additionally, including digital assessment promotes student involvement, self-control, and digital flexibility, bringing higher education results into line with the demands of the job market and society in the twenty-first century. But there are still issues with protecting data privacy, lowering technical disparity, and striking a balance between quantitative measurements and qualitative insights. All things considered, this study emphasizes that a technology-enabled assessment system serves as a strategic instrument for developing graduates who are well-rounded and prepared for the future, in addition to being a means of gauging performance.

References

[1] H. Zhang, J. Wang, and X. Chen, "An outranking approach for multi-criteria decision-making problems with interval-valued neutrosophic sets," *Neural Comput. Appl.*, vol. 27, pp. 615–627, 2016.

[2] A. Saha and S. Broumi, *New operators on interval valued neutrosophic sets*. Infinite Study, 2019.

[3] I. Deli, "Interval-valued neutrosophic soft sets and its decision making," *Int. J. Mach. Learn. Cybern.*, vol. 8, pp. 665–676, 2017.

[4] T. Quraishi, H. Ulusi, A. Muhid, M. Hakimi, and M. R. Olusi, "Empowering students through digital literacy: A case study of successful integration in a higher education curriculum," *J. Digit. Learn. Distance Educ.*, vol. 2, no. 9, pp. 667–681, 2024.

[5] Y. Zhu, "Construction of evaluation framework for classroom teaching reform of students empowered by digitalization," *Pacific Int. J.*, vol. 7, no. 1, pp. 174–178, 2024.

[6] I. Hidayat-Ur-Rehman, "Digital competence and students' engagement: a comprehensive analysis of smartphone utilization, perceived autonomy and formal digital learning as mediators," *Interact. Technol. smart Educ.*, vol. 21, no. 3, pp. 461–488, 2024.

[7] N. T. Thong, L. Q. Dat, N. D. Hoa, M. Ali, and F. Smarandache, "Dynamic interval valued neutrosophic set: Modeling decision making in dynamic environments," *Comput. Ind.*, vol. 108, pp. 45–52, 2019.

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