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Validating Instruments for Measuring Adaptive Intelligence: A Construct Validation Study of Five Components

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ABSTRACT

This study aimed to validate instruments designed to measure the five components of adaptive intelligence, wisdom, creativity, problem-solving, analytical skills, and practical ability, and to identify the underlying factors of each construct. Adaptive intelligence is increasingly recognized as an essential competence for individuals to navigate rapidly changing environments, yet empirical studies that systematically validate its measurement tools remain limited. The study employed a quantitative validation design using exploratory factor analysis. Data were collected from 144 university students in Malang, Indonesia, selected through cluster sampling from a larger population. Five questionnaires, each consisting of 20 items, were developed in collaboration with expert lecturers to ensure content validity. Following a pilot test and revisions, the instruments were administered, and the data were analyzed using SPSS version 25 with Promax rotation and a loading threshold of 0.40. The results confirmed the multidimensional nature of adaptive intelligence. Wisdom was represented by three factors, creativity by two, problem-solving by three, analytical skills by three, and practical ability by four. These factor structures provide empirical evidence of adaptive intelligence's latent dimensions, highlighting its complexity as an integrated but multifaceted construct. The contribution of this study lies in both theoretical and practical domains. Theoretically, it advances the conceptual clarity of adaptive intelligence by specifying its latent dimensions. Practically, it provides validated instruments that educators and psychologists can employ to assess and foster adaptive capacities in students and professionals, supporting resilience and adaptability in diverse contexts.

INTRODUCTION

Education in some Asian countries still has a long way to go to improve quality. In terms of reading skills and knowledge of science and mathematics alone, Indonesian students' scores on the PISA test have not moved from the low ranking, which is ranked 74th, or seventh from the bottom (Fa et al., 2024; Wijaya et al., 2024). Although the Human Resources Index is quite good with a score of 71.94, the low

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PISA score certainly requires corrective action (AlAli & Wardat, 2024; J. Li et al., 2025). Meanwhile, the world continues to develop and change rapidly. In an era where artificial intelligence, or better known as AI, is increasingly spreading into all professional fields, educational efforts are certainly needed to make students more adaptive. Adaptive intelligence makes students more flexible and agile in adapting to the rapidly changing world.

Before delving deeper into the main issue, it is necessary to present the theoretical foundations of Adaptive Intelligence. The concept was originally proposed by Sternberg (2000), which essentially states that intelligence is formed by elements of creative, analytical, and practical attitudes, problem-solving skills, and relies on wisdom (wisdom-based skills). In addition, adaptive intelligence as a characteristic of humans (not a type of intelligence that machines can replace) must enable humans to preserve their existence (Chigbu et al., 2024). It is solution-oriented and is seen in the ability to design and implement strategies to address social, physical, and socioeconomic challenges.

Relevant research validated an instrument designed to measure practical abilities, which they described as an extension of the concept of adaptive intelligence. The validation technique employed was criterion-related validity. A correlation of 0.79 with the criterion was obtained, concluding that the newly developed instrument reliably measured the same competency, namely, practical abilities (Yalon-Chamovitz & Greenspan, 2005). In wisdom measurement, another research validated the 3D-WS instrument to assess wisdom. The results revealed the presence of three underlying factors: reflective, cognitive, and affective components (García-Campayo et al., 2018).

In problem-solving abilities, Díaz Quezada & Albornoz (2023) validated an instrument designed to measure deductive reasoning as a component of problem-solving skills. The results demonstrated that the instrument, comprising both multiple-choice and open-ended items, exhibited adequate content validity, construct validity, and reliability. However, the study did not explicitly identify the specific factors being measured by the instrument. Similarly, another research developed an instrument to assess the validity of problem-solving measurement tools among high school students. Their findings indicated adequate construct validity and reliability (Qomariyah et al., 2023). However, akin to the study by Díaz Quezada & Albornoz (2023), the underlying factors of the measurement were not explicitly delineated.

In analytical skills, relevant research developed an instrument to measure analytical competencies, with validation efforts focused on obtaining expert panel assessments. This content validation process yielded high validity levels, with inter-expert agreement reaching approximately 90% (Bohle Carbonell et al., 2016; Mat Said et al., 2022). However, the study did not identify the specific factors measured by the instrument, as it stopped at content validation without extending to construct validation.

Another study on validating analytical skills measurement tools was conducted by Ad'hiya & Laksono (2018). This study sought to determine the reliability and content validity of an instrument designed to measure analytical skills in chemistry. Although the authors mentioned expert considerations of analytical elements such as differentiation, organization, and attribution, no solid evidence was provided regarding the dimensions or factors underlying the measurement.

Lastly, in the context of practical abilities, Okoye & Auta (2020) validated an instrument to measure practical skills among a group of secondary school students in Nigeria. While their study claimed to employ factor analysis, it failed to elaborate on the factors underlying their instrument. The only reported finding was a factor loading of 0.35, without further explanation of the associated factors.

Reviewing those previous studies implies a research gap that the present research would address. The research aimed to examine data to identify the underlying factors across five dimensions of adaptive intelligence. While the previous studies often refrained from explicitly delineating the foundational factors of their constructs, this study endeavored to comprehensively elucidate these factors, contributing to a deeper understanding of assessing adaptive intelligence. Thus, the significance of this research lies in its contribution to the empirical conceptualization of adaptive intelligence. It informs the validity of the instruments that measure each construct that makes up adaptive intelligence.

In light of the research gap identified, this study was designed to investigate the underlying factors of the five components of adaptive intelligence: wisdom, creativity, problem-solving, analytical ability, and practical ability. The primary aim was to validate instruments that capture these dimensions, providing a more comprehensive empirical basis for measuring adaptive intelligence. By elucidating the factor structures of each domain, this study contributes to the refinement of theoretical frameworks and the development of practical tools that can be applied in educational and psychological contexts.

LITERATURE REVIEW

Wisdom

An element of adaptive intelligence is wisdom, which is defined by (Sternberg, 2004) as the wise application of knowledge and experience to achieve a common good. In its further conceptualization, wisdom involves cognitive ability, emotional control, and ethical aspects that culminate in a balance among intrapersonal, interpersonal, and extrapersonal interests (Sternberg, 2023). Bracher (2022) also emphasized the importance of moral imagination and systems thinking in his conceptualization of wisdom. Vorster (2025) identified its six components: pro-social behaviors, emotional regulation, self-reflection, value relativism, decisiveness, and general knowledge about life. It aligns with relevant research, which suggested that wise behavior is an interplay between non-cognitive components, such as concern for others and regulation of emotion, and cognitive components, such as knowledge and self-reflection (Glück & Weststrate, 2022). Finally, culture also plays an important role. As K. Li et al. (2019) argued, wisdom is also shaped by diverse cultural perspectives. People with adaptive intelligence in this ever-changing world would be culturally sensitive when practicing wisdom.

Creativity

Creativity, another vital component of adaptive intelligence, is the ability to identify and develop the potential of ideas that at first may seem undervalued or unconventional (Sternberg, 2000, 2021). A person with this capacity generally nurtures divergent thinking, which allows them to approach a problem from different views and suggest a range of solutions to the issue (Fletcher & Benveniste, 2022; Thornhill-Miller et al., 2023). Kaufman et al. (2022) proposed a model in which creativity exists on a spectrum and can manifest in various forms depending on the context and the individual's level of expertise. In addition to this, creativity also has a social dimension. The presence of creative people in a collaborative atmosphere of a team will likely promote exchange of ideas and innovative thinking (G. Li & Xie, 2023). Thus, creativity is an individual trait and a collective phenomenon with an element of social dynamics (Karwowski & Beghetto, 2019).

Problem-Solving Skill

Problem-solving skills are mental stages comprising preparation, incubation, inspiration, and verification (Dostál, 2015). In preparation, the problem is determined, and relevant information is collected. In incubation, the problem is contemplated. In inspiration, ideas to solve the problem emerge. Finally, the effectiveness of the solution is verified. This skill is also enhanced by metacognitive skills (Güner & Erbay, 2021), which require awareness and regulation of one's cognitive process. Added to this is self-efficacy as another supporting factor (Mashinchi et al., 2024). People who see challenges as opportunities for learning and development tend to be better in solving problems. In addition, problem-solving is viewed as a mental act that involves an interplay between memory, reasoning, and learning (Ma et al., 2021; Voica et al., 2020). Furthermore, Khoshneshan et al. (2023) proposed the Gestalt theory of problem-solving,, which essentially involves understandinge entire problem before apapplying In short, problem-solving skills are conceptualized as a set of mental processes characterized by awareness of the problem, strategies, and the implementthe

Analytical Skills

Analytical skills are the ability to "break down problems, systems, or ideas into parts, identify patterns or relationships among data, draw conclusions, and articulate how the parts relate to the whole" (Brandt, 2023). As such, the skills are vital components of adaptive intelligence because they allow for effective problem-solving and decision-making in many contexts. The information processing theory states that analytical skills encompass the ability to encode, store, and retrieve information effectively and manipulate that information to solve problems (Jun et al., 2024; Pérez et al., 2013). Another relevant framework is the Cattel-Horn model of intelligence, which differentiates fluid intelligence (Gf) from crystallized intelligence (Gc) (Hunt, 2008; Saw & Han, 2022). Fluid intelligence refers to the ability to solve new problems without relying on previously learned knowledge, while crystalized intelligence is the application of knowledge that has been learned before to solve existing problems. The former is closely linked to analytical skills. Finally, research findings have suggested the role of metacognitive awareness in analytical skills. People with strong metacognitive skills tend to monitor their thinking process and thus fare better in analyzing problems, evaluating their approaches, and adjusting their strategies (S. R. Gopinath & Dr. A. R. Krishnamurthy, 2018; Yuan, 2021).

Practical Skills

Practical skills are a vital component of adaptive intelligence, as defined by Sternberg (2000). They encompass the ability to apply knowledge and skills effectively in real-world situations. At least two theories have been proposed to explain practical skills, emphasizing their importance in everyday functioning and problem-solving. Practical intelligence is the ability to "adapt to, shape and select everyday environments" (Sternberg, 2000). It is what people usually call common sense. It refers to the learning and use of tacit knowledge, which is procedural, action-oriented, and domain-specific. It manifests when intelligence is applied to real-world contexts. In the framework of adaptive intelligence, it belongs to a triarchic theory, namely a combination of analytical, creative, and practical skills that enables one to adapt to the changing environments (Sternberg, 2000). Sternberg's abovementioned theory aligns with adaptive behavior theory (G. Li & Xie, 2023). This theory posits that conceptual, social, and practical skills are necessary to function effectively. One's ability to navigate through practical activities in daily life, like managing money, ordering goods online, communicating with others, and solving small technical problems, reflects one's adaptive behavior needed to cope with an ever changing environment.

METHODS

Research Design

This study employed a quantitative validation to examine the construct validity of instruments measuring adaptive intelligence. The design emphasized using exploratory factor analysis (EFA) as the main statistical procedure to uncover latent structures within the five targeted domains: wisdom, creativity, problem-solving, analytical ability, and practical ability. By adopting this approach, the study sought to establish the psychometric soundness of the developed instruments and provide empirical evidence for the multidimensional nature of adaptive intelligence. This design choice is considered appropriate because it integrates theoretical grounding with statistical validation, ensuring that the instruments developed can capture the complexity of adaptive intelligence systematically and reliably.

Participants

The sample for this study consisted of 144 respondents aged between 18 and 25 years. These respondents were selected using cluster sampling (Barbu & Zhu, 2020) from a larger population of 4,503 students at a university in Malang. The respondents' demographic data provide insights into the distribution of gender and age within the sample. Thus, the distribution among the respondents was relatively balanced, with 53% female and 47% male. As for their age distribution, there were 60 respondents aged between 18 and 20 years (42%), 55 respondents aged between 21 and 23 years (38%), and 29 respondents aged between 24 and 25 years (20%).

Data Collection

Data were collected using five questionnaires. They were developed through a collaboration with a panel of educators, which consisted of 2 Ph.D. lecturers. The questions were designed based on theoretical frameworks corresponding to the measured constructs: wisdom, analytical skills, problem-solving abilities, creativity, and practical skills. These experts assisted in the writing of the items by referring to several theoretical frameworks about each of the components that make up adaptive intelligence. The researcher and the panel jointly constructed the items for each questionnaire. The items were carefully crafted to align with the theories of the components. The questionnaires were then sent to a group of 35 third-semester students at a university. The results of the tryout were used to revise the questionnaires further. The results showed which items were weakly correlated with the others. The researcher then omitted these weak items and wrote the remaining ones, producing 20 for each questionnaire as the final version. The questionnaires were then distributed to 144 respondents studying in different study programs at a private university in Malang.

Data Analysis

The data consisted of respondents' answers, which Google Forms automatically summarized. These summarized responses were subsequently analyzed using exploratory factor analysis in SPSS version 25. Promax rotation was selected for each analysis because the 5 elements making up the adaptive intelligence were regarded as correlated with each other. In selecting the variables that load onto the factors, a threshold of factor loading was set at 0.40 or higher. Thus, only variables whose factor loading was higher than the threshold were included in a specific factor.

RESULTS

Factors Underlying the Measurement of Wisdom

This section answers the first objective: identifying the factors underlying the instrument for measuring wisdom. Before the factor analysis step was carried out, it was necessary to ensure that the data met the requirements, namely sample adequacy and correlation between the variables as indicated by the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. The following table shows that the data met the requirements:

Table 1. The Results of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.706
Bartlett's Test of Sphericity	Approx. Chi-Square	598.868
	df	190
	Sig.	.000

Bartlett's Test of Sphericity was significant ($p < .05$), indicating that the correlation matrix is not an identity matrix, and factor analysis may be appropriate. It, combined with a KMO value of 0.706, suggests the data is suitable for factor analysis. Next, the scree plot generated by the calculation was observed to help determine the number of underlying factors:

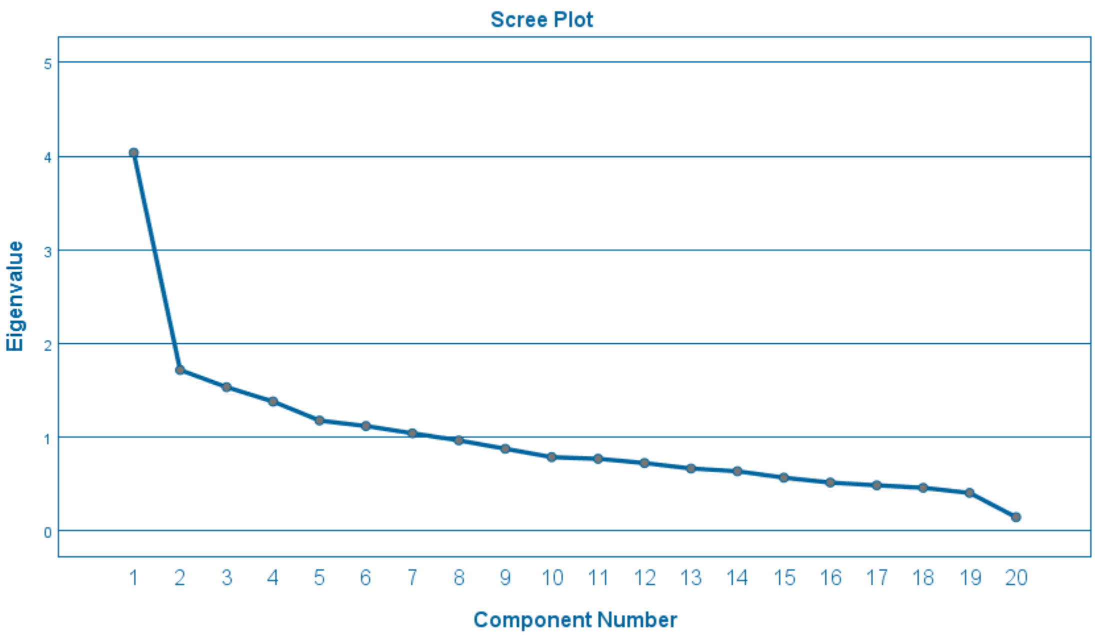

Figure 1. The Scree Plot of the Data for Measuring Wisdom

By also looking at the Kaiser criterion, scree plot, rotated component matrix, and total variance explained, three factors were determined: factor 1, factor 2, and factor 3. The factors and their variable loadings are summarized in the following table:

Table 2. The Factors and the Loadings of the Variables for the Measurement of Wisdom

Variable		Content of the variable
Factor 1	Q3	Response to failure
	Q4	Response to problems
Factor 2	Q13	Response to provocation
	Q16	Response to sudden change
	Q18	Response to the obligation to learn new things
Factor 3	Q15	Response to the obligation to understand others
	Q11	Response to shocking information
	Q20	Response to the obligation to judge others
	Q5	Response to uncertainty in life

Based on this table, the factors underlying the measurement of wisdom can be determined, namely factor 1 (responses to failure, responses to problems), factor 2 (responses to provocation, responses to sudden change, responses to the obligation to learn new things), and factor 3 (responses to the obligation to understand others, responses to shocking information, responses to the obligation to judge others, and responses to uncertainty in life). The concept of wisdom and its underlying factors are visualized below:

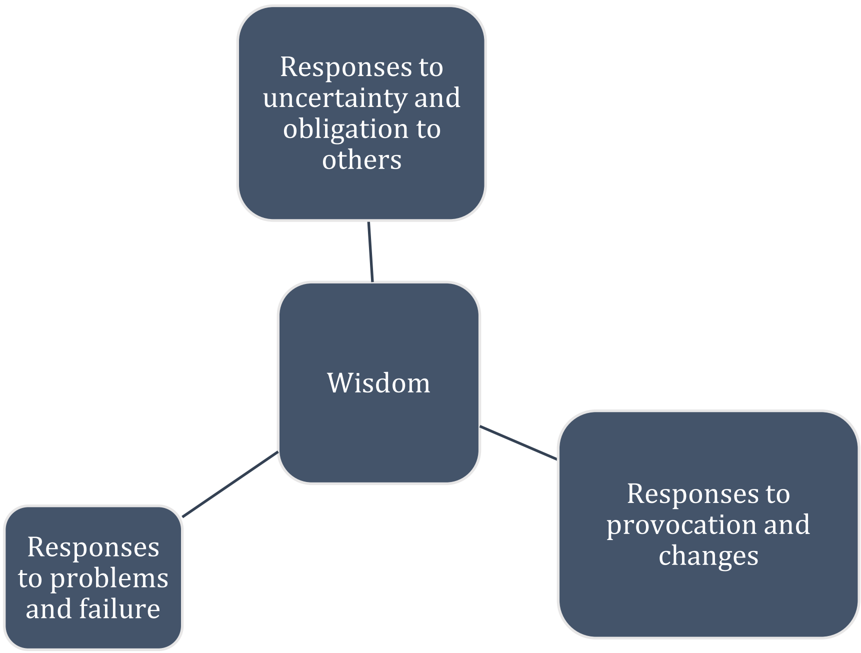

Figure 2. The Factors Underlying Wisdom

Factors Underlying the Measurement of Creativity

This section answers the second objective: identifying the factors underlying the instrument for measuring creativity. As in the previous section, steps were taken to ensure that the data met the requirements for factor analysis. The following table shows that the data met the requirements:

Table 3. The Results of KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.492
Bartlett's Test of Sphericity	266.786	598.868
	190	190
	.000	.000

The table above shows that the KMO index (0.492) is sufficient, and Bartlett's Test ($p < 0.05$) indicates that there is a correlation between the variables being studied. The results allow the use of factor analysis for analyzing the data. Next, the scree plot below helped to determine the number of underlying factors:

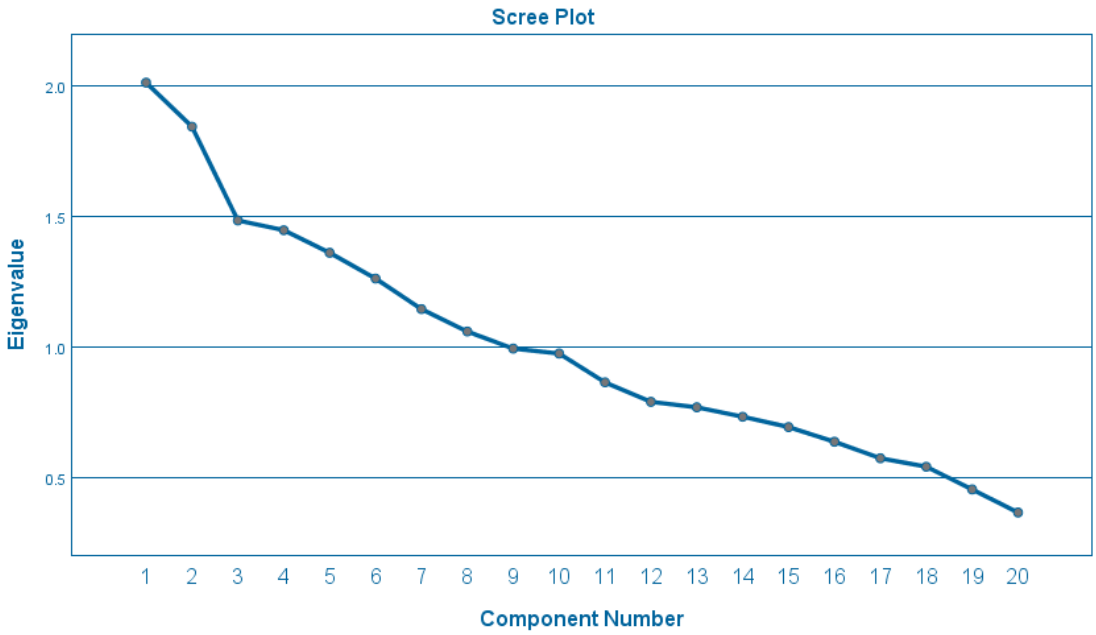

Figure 3. The Scree Plot of the Data for Measuring Creativity

By looking at the Kaiser criterion, scree plot, rotated component matrix, and total variance explained, two factors were determined, namely factor 1 (the understanding of the concept of creativity), and factor 2 (the ability to solve problems critically when working individually or with a group). The factors and their variable loadings are summarized in the following table:

Table 4. The Factors and the Loadings of the Variables for the Measurement of Creativity

	Variable	Content of the Variable
Factor 1	Q10	Ways of solving problems
	Q2	Ability to find a solution.
	Q17	Ability to overcome obstacles in creativity
	Q9	Creativity in spare time
Factor 2	Q5	Acts done when facing an obstacle
	Q20	The definition of success
	Q3	Roles in groups

Variable	Content of the Variable
Q12	Preferences in doing things

The construct of creativity and its underlying factors are visualized below:

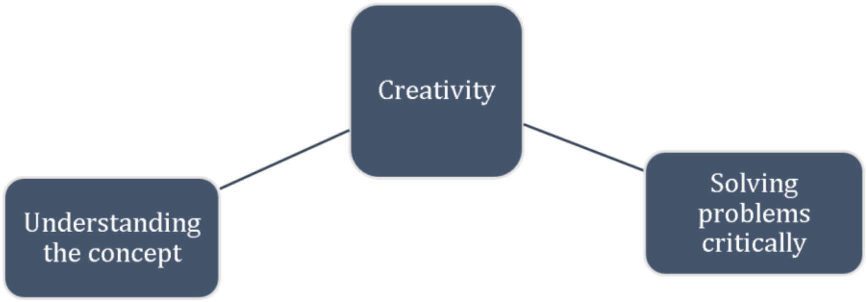

Figure 4. The Factors Underlying Creativity

Factors Underlying the Measurement of Problem-solving Skills

This section answers the third objective: identifying the factors underlying the instrument for measuring problem-solving skills. As in the previous section, steps were taken to ensure that the data met the requirements for factor analysis. The following table shows that the data met the requirements:

Table 5. The Results of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.557
Bartlett's Test of Sphericity	303.711	598.868
	190	190
	.000	.000

The table above shows that the KMO index (0.557) is sufficient, and Bartlett's Test ($p < 0.05$) indicates that there is a correlation between the variables being studied. The results of this preliminary checking allow factor analysis to analyze the data. Next, the scree plot generated by the calculation was observed to help determine the number of underlying factors:

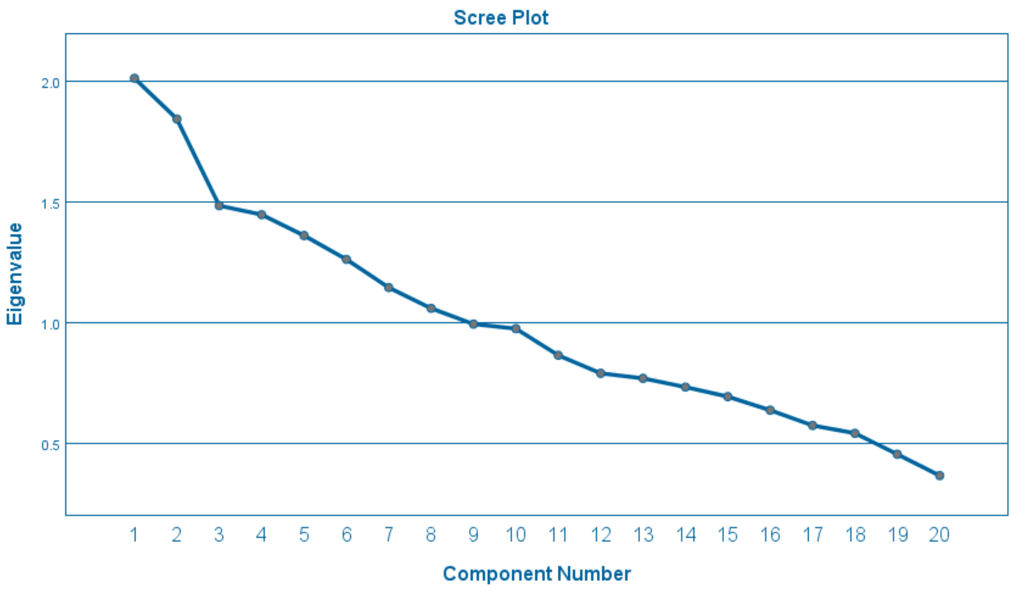

Figure 5. The Scree Plot of the Measurement of Problem-solving Skills

By looking at the Kaiser criterion, scree plot, rotated component matrix, and total variance explained, three factors were determined, namely factor 1 (attitude toward problems and ways of solving problems), factor 2 (degree of reflectivity), and factor 3 (determination of ideal environment). The factors and their variable loadings are summarized in the following table:

Table 6. The Factors and the Loading of Variables in the Measurement of Problem-Solving Skills

	Variable	Content of the Variable
Factor 1	Q3	Attitude when dealing with difficult choices
	Q17	What is done before taking action.
	Q12	Feelings when making mistakes
	Q1	Feelings when facing a problem
	Q16	Situations that increase motivation
Factor 2	Q7	Ways of solving difficult problems
	Q15	Learning resources
	Q5	Attitude when facing obstacles
Factor 3	Q19	Ideal working environment
	Q13	Preferences for tasks
	Q8	Situations that trigger frustration

Thus, three major factors were identified. First is factor 1, which can be labeled as feelings, attitudes toward challenges, and ability to overcome challenges; second is factor 2, which can be labeled as attitudes to obstacles, and third is factor 3, which can be labeled as task preferences. The concept of problem-solving skills and the underlying factors can be visualized below:

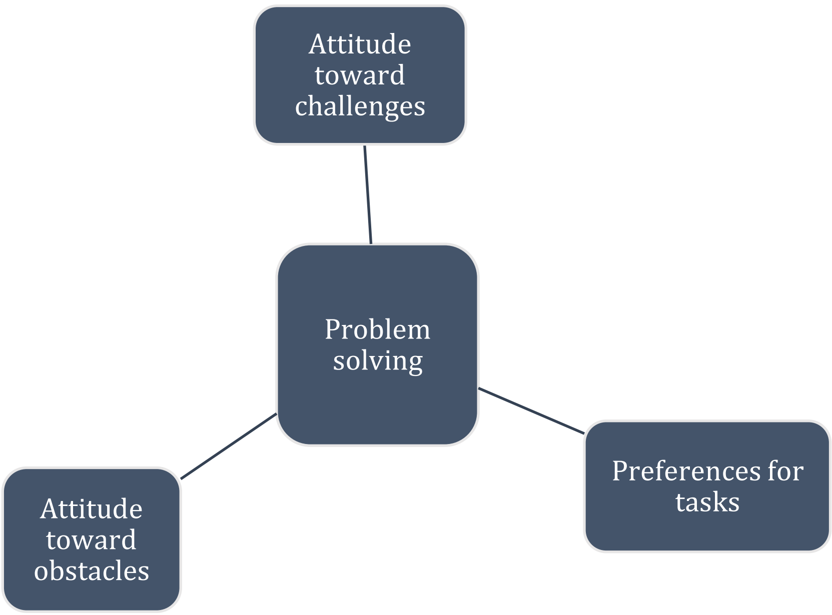

Figure 6. The Factors Underlying Problem-Solving Skills

Factor Underlying the Measurement of Analytical Ability

As in the previous section, steps were taken to ensure that the data met the requirements for factor analysis. The following table shows that the data met the requirements:

Table 7. The Results of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.588
Bartlett's Test of Sphericity	Approx. Chi-Square	466.930
	Df	190
	Sig.	.000

The table above shows that the KMO index (0.588) is high, and Bartlett's Test ($p < 0.05$) indicates that there is a correlation between the variables being studied. The results of this preliminary checking allow factor analysis to analyze the data. Next, the scree plot generated by the calculation was observed to help determine the number of underlying factors:

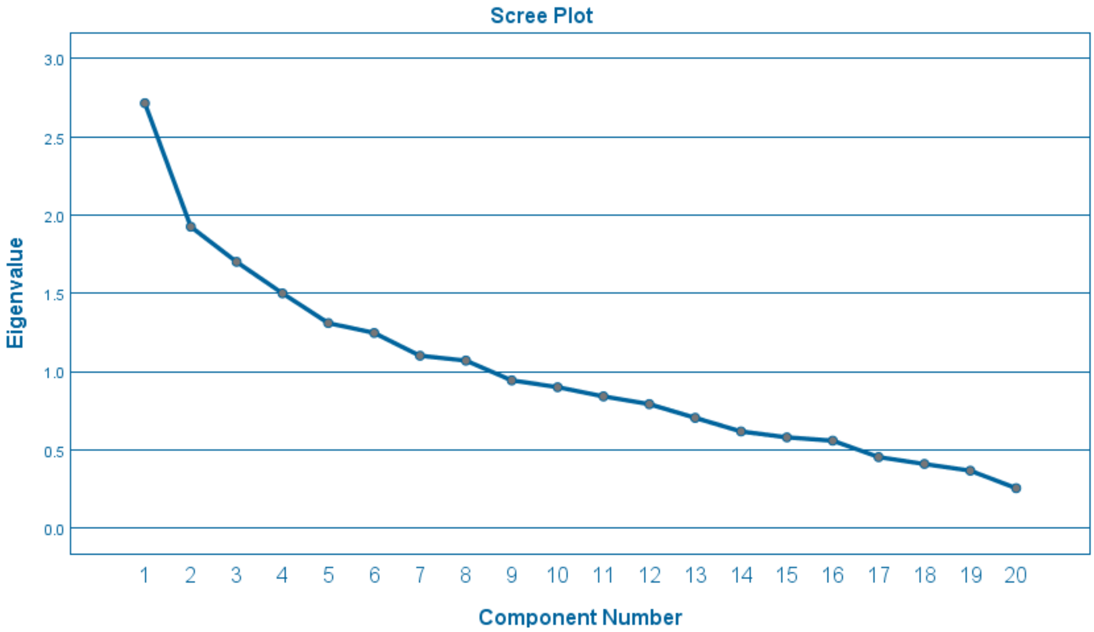

Figure 7. The Scree Plot of the Data for Measuring Analytical Abilities

By looking at the Kaiser criterion, scree plot, rotated component matrix, and total variance explained, three factors were determined, namely factor 1 (problem-solving abilities and ways of handling complex data), factor 2 (response to information), and factor 3 (tendencies to act and learning styles). The factors and their variable loadings are summarized in the following table:

Table 8. Factors and Loadings of Related Variables for Measurement of Analytical Skills

	Question/Variable	Content of the Variables
Factor 1	Q17	Solving problems
	Q1	Ways of solving problems
	Q3	Ways of handling complex data
Factor 2	Q18	Response to information
	Q2	Response to information
Factor 3	Q10	Tendencies to act
	Q8	Learning styles
	Q12	Learning styles

Thus, three major factors were identified. First is factor 1, which can be labeled as problem-solving ability; second is factor 2, which can be labeled as response to information, and third is factor 3, which can be labeled as learning styles. They can be visualized below:

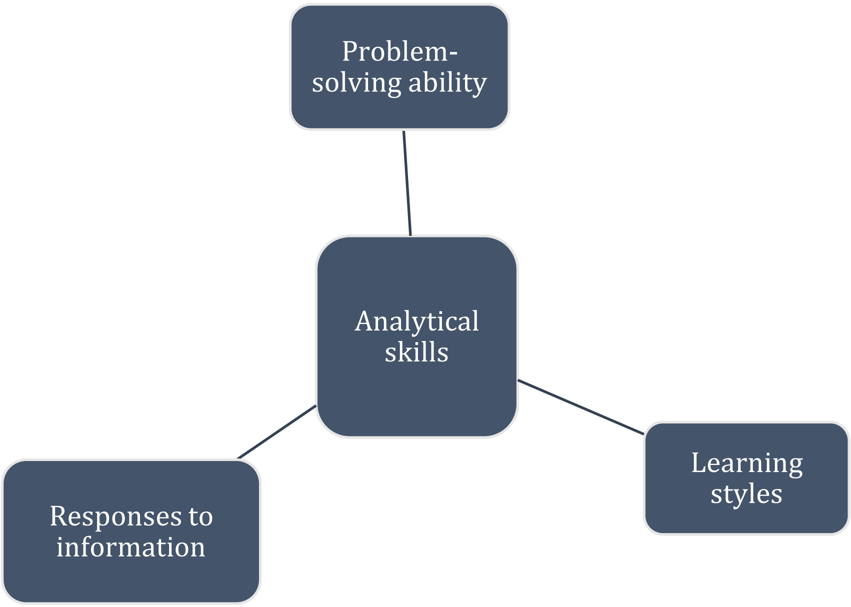

Figure 8. The Factors Underlying Analytical Skills

Factor Underlying the Measurement of Practical Ability

As in the previous section, steps were taken to ensure that the data met the requirements for factor analysis. The following table shows that the data met the requirements:

Table 9. The Results of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.543
Bartlett's Test of Sphericity	Approx. Chi-Square	389.481
	Df	190
	Sig.	.000

The table above shows that the KMO index (0.543) is high, and Bartlett's Test ($p < 0.05$) indicates that there is a correlation between the variables being studied. The results of this preliminary checking allow factor analysis to analyze the data. Next, the scree plot generated by the calculation was observed to help determine the number of underlying factors:

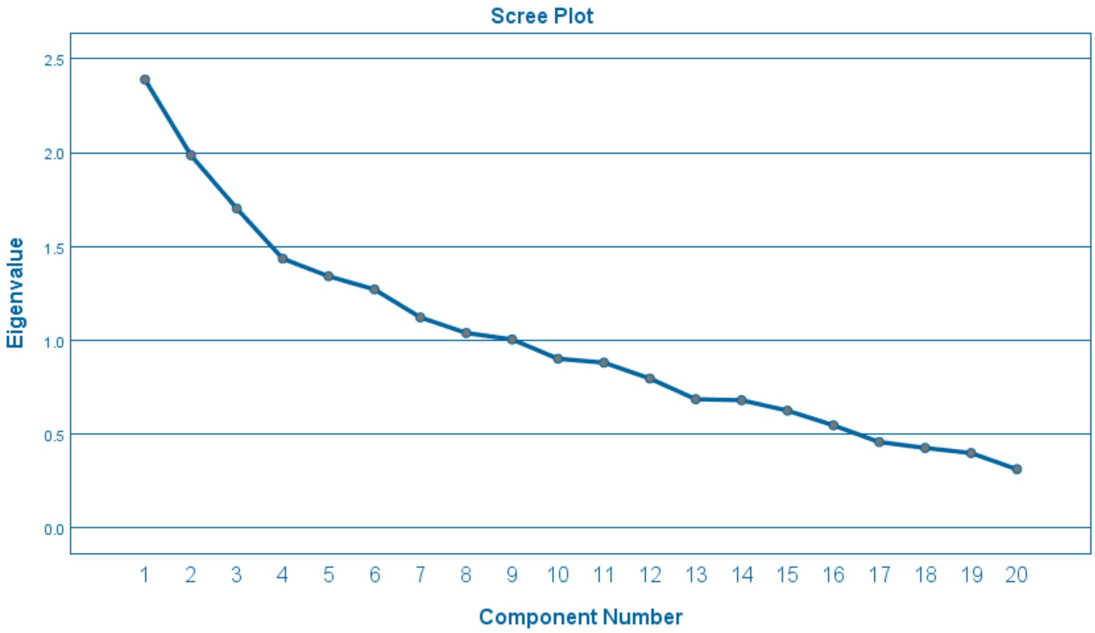

Figure 9. The Scree Plot of the Data for Measuring Practical Abilities

By looking at the Kaiser criterion, scree plot, rotated component matrix, and total variance explained, four factors were determined, namely factor 1 (response to external stimuli), factor 2 (acts toward new things), factor 3 (preferences for types of tasks), and factor 4 (preferences for external stimuli).

Table 10. Factors and Loadings of Related Variables for the Measurement of Practical Abilities

	Variable	Content of the Variable
Factor 1	Q20	Response to information
	Q11	Response to a sudden situation
	Q3	Acts when faced with problems
	Q13	Response to complex instruction
Factor 2	Q7	Acts when trying new tools
	Q17	Acts when trying new tools
Factor 3	Q18	Preferences for types of tasks
	Q10	Learning styles
Factor 4		
	Q8	Preferences for types of stimuli

The concept of practical abilities and the underlying factors can be visualized below:

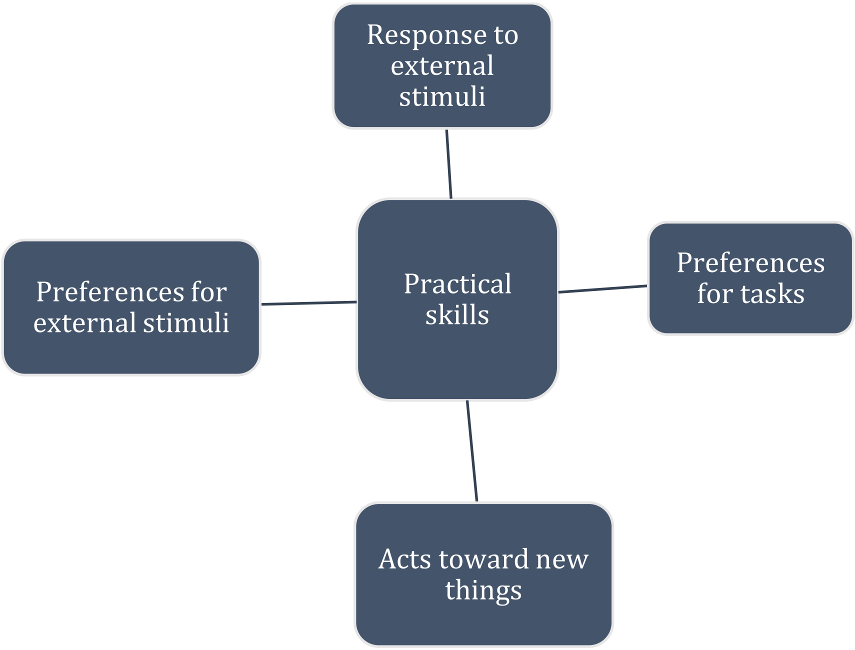

Figure 10. The Factors Underlying Practical Skills

DISCUSSION

The present study sought to empirically validate instruments for measuring the five components of adaptive intelligence—wisdom, creativity, problem-solving skills, analytical skills, and practical ability—through exploratory factor analysis. The results confirmed that each component is multidimensional, supporting the argument that adaptive intelligence cannot be reduced to a single unitary construct (Sternberg, 2021). Instead, it reflects a constellation of interrelated yet distinct abilities that jointly enable individuals to function effectively in complex, dynamic environments.

The emergence of three distinct factors—responses to failure and problems, responses to provocation and change, and responses to understanding others and uncertainty—offers a nuanced extension of earlier conceptualizations. While pro-social emphasized prosocial behavior, emotional regulation, and decisiveness (Vorster, 2025), the findings suggest that *uncertainty management* should also be treated as a core facet of wisdom. It resonates with relevant research that claims wisdom involves balancing intrapersonal, interpersonal, and extrapersonal interests in often unpredictable contexts (Bracher, 2022; Sternberg, 2023). The ability to tolerate and adapt to uncertainty is particularly critical in contemporary societies marked by rapid technological and sociopolitical changes.

Two factors were identified: conceptual understanding of creativity and critical problem-solving in individual or group contexts. This dual structure parallels the model of creativity as existing on a spectrum, ranging from personal insights to "Big-C" creativity that shapes cultural products (Kaufman et al., 2022). However, the present study adds to this by highlighting the *social dimension* of creativity, as group problem-solving emerged as a distinct factor. It aligns with relevant studies' argument that creativity is fostered through social exchange, underscoring the importance of collaboration in nurturing adaptive intelligence (Lee et al., 2022; Wang et al., 2022). The implication is that creativity assessment should not only focus on divergent thinking at the individual level but also capture collaborative dynamics that enhance collective innovation.

The factor structure for problem-solving comprised attitudes toward challenges, approaches to obstacles, and task preferences. These findings confirm and extend Dostál's (2015) stage model and Gestalt theory (Khoshneshan et al., 2023). While emotional readiness and cognitive reflection are well-established, identifying *task preference* as a separate factor indicates that motivational and contextual alignment play a non-trivial role in effective problem-solving. It suggests that problem-solving ability cannot be fully understood without considering individuals' intrinsic interests and contextual fit, echoing Mashinchi et al. (2024)'s emphasis on self-efficacy.

Three factors emerged—problem-solving ability, response to information, and learning styles—illustrating that analytical competence goes beyond cognitive processing. The results align with the Cattell-Horn distinction between fluid and crystallized intelligence (Blanch & Blanco, 2025; Hertler et al., 2025), but they also introduce the element of *metacognitive self-regulation*, consistent with (Braund & Timmons, 2021; Frazier et al., 2021). Specifically, the "learning styles" factor reflects how individuals regulate their engagement with information, thereby influencing analytical outcomes. It indicates that analytical intelligence involves not only logical operations but also personal strategies for information management, a finding with implications for instructional design and personalized learning.

Practical ability revealed the richest structure: responses to external stimuli, actions toward new tools, preferences for tasks, and preferences for stimuli. Sternberg (2000) defined practical intelligence as tacit knowledge applied to real-world contexts, but the present findings show that it also incorporates *adaptive behavioral dispositions*. The distinction between actions toward new tools and preferences for stimuli suggests that practical intelligence is shaped not only by procedural knowledge but also by motivational orientations toward novelty and contextual engagement. This insight resonates with the adaptive behavior framework, which emphasizes practical functioning in daily life (Glück & Weststrate, 2022; Karwowski & Beghetto, 2019). Importantly, these results imply that practical ability is not a static skill set but a dynamic interaction between environment, motivation, and cognitive adaptability.

Theoretically, this study advances the operationalization of adaptive intelligence by mapping its factor structures across domains. Unlike previous validation studies that stopped at content or reliability checks (Okoye & Auta, 2020), the present research delineates the *latent dimensions* of each construct. It offers a stronger empirical foundation for adaptive intelligence theory (Sternberg, 2021), often criticized for being conceptually rich but empirically underdeveloped.

Practically, the validated instruments hold promise for educational and psychological applications. These tools can help identify students' adaptive profiles in educational settings, enabling teachers to design interventions that foster resilience, collaboration, and practical problem-solving. In organizational contexts, the instruments could be used for talent assessment, particularly in industries undergoing rapid technological transformation where adaptability is paramount.

Despite its contributions, the study has limitations. The sample was restricted to university students from a single institution, limiting the generalizability of findings. Cross-cultural validation is needed, as adaptive intelligence may manifest differently across cultural contexts (K. Li et al., 2019). Furthermore, the study relied on exploratory factor analysis; confirmatory factor analysis and longitudinal studies are required to establish stability and predictive validity of the instruments. Future research should also explore the interconnections among the five domains, investigating whether higher-order factors can account for integrating adaptive intelligence as a unified construct.

CONCLUSION

This study validated instruments for measuring the five components of adaptive intelligence: wisdom, creativity, problem-solving, analytical skills, and practical ability. Factor analysis revealed that each construct is multidimensional, confirming the complexity of adaptive intelligence as an integrated set of interrelated abilities. The findings extend existing theories by uncovering specific latent dimensions, such as uncertainty management within wisdom, collaborative aspects of creativity, motivational orientations in problem-solving and practical skills, and self-regulation in analytical ability. These insights enrich the empirical foundation of adaptive intelligence, offering clearer operational definitions for future research. The validated instruments provide educators and professionals with reliable tools to assess adaptive capacities and design interventions that foster resilience, creativity, and real-world problem-solving. It directly impacts education and workforce development in contexts of rapid social and technological change. The study's scope was limited to a single student population, and further validation across diverse cultural and professional groups is necessary. Future studies should employ confirmatory factor analysis and longitudinal approaches to strengthen validity and explore whether adaptive intelligence can be modeled as a higher-order construct.

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