

Situational judgment test measures administrator computational thinking with factor analysis

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ABSTRACT

Computational thinking skills (CTS) play a crucial role across diverse domains, involving a thinking process that allows the execution of solutions by information processing agents. Measuring the level of CTS becomes essential to ensure that administrators effectively leverage technology. However, finding suitable instruments to measure and justify CTS levels in administration can be challenging. The selection of situational judgement test (SJT) is supported by its validity and reliability in assessing attributes, including professionalism. The instrument's development includes face validity, discriminant validity (using Pearson correlation and Cronbach's alpha), and exploratory factor analysis (EFA). The study involved 111 undergraduate administration students from various Indonesian universities, and data were collected in 2023. Following a discriminant validity analysis, ten items were eliminated, while 23 met the criteria with $p < 0.050$ and $r > 0.185$. Subsequently, EFA yielded 16 items forming seven components, covering algorithmic thinking, problem-solving, technology literacy, problem abstraction, problem reformulation, data management in administration technology, and administrative data presentation with loading factor variations (0.421-0.868). The final instrument, consisting of 16 valid items and seven components, effectively evaluates the level of administrator computational thinking skills (ACTS) among administration students.

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1. INTRODUCTION

Computational thinking skills (CTS) originated from the work of constructivists Wooster and Papert [1], [2] and were first introduced as a term in an article by Wing [3]. Researchers describe CTS as “problem-solving, system design, and understanding human behavior using fundamental computer science concepts.” Therefore, CTS represents the ability to analyze and subsequently solve various problems. The most frequently cited definition of CTS comes from Shute *et al.* [4], who posits that CTS is a thinking process where “solutions are represented in a form that information processing agents can effectively execute”. Berland defines CTS as the “ability to think using computers as tools” [5]. Therefore, this skill is essential for individuals in any field related to computation, regardless of the level of usage, including non-development users and master CTS [6]–[8]. Computational thinking skills are versatile and valuable in

today's world. They enable systematic problem-solving, algorithmic thinking, and critical analysis [9]. These skills find applications across various fields, including computer science, data analysis, and automation [10], [11]. They foster innovation, enhance education, create career opportunities, and contribute to global competitiveness. Furthermore, computational thinking promotes ethical considerations in technology use. These skills are essential for navigating the challenges and opportunities of the digital age [12].

One field that positions itself as a user of existing technologies is administration. Administration encompasses the execution of administrative tasks across various organizations, leading to increased interaction between individuals (administrators) and technology. This stems from the significant improvement in work effectiveness and efficiency when administrators leverage technology to support their work. However, this assumption hinges upon the premise that administrators have attained a high level of proficiency in technology utilization. This aligns with the findings of The Australian Association of Mathematics Teachers (AAMT) [13], which emphasize that more mere technology usage is required to affect specific practical competencies automatically. Still, educators or trainers need to improve their knowledge of technology utilization for maximum competency achievement. These insights underscore the pivotal role of CTS in enhancing the effectiveness and efficiency of learning and work [14], [15]. Therefore, formal and non-formal education in administration should prioritize the development of students' CTS abilities, thereby preparing them as adept professionals upon the completion of their education or training.

Unfortunately, there is a scarcity of available instruments that can be used to evaluate students' CTS in the administration field, making it challenging to accurately evaluate their CTS proficiency. In the administration field, there is an urgent need to measure computational thinking skills (CTS) abilities accurately and quantifiably. However, the existing literature lacks a significant number of numbers of specific and relevant instruments to measure CTS in the context of administration. For example, some previous studies, such as [16]–[19], have utilized Likert scale-based instruments to measure CTS ability. It should be noted that Likert scales are typically used to analyze specific categories in respondents' answers, and the coding of responses cannot be used to justify an individual's level since there is no value in differentiating agreement or disagreement with the reaction [20]–[22]. Andrade [23] stated that Likert scales in assessments are not used for discerning one student's ability from another. Rather, they may be used by educators or instructors for preliminary evaluation, provided that students respond honestly without any inclination to achieve particular scores when completing the instrument. Therefore, there is a need to develop an instrument that can justify students' CTS level in the field of administration, offering a precise means of evaluating CTS and facilitating the accurate advancement of CTS competencies in administration students. This gap allows this research to develop a suitable and contextually relevant instrument called administrator computational thinking skills (ACTS) in the administration field. In today's fast-paced professional landscape, administrative roles have evolved to require a distinct set of skills, including computational thinking—the ability to analyze data, solve problems, and make data-driven decisions. The situational judgment test (SJT) has gained prominence as a tool for assessing various competencies in organizational contexts. However, its application in evaluating computational thinking within administrative roles remains uncharted territory. This research aims to fill this gap by investigating the effectiveness of SJTs in measuring computational thinking in administrators. Utilizing a factor analysis approach, we seek to understand how well SJTs align with the multifaceted aspects of computational thinking and assess the reliability and validity of these tests in evaluating this critical cognitive skill. This study can improve talent assessment and development strategies in the digital age by shedding light on the compatibility between SJTs and computational thinking in administrative roles.

In light of this urgency, researchers developed an instrument, administrator computational thinking skills (ACTS), based on the situational judgment test (SJT). SJT was chosen as the basis for developing this instrument is grounded in the consensus among experts regarding its validity and reliability when used to measure attributes such as professionalism in the field studied by students [24]–[26]. Furthermore, the situational judgment test (SJT) is a form of assessment designed to measure individuals' ability to evaluate and respond to realistic work situations [27]–[29]. Therefore, SJT is likely to have high relevance when developing this CTS instrument. The analysis technique used in creating this instrument includes: i) Face validity to validate the instrument's readability to avoid ambiguous questions; ii) Discriminant validity, involving Pearson correlation and Cronbach's alpha to determine and test the correlation strength between questionnaire items and CTS, and iii) Exploratory factor analysis which is used to test the instrument's strength through Kaiser-Meyer-Olkin (KMO) test, Bartlett's test, minimum sample adequacy (MSA), and communalities, then form components through loading factors with extraction method principal component analysis and rotation method: Varimax with Kaiser normalization. It is anticipated that these three primary analytical approaches will result in the creation of a robust CTS assessment instrument, with the identified components serving as constructs or indicators of CTS variables specific to the administration field. Through the development of ACTS based on SJT and refined through various analytical techniques, this research aims to fill the gap in the existing literature and provide a valid and reliable evaluation tool to measure CTS in the

context of administration. It is expected that the findings of this study will significantly contribute to developing CTS abilities among students or prospective professionals in the field of administration and provide a strong foundation for decision-making and policy formulation in formal and non-formal education in this field. In the subsequent sections, we will explore relevant literature, outline research objectives, detail the research methodology, and discuss the potential implications of our findings. Through this research, we aspire to provide valuable insights that can benefit academia and industry, guiding them in assessing and cultivating talent within the evolving landscape of administrative positions, where computational thinking is increasingly essential.

2. METHOD

The sample group in this study consisted of undergraduate students from universities in Indonesia during the 2022-2023 academic year who voluntarily participated in the study. Of 150 students, 111 provided complete responses to the instrument after validation. The sample size was determined based on a stable factor structure model, requiring a minimum of 100 to 200 subjects with a subject-variable ratio of at least 2:1 to reduce the standard error (SE) of correlations to negligible proportions [30]. The method used in this study was exploratory factor analysis (EFA) for convergent validity. EFA was used to determine the construct validity [31] of the CTS instrument. It should be noted that face validity with expert judgment and discriminant validity with product-moment analysis and Cronbach's alpha are not the primary analyses in instrument development; both are used as reinforcement [32]. Taherdoost revealed that "face validity is the degree to which a measure appears to be related to a specific construct, in the judgment of non-experts such as test-takers," and discriminant validity is the extent to which latent variable A discriminates from other latent variables (e.g., B, C, D) [32].

Our research procedure consisted of five phases in Table 1. Phase 1 of the draft CTS assessment instrument was prepared based on a literature review using the Indonesian language by adapting a situational judgment test with five options, each rated on a scale of 1 (least relevant answer to the given situation) to 5 (most appropriate answer to the given situation). The phase pertains to the preliminary phase of a tool or method's creation, specifically the "CTS assessment instrument". The term "draft" suggests that this version is evolving, open to future modifications. This draft's foundation was a thorough review of existing research, particularly in Indonesian, implying that the primary references were Indonesian works or studies. In the test, each scenario offered five potential reactions for an individual to select from. These options were not arbitrary but ranked based on their pertinence to the given situation. A score of "1" signified the least relevant choice, while a "5" denoted the most suitable answer. Phase 2 involved expert validation, where experts evaluated the instrument by completing a validation sheet using a rating scale ranging from (1) very poor, (2) not good, (3) fair, (4) reasonable, and (5) very good. If an item received a score of (2) or (1) during expert validation, then the statement item would be eliminated. In this phase, experts in the relevant field provided feedback and validation, ensuring the instrument's suitability, accuracy, and effectiveness. Qualified individuals in the pertinent field conducted the assessment, utilizing a designated form which likely listed components requiring validation. They employed a rating system from 1 (least favorable) to 5 (most favorable) to evaluate each item's quality. Any component rated as "very poor" or "not good" was excluded, guaranteeing that the final instrument retained only items of satisfactory quality. Phase 3 involved collecting data by distributing assessment instruments to 242 samples. In the third stage of the investigation or project, data was gathered using specific evaluation tools distributed to 242 participants or units, referred to as 'samples'. These participants or units provided their responses or data through these evaluation tools, contributing to the collection of information needed for the study. Phase 4 included data tabulation and validity and reliability tests (product-moment and Cronbach's alpha). In this phase, the collected data was systematically arranged, known as 'data tabulation,' making it more accessible and interpretable. Along with this, the data's accuracy and consistency were verified. Two specific statistical techniques were employed. Product-moment: a statistical method that gauges the linear relationship intensity and direction between two variables, helping to identify how two data sets correlate. Cronbach's alpha: a metric that evaluates the internal consistency of a test or scale. It ensures that various items in a questionnaire, aiming to gauge a similar concept, yield comparable scores. These methods are vital to confirm that the data is valid (accurately represents what it intends to) and reliable (offers consistent outcomes). To test validity and reliability, Pearson correlation Cronbach's alpha was applied with the utilization of SPSS 26, employing the following criteria: i) If the value of Sig. (2-tailed) < 0.05 and the Pearson correlation is positive, the item is declared valid. ii) If the value of Sig. (2-tailed) < 0.05 and the Pearson correlation is negative, the item is declared invalid. And iii) If the value of Sig. (2-tailed) > 0.05, the item is declared invalid.

After criterion "a" is met, the next step is to compare the Pearson correlation with r table df 111 (0.185). The item is declared valid if the Pearson correlation $p > 0.185$. Furthermore, the instrument is

displayed as reliable if Cronbach’s alpha > 0.6. Phase 5 involved carrying out EFA. This phase utilized a statistical technique called exploratory factor analysis (EFA) that helps in understanding the hidden relationships among observed variables. It allows researchers to pinpoint latent variables or ‘factors’ that explain the observed data patterns. EFA simplifies a vast set of variables into fewer, more meaningful groups. This method clarifies the main dimensions or factors influencing the data or responses. EFA was employed in this study due to the absence of locally developed instruments for assessing CTS and collaboration skills (CS) within the context of office administration education in Indonesia. In this study, EFA employed the extraction method in the form of principal component analysis and the rotation method in the form of varimax to determine which statement items will be eliminated, to group items into indicators, and to find out which items have vital dimensions with computational thinking skills and collaboration skills. The first requirement that must be met to perform factor analysis is $KMO > 0.50$ and $sig. < 0.05$. The second requirement is the anti-image correlation of $MSA > 0.50$; if $MSA < 0.50$, the statement item must be eliminated and retested. The third condition is communalities > 0.50; if communalities < 0.50, the item must be destroyed and retested. These conditions must be met before describing how many factors or dimensions appear based on the total initial eigenvalues > 1. Additionally, they are instrumental in determining which items constitute factors or dimensions by examining the maximum rotated component matrix value per dimension component, manifesting a loading factor of 0.40 [31]. The instrument consists of several aspects, each of which is interpreted and described in several indicators. In detail, research aspects and indicators are described in Table 1.

After accumulating the instruments in this study, the procedure is to determine the research phases. These phases are divided into five main sections, commencing with deciding the instrument to assessing the validity of the instrument. The phases are described in detail in Figure 1.

Table 1. Instrument validation “experts”

Aspect	Indicator	Item question				
		1	2	3	4	etc
Clarity	Clarity title sheet question					
	Clarity sheet statement					
	Clarity item statement					
	Clarity instruction charging					
Accuracy	Accuracy statement with the expected answer					
Relevance	The statement is related to indicator					
	The statement by aspect that wanted to be achieved					
Validity contents	The statement uncovers correct information.					
Absence of bias	The statement has complete idea.					
Language accuracy	The language used is easily understood.					
	The language used is effective					
	Writing with good and correct Indonesian spelling					

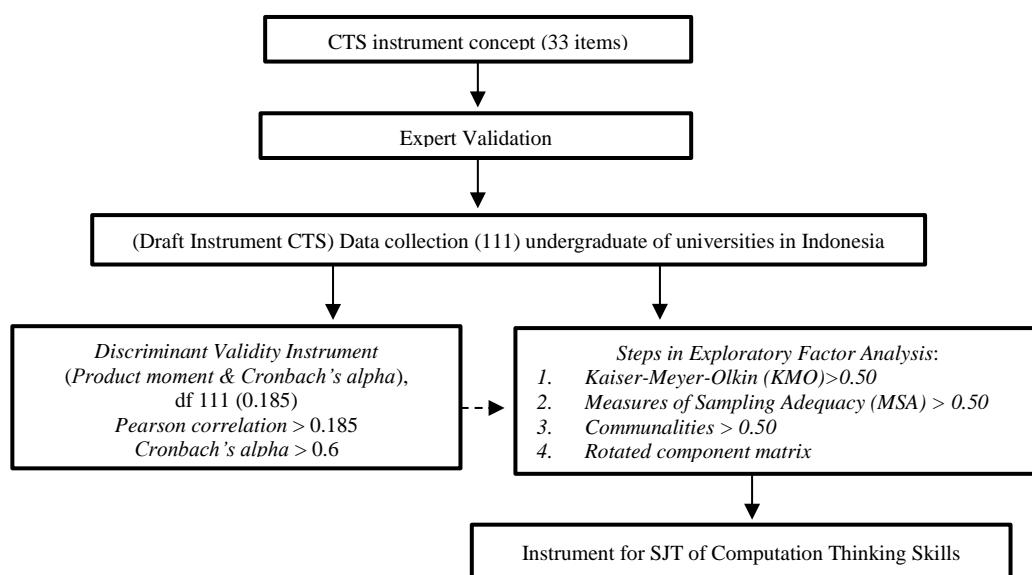


Figure 1. Research phase

3. RESULTS AND DISCUSSION

3.1. Phase-1: instrument computation thinking skills (CTS)

Computational thinking skills (CTS) originated from the constructivist work of Seymour [1], [2] and was first introduced as a term in an article by Wing [3], defining it as a process of “problem-solving, system design, and understanding human behavior, using fundamental concepts of computer science.” Therefore, CTS represents the ability to analyze and solve various problems. One of the most commonly cited definition of CTS [4], characterizes it as a thinking process in which “...solutions are represented in a form that information processing agents can effectively execute”. Berland defines CTS as “the ability to think using a computer as a tool” [5]. In today’s digitally and computationally-driven professional world, CTS holds significant importance, as Guler stated, “computational thinking skills are considered as qualifications that today’s individuals should have in order to cope with the situations they face and may encounter” [33]. Therefore, improving these skills is of high urgency, as relying on technology without mastering its underlying skills may be insufficient [13]. The initial step before implementing any action is to evaluate the level of CTS; hence, a test instrument is needed to assess the level of CTS [34], [35].

In developing this draft instrument, the researchers considered indicators such as the five essential and universal elements in various computation domains [36]: i) hypothesis testing, ii) data management, iii) parallelism, iv) abstraction, and v) debugging. Recently, [37] described five components of CTS: i) problem-solving, ii) pattern recognition, iii) abstraction (i.e., generalizing recurring patterns), iv) algorithm design for solutions, and v) solution evaluation (i.e., debugging). Guler herself stated that CTS is generally related to abstraction, modeling, and programming utilization [33]. Özgen Korkmaz also stated that algorithmic thinking, cooperativity, creativity, critical thinking, and problem-solving are integral parts of CTS [16]. Based on the consideration of these indicators, this study developed 33 draft items for the ACTS questionnaire, which were tested in several subsequent stages. As shown in Table 2 for sample question items.

Table 2. Sample CTS question items

Code item	Question item	Options (A, B, C, D)
ACTS3_5	An administrator needs to develop an algorithm for scheduling room reservations in organization x. How can an effective algorithm be developed?	
ACTS3_6	An administrator needs to create an algorithm for arranging thesis defense schedules for students. How can an efficient algorithm be developed?	
ACTS4_1	An administrator in organization x must perform testing and debugging on a developed application. What should the administrator do when encountering a bug in the application?	

3.2. Phase-2: face validity

The second phase of the exploratory analysis process involves verifying the validity of the instrument items through expert validation. This stage requires several processes to complete the validation. Firstly, expert categories are determined to assess the instrument item. Then, experts are assigned to each category for evaluation. This decision is based on the considerations of the research team through various scientific reasons and criteria relevant to the research theme. The appointed experts are individuals who can independently and objectively be accountable for assessing the instrument item in this study. The designated expert categories are content experts and language experts. Each expert is provided with an evaluation form and the draft items of the ACTS instrument to be assessed. The assessment is ranked on a scale of 1 to 5, with category 1 being “not suitable” and category 5 being “very suitable.” Aspects assessed in the expert validation include clarity, accuracy, relevance, content validity, absence of bias, and language accuracy. Based on the expert validation results from the content and language experts conducted, the following are the validation outcomes:

The diagram’s legend indicates the following annotations: Q1: clarity, Q2: accuracy, Q3: relevance, Q4: content validity, Q5: absence of bias, and Q6: language accuracy. Based on the expert validation results in Figure 2, the average validation scores for each aspect in each category are significantly high (above suitable). This indicates that the instrument has good validity in assessing administrator computational thinking skills. Both content experts and language experts suggest that the instrument is ready to be administered to respondents to determine the measurement outcomes for this research and proceed with the analysis to test the existing hypotheses.

3.3. Phase-3: data collection

This research involved undergraduate students majoring in administration from several universities in Indonesia who had an active status. It is expected that students majoring in administration, who have

undergone administration-related courses, can reflect their acquired administrative skills during their academic journey. Therefore, the ACTS instrument can effectively capture the ACTS abilities. Data collection using the ACTS instrument commenced in May 2023 and continued until June 2023. A total of 150 data points were collected, and 111 were deemed valid) for participation in this study. Among the participants, 23 were male and 88 were female, with 51 participants from urban areas and 60 participants from rural areas, ranging in age from 17 to 22 years old as shown in Table 3.

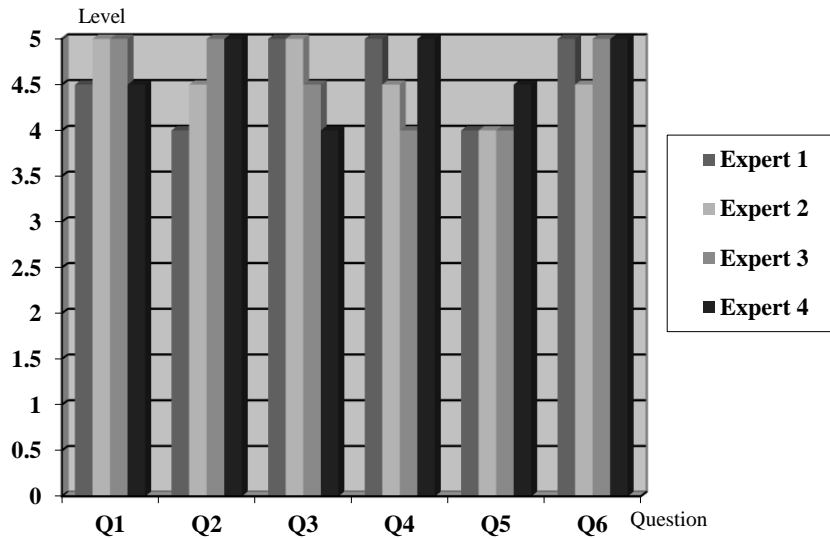


Figure 2. Expert validation results

Table 3. Description of pilot test participants

		N	%	Mean	Median	SD
Age	17 to 19 years old	66	59.4	19.44	19	0.901
	20 to 22 years old	45	40.6			
Gender	Male	23	20.7	1.79	2	0.407
	Female	88	79.3			
Admission Pathways	Government	48	43.2	1.57	2	0.498
	University	63	56.8			
Environment	Urban	51	45.9	1.54	2	0.501
	Rural	60	54.1			

3.4. Phase-4: discriminant validity

The researchers used Pearson correlation in Table 4, which is the most commonly used method for numeric variables, to examine the relationship between variables. It provides values between -1 and 1, where 0 indicates no correlation [38]–[40]. The minimum required value for r (correlation coefficient) based on the r table is $r > 0.185$, and the p-value must be sig. $p < 0.050$. The results indicated that items ACTS1_1, 1_5, 2_1, 3_3, 4_2, 5_1, 5_5, 5_6, 6_2, and 6_5 had $p > 0.050$ and $r < 0.185$, which means they did not have a significant correlation with ACTS and were therefore eliminated. Items with significant correlation based on previous analysis with $p < 0.050$ and $r > 0.185$ were retained and proceeded to the EFA test phase to confirm their validity and identify components as indicators of ACTS. Furthermore, the reliability analysis indicated that Cronbach’s alpha was > 0.6 for all question items.

3.5. Phase-5: exploratory factor analysis (EFA)

The first step in the exploratory factor analysis is to check the suitability of the KMO value (> 0.50) and the Bartlett’s Test of Sphericity value (< 0.050) [31]. The results of the suitability test for EFA through KMO and Bartlett’s test show that the values have been met, where KMO is 0.678 (> 0.50) and Bartlett’s test is 0.000 (< 0.050) as shown in Table 5.

The results of the MSA analysis show that out of the 23 question items analyzed, 16 question items met the criteria with MSA values > 0.50 as shown in Table 5. The lowest MSA value was found in item ACTS1_2 (0.538 > 0.50), while the highest MSA value was item ACTS3_5 (0.834 > 0.50). Subsequently, the

16 question items that meet the MSA value requirements underwent communalities analysis. The extraction method used in the communalities analysis was principal component analysis. The extraction results show that all 16 question items of ACTS as shown in Table 5 have values > 0.50 , with the lowest value in item ACTS4_3 (0.563) and the highest value in item ACTS3_6 (0.743). Therefore, these 16 question items are deemed valid out of the initial 33 questions the researchers designed. During the Pearson correlation test, 10 question items were eliminated due to $p > 0.05$, indicating that the correlations were not statistically significant. Subsequently, 23 question items were analyzed using EFA, resulting in the elimination of 7 question items as they did not meet the MSA value > 0.50 criteria. The final outcome yielded 16 valid question items and demonstrated good and strong validity in the EFA test in Table 6.

Table 4. Pearson correlation results

Code Item	r (sig.)	Code item	r (sig.)	Code item	r (sig.)
ACTS1_1	0.004 (0.967)	ACTS3_2	0.254 (0.007)	ACTS5_2	0.261 (0.006)
ACTS1_2	0.276 (0.003)	ACTS3_3	0.037 (0.703)	ACTS5_3	0.319 (0.001)
ACTS1_3	0.310 (0.001)	ACTS3_4	0.283 (0.003)	ACTS5_4	0.298 (0.001)
ACTS1_4	0.297 (0.002)	ACTS3_5	0.331 (0.000)	ACTS5_5	0.172 (0.071)
ACTS1_5	0.156 (0.103)	ACTS3_6	0.352 (0.000)	ACTS5_6	0.088 (0.360)
ACTS2_1	0.011 (0.909)	ACTS4_1	0.353 (0.000)	ACTS5_7	0.319 (0.001)
ACTS2_2	0.336 (0.000)	ACTS4_2	0.170 (0.074)	ACTS6_1	0.353 (0.000)
ACTS2_3	0.388 (0.000)	ACTS4_3	0.278 (0.003)	ACTS6_2	0.116 (0.225)
ACTS2_4	0.322 (0.001)	ACTS4_4	0.285 (0.002)	ACTS6_3	0.317 (0.001)
ACTS2_5	0.238 (0.012)	ACTS4_5	0.304 (0.001)	ACTS6_4	0.254 (0.007)
ACTS3_1	0.424 (0.000)	ACTS5_1	0.076 (0.426)	ACTS6_5	0.138 (0.149)

r table df 111 is 0.185

Table 5. KMO and Bartlett's test results

KMO & Bartlett's Test		
Kaiser-Meyer-Olkin Measure		0.678
Bartlett's test of sphericity	Chi-Square	299.762
	Sig	0.000

Table 6. MSA analysis results

Code Item	MSA	Communalities	Code Item	MSA	Communalities
ACTS6_1	0.566	0.685	ACTS3_5	0.834	0.635
ACTS5_7	0.564	0.807	ACTS3_1	0.689	0.647
ACTS5_4	0.730	0.655	ACTS2_5	0.534	0.640
ACTS4_5	0.610	0.697	ACTS2_3	0.686	0.610
ACTS4_4	0.556	0.686	ACTS2_2	0.586	0.682
ACTS4_3	0.820	0.563	ACTS1_4	0.573	0.654
ACTS4_1	0.680	0.721	ACTS1_3	0.663	0.630
ACTS3_6	0.656	0.743	ACTS1_2	0.538	0.686

Extraction method: Principal component analysis.

After the 16 question items were declared valid and met the required values in the EFA analysis, including KMO, Bartlett's test, MSA, and communalities, the next step in the EFA stage was to examine the loading factor for each question item and identify the loading factor formed by EFA. The results show that the lowest loading factor was created by question item ACTS2_3 (0.421), while the highest loading factor was formed by question item ACTS5_7. Seven components have been developed from the EFA analysis with eigenvalues, extraction, and rotation > 1.000 as shown in Table 7, and these seven components in the MSA analysis results consist of several question items that can be used to reflect each component. The component with the most question items was found in the first component (ACTS3_5. ACTS4_1. ACTS3_6. ACTS4_3. and ACTS5_4). Each component has a percentage of variance, with the highest percentage found in the first component "algorithmic thinking in administrative technology" with a value of 20.49%. The second component "administrative problem-solving" accounts for 10.75% of the variance. The third component "administrative technology literacy" accounts for 8.29% of the variance. The fourth component "administrative problem abstraction" accounts for 7.35% of the variance. The fifth component "administrative problem reformulation" accounts for 7.10% of the variance. The sixth component "data management in administrative technology" accounts for 6.84% of the variance. and the seventh component "administrative data presentation" accounts for 6.30% of the variance. Table 7 shows the results of the factor loading analysis for each item studied.

Table 7. Loading factor

Item	Component (% of variance) & Loading factor						
	1 (20.49%)	Item	2 (10.75%)	Item	3 (8.29%)	Item	4 (7.35%)
ACTS3_5	0.783	ACTS2_2	0.786	ACTS4_5	0.760	ACTS1_3	0.773
ACTS4_1	0.778	ACTS1_4	0.608	ACTS4_4	0.715	ACTS2_3	0.421
ACTS3_6	0.665	Item	5 (7.10%)	Item	6 (6.84%)	Item	7 (6.30%)
ACTS4_3	0.628	ACTS1_2	0.728	ACTS2_5	0.755	ACTS5_7	0.868
ACTS5_4	0.620	ACTS3_1	0.509	ACTS6_1	0.679		

*Note: Component 1 represents “algorithmic thinking in administrative technology,” Component 2 represents “administrative problem-solving,” Component 3 represents “administrative technology literacy,” Component 4 represents “administrative problem abstraction,” Component 5 represents “administrative problem reformulation,” Component 6 represents “data management in administrative technology,” and Component 7 represents “administrative data presentation.”

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser normalization.

As a discussion point, CTS is not merely about thinking using a computer or engaging in programming [3], [41], [42] but it is a way of thinking to solve problems using computer technology or similar means [33]. CTS is closely related to using and utilizing technology to address and benefit from the challenges faced. This aligns with the findings of researchers [43]–[46] who state that leveraging technology with strong CTS abilities can have positive impacts on individuals and specific groups. Therefore, the terms “technology” and “CTS” should not be separated because using technology without the ability to utilize it effectively would result in suboptimal outcomes, and vice versa [13]. This study has produced the ACTS instrument with 16 question items and seven components as the reclassification factors in the MSA analysis results. These seven factors include component-1: algorithmic thinking in administrative technology, component-2: administrative problem-solving; component-3: administrative technology literacy, component-4: administrative problem abstraction, component-5: administrative problem reformulation, component-6: data management in administrative technology; and component-7: administrative data presentation. Algorithmic thinking is reflected through question item 5: “An administrator needs to develop an algorithm to create a room booking schedule in organization x. How to develop an effective algorithm?” This question reflects the effort of understanding the situation and efficiently solving the problem systematically, step by step. Creating a room usage schedule is not something that can be easily accomplished; it requires a systematic and efficient approach. Errors in developing the plan can lead to complexity or chain reactions that result in more significant issues and losses for various parties. Therefore, it is reclassified into the algorithmic thinking (AT) component since AT can be described as high-level intellectual actions involving understanding the situation, finding systematic and generalizable solutions to problems, examining the accuracy and efficiency of the solutions, and expressing these solutions step by step [33].

Administrative problem-solving is reflected through question item 2: “How do you handle problems when you have tight time constraints?” This question demonstrates the approach to finding solutions to the problems faced, where cognitive thinking is necessary for effective problem-solving. In any professional role, the occurrence of issues entailing time constraints is inevitable and necessitates accurate problem-solving within specified time limits. Problem-solving is considered a separate part of computational thinking alongside algorithmic thinking [16], [47]. Doleck *et al.* [47] states that problem-solving is finding a way out of difficulties by engaging in cognitive thinking to find a solution. Unlike algorithmic thinking, problem-solving does not necessarily follow a step-by-step process; the most critical aspect is that the problem is resolved in its way. Administrative technology literacy is reflected through question item 2: “You encountered an application that crashes when opening a new feature. What should you do first?” In this modern age, technology will continue to evolve and be upgraded to improve, with the possibility of different features. The ability to understand technology, as reflected in the literacy component, should also be considered as part of ACTS. This finding differs from Özgen Korkmaz’s research, which identified algorithmic thinking, cooperativity, creativity, critical thinking, and problem-solving as parts of CTS. We propose administrative technology literacy as part of CTS because it represents the ability to understand the use of technology to benefit from it. This perspective aligns with research findings indicating that a positive grasp of technology literacy can provide positive benefits [48]–[52].

Administrative problem abstraction is reflected through question item 2: “In different situations, administrative employees need to identify common patterns and simplify problems by ignoring irrelevant details. Here are some situations frequently faced by administrative employees in organization x, except:” This question explores individuals’ understanding of identifying general patterns and then generalizing those patterns into a simple but detailed representation to solve problems. As Anderson stated, “Computational generate an abstract representation of the pattern once it has been identified.” [37]. Similarly, Cetin and Dubinsky [53] describe abstraction as considering the typical characteristics of several examples (the more, the merrier) and building a structure or category that includes all these features. Wing emphasizes that this

aspect is essential in CTS and deserves significant attention [54]. During abstraction, individuals think in a general manner and ignore specific details [53]. Administrative problem reformulation is reflected through question item 2: “When dealing with complex problems, what is usually your priority?” This question explores individuals’ understanding of reformulating problems into new formulations to enable problem-solving. This notion aligns with Wing’s assertion that computational thinking encompasses the task of reformulating intricate problems into ones for which we possess a method of resolution, possibly by reducing complexity, inserting, changing, or simulating [3], [54]. With better experience and proficiency in technology, problem reformulation occurs more frequently than in less experienced and less competent individuals, as found by researchers [55]. Strengthening competence in this area is essential to maximize problem-solving efficiency and effectiveness.

The management of data in administrative technology is also reflected through 2 question items, one of which is “An admin in organization x wants to analyze room usage data. Which one is an example of structured data?” Effective data management holds paramount significance in nearly every profession, particularly within the realm of administration, where the manipulation and utilization of data are pervasive. Administrators frequently engage with software or tools developed by their organizations or other developers to analyze the requisite data. This is a new finding in the ACTS capability, representing a reclassification from CTS. Yu and Prince [56] identified administrator performance, with one component being the use of technology in managing and analyzing data in Systemic Improvement. Significant results can reflect the performance of a professional administrator. This is supported by Bolaji’s findings, stating that administrators with limited abilities in the management of administrative data through technology often exhibit ineffective and inefficient performance [57]. The presentation of administrative data is reflected through the question item: “After you manage the data, you are asked to present the data in the form of a bar chart. What will you do?” The conveyance of data management outcomes through technology, as a realignment within ACTS is crucial. This facet, denoted as “data presentation in administration,” is newly reflected through one question item, even though it has the highest loading factor (0.868). Therefore, the researchers will investigate and report in subsequent articles to obtain more accurate data.

4. CONCLUSION

This research has developed a draft instrument called ACTS consisting of 33 questions derived from literature reviews on CTS. Through several robustness tests, including face validity, discriminant test, and EFA, 16 ACTS question items with high reliability were obtained. Through EFA, we discovered 7 components reclassified by the EFA test using the extraction method principal component analysis and rotation method Varimax with Kaiser normalization. These components were identified as follows: component 1 is algorithmic thinking in administrative technology, component 2 is administrative problem-solving, component 3 is technology literacy in administration, component 4 is problem abstraction in administration, component 5 is problem reformulation in administration, component 6 is data management in administrative technology, and component 7 is data presentation in administration. Four components (components 1, 2, 4, and 5) are consistent with previous research findings on CTS. In comparison, three components (components 2, 6, and 7) are newly discovered in building the framework of the ACTS instrument.

This research has broad implications for administrative subjects across education, problem-solving, innovation, workforce development, interdisciplinary collaboration, equity and access, policy development, global competitiveness, data analysis, and ethical considerations. This research can inform education strategies, drive innovation, enhance workforce skills, promote collaboration, address equity issues, shape policies, boost global competitiveness, improve decision-making, and guide ethical technology use. The implications are diverse and impactful, with potential benefits for individuals, organizations, and society. We hope this research can serve as a foundation for decision-making, particularly in developing the ACTS capabilities of students or prospective professionals in the administration field. Moreover, we encourage fellow researchers to delve deeper into these novel findings further to develop even more robust ACTS instruments.

REFERENCES




- [1] J. S. Wooster and S. Papert, “Mindstorms: children, computers, and powerful ideas,” *The English Journal*, vol. 71, no. 8, Dec. 1982, doi: 10.2307/816450.
- [2] S. Papert and I. Harel, “Situating constructionism,” *constructionism*, pp. 1–12, 1991.
- [3] J. M. Wing, “Computational thinking,” *Communications of the ACM*, vol. 49, no. 3, pp. 33–35, 2006, doi: 10.1145/1118178.1118215.

- [4] V. J. Shute, C. Sun, and J. Asbell-Clarke, "Demystifying computational thinking," *Educational Research Review*, vol. 22, pp. 142–158, Nov. 2017, doi: 10.1016/J.EDUREV.2017.09.003.
- [5] M. Berland and U. Wilensky, "Comparing virtual and physical robotics environments for supporting complex systems and computational thinking," *Journal of Science Education and Technology*, vol. 24, no. 5, pp. 628–647, Oct. 2015, doi: 10.1007/S10956-015-9552-X.
- [6] R. Richado, S. I. A. Dwiningrum, and A. Wijaya, "Computational thinking skill for mathematics and attitudes based on gender: comparative and relationship analysis," *Pegem Egitim ve Ogretim Dergisi*, vol. 13, no. 2, pp. 345–353, 2023, doi: 10.47750/pegog.13.02.38.
- [7] F. Fakhriyah, S. Masfuah, and D. Mardapi, "Developing scientific literacy-based teaching materials to improve students' computational thinking skills," *Jurnal Pendidikan IPA Indonesia*, vol. 8, no. 4, pp. 482–491, 2019, doi: 10.15294/jpii.v8i4.19259.
- [8] L. S. Riza, B. Handoko, Y. Wihardi, and Herbert, "Computational story: learning media for algorithm and programming based on computational thin," *International Journal of Engineering and Advanced Technology*, vol. 9, no. 1, pp. 2682–2685, 2019, doi: 10.35940/ijeat.A9738.109119.
- [9] R. Richardo *et al.*, "The impact of STEM attitudes and computational thinking on 21st-century via structural equation modelling (IJERE)," *International Journal of Evaluation and Research in Education*, vol. 12, no. 2, pp. 571–578, 2023, doi: 10.11591/ijere.v12i2.24232.
- [10] D. Mulyati *et al.*, "Development and evaluation of granular simulation for integrating computational thinking into computational physics courses," *Education and Information Technologies*, vol. 27, no. 2, pp. 2585–2612, 2022, doi: 10.1007/s10639-021-10724-8.
- [11] S. Amri, C. W. Budiyo, K. Fenyvesi, R. A. Yuana, and I. Widiastuti, "Educational robotics: evaluating the role of computational thinking in attaining 21st century skills," *Open Education Studies*, vol. 4, no. 1, pp. 322–338, 2022, doi: 10.1515/edu-2022-0174.
- [12] E. F. Rusydiyah, E. Purwati, and A. Prabowo, "How to use digital literacy as a learning resource for teacher candidates in Indonesia," *Cakrawala Pendidikan*, vol. 39, no. 2, pp. 305–318, 2020, doi: 10.21831/cp.v39i2.30551.
- [13] Australian Association of Mathematics Teachers, *Identifying and supporting quantitative skills of 21st century workers: quantitative skills map*. The Australian Association of Mathematics Teachers (AAMT) Inc, 2014.
- [14] D. E. Sondakh, K. Osman, and S. Zainudin, "A pilot study of an instrument to assess undergraduates' computational thinking proficiency," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 11, pp. 263–273, 2020, doi: 10.14569/IJACSA.2020.0111134.
- [15] S. Syafril, T. Rahayu, and G. Ganefri, "Prospective science teachers' self-confidence in computational thinking skills," *Jurnal Pendidikan IPA Indonesia*, vol. 11, no. 1, pp. 119–128, 2022, doi: 10.15294/jpii.v11i1.33125.
- [16] O. Korkmaz, R. Cakir, and M. Y. Ozden, "A validity and reliability study of the computational thinking scales (CTS)," *Computers in Human Behavior journal*, vol. 72, pp. 558–569, 2017, doi: 10.1016/j.chb.2017.01.005.
- [17] H. Y. Durak and M. Saritepeci, "Analysis of the relation between computational thinking skills and various variables with the structural equation model," *Computers and Education*, vol. 116, pp. 191–202, 2018, doi: 10.1016/j.compedu.2017.09.004.
- [18] M. Yağcı, "A valid and reliable tool for examining computational thinking skills," *Education and Information Technologies*, vol. 24, no. 1, pp. 929–951, 2019, doi: 10.1007/s10639-018-9801-8.
- [19] A. T. Korucu, A. T. Gencturk, and M. M. Gundogdu, "Examination of the computational thinking skills of students," *Journal of Learning and Teaching in Digital Age*, vol. 2, no. 1, pp. 11–19, 2017.
- [20] S. E. Harpe, "How to analyze Likert and other rating scale data," *Currents in Pharmacy Teaching and Learning*, vol. 7, no. 6, pp. 836–850, 2015, doi: 10.1016/j.cptl.2015.08.001.
- [21] I. H. Bernstein, "Likert Scale Analysis," in *Encyclopedia of Social Measurement*, K. Kempf-Leonard, Ed. New York: Elsevier, 2005, pp. 497–504.
- [22] B. Weijters, K. Millet, and E. Cabooter, "Extremity in horizontal and vertical likert scale format responses. Some evidence on how visual distance between response categories influences extreme responding," *International Journal of Research in Marketing*, vol. 38, no. 1, pp. 85–103, 2021, doi: 10.1016/j.ijresmar.2020.04.002.
- [23] H. L. Andrade, "A critical review of research on student self-assessment," *Frontiers in Education*, vol. 4, pp. 1–13, 2019, doi: 10.3389/educ.2019.00087.
- [24] F. Patterson, L. Zibarras, and V. Ashworth, "Situational judgement tests in medical education and training: Research, theory and practice: AMEE Guide No. 100.," *Medical teacher*, vol. 38, no. 1, pp. 3–17, 2016, doi: 10.3109/0142159X.2015.1072619.
- [25] B. D. Goss *et al.*, "Beyond selection: the use of situational judgement tests in the teaching and assessment of professionalism," *Academic medicine: journal of the Association of American Medical Colleges*, vol. 92, no. 6, pp. 780–784, Jun. 2017, doi: 10.1097/ACM.0000000000001591.
- [26] K. J. Smith *et al.*, "Development and validation of a situational judgement test to assess professionalism," *American Journal of Pharmaceutical Education*, vol. 84, no. 7, Jul. 2020, doi: 10.5688/ajpe7771.
- [27] M. A. McDaniel, E. B. Finnegan, F. P. Morgeson, M. A. Campion, and E. P. Braverman, "Use of situational judgment tests to predict job performance: A clarification of the literature," *Journal of Applied Psychology*, vol. 86, no. 4, pp. 730–740, 2001, doi: 10.1037/0021-9010.86.4.730.
- [28] M. D. Wolcott, F. Hahn, J. E. McLaughlin, and W. Cox, "Interested in situational judgment tests? Preparing pharmacy educators for potential challenges," *Currents in Pharmacy Teaching and Learning*, vol. 14, no. 6, pp. 785–789, 2022, doi: 10.1016/j.cptl.2022.06.010.
- [29] D. Wang, J. K. Oostrom, and E. Schollaert, "The importance of situation evaluation and the ability to identify criteria in a construct-driven situational judgment test," *Personality and Individual Differences*, vol. 208, 2023, doi: 10.1016/j.paid.2023.112182.
- [30] P. Kline, *The Handbook of Psychological Testing*. Routledge, 1013.
- [31] J. F. Hair, W. Black, B. J. Babin, and R. E. Anderson, *Multivariate data analysis: A Global perspective*, 7th ed. Pearson Education, 2010.
- [32] H. Taherdoost, "Validity and reliability of the research instrument; How to test the validation of a questionnaire/survey in a research," *International Journal of Academic Research in Management*, vol. 5, no. 3, pp. 28–36, 2016, doi: 10.2139/ssrn.3205040.
- [33] Ç. Guler, "Algorithmic thinking skills without computers for prospective computer science teachers," *Kuramsal Egitimbilim*, vol. 14, no. 4, pp. 570–585, Oct. 2021, doi: 10.30831/AKUKEG.892869.
- [34] H. H. Peng, A. T. Murti, L. M. Silitonga, and T. T. Wu, "Effects of the fundamental concepts of computational thinking on students' anxiety and motivation toward K-12 English writing," *Sustainability (Switzerland)*, vol. 15, no. 7, 2023, doi: 10.3390/su15075855.




- [35] B. Muchsini, Siswandari, Gunarhadi, and Wiranto, "Promoting college students' computational thinking: the use of constructionism-based accounting spreadsheets designing activities," *Cogent Education*, vol. 10, no. 1, 2023, doi: 10.1080/2331186x.2023.2222866.
- [36] National Research Council, *Report of a workshop on the scope and nature of computational thinking*. National Academies Press, 2010.
- [37] N. D. Anderson, "A call for computational thinking in undergraduate psychology," *Psychology Learning & Teaching*, vol. 15, no. 3, pp. 226–234, Jul. 2016, doi: 10.1177/1475725716659252.
- [38] R. F. DeVellis, "Inter-rater reliability," K. B. T.-E. of S. M. Kempf-Leonard, Ed. New York: Elsevier, 2005, pp. 317–322.
- [39] D. Nettleton, "Chapter 6 - Selection of variables and factor derivation," D. B. T.-C. D. M. Nettleton, Ed. Boston: Morgan Kaufmann, 2014, pp. 79–104.
- [40] J. Mun, "Chapter 3 - A primer on quantitative risk analysis," M. Glantz and R. B. T.-M.-A. R. M. Kissell, Eds. San Diego: Academic Press, 2014, pp. 63–118.
- [41] H. Çakır, Ö. F. İslim, E. Solmaz, B. Berikan, and F. Yılmaz, "Development and evaluation of unplugged algorithmic thinking activities training program for in-service primary school teachers," *Journal of Learning and Teaching in Digital Age*, vol. 7, no. 2, pp. 222–234, 2022, doi: 10.53850/joltida.1036460.
- [42] S. Hubalovsky and O. Korinek, "Evaluation of algorithmic thinking of students using control testing environment," *International Journal of Education and Information Technologies*, vol. 9, 2015.
- [43] B. Hu *et al.*, "A transformational learning framework for sustainable entrepreneurship education: The power of Paulo Freire's educational model," *International Journal of Management Education*, vol. 8, no. 1, 2023, doi: 10.1016/j.heliyon.2022.e12763.
- [44] S. Patnaik, "My journey in technology enhanced education within engineering to achieve sustainability amidst disruptions," *Procedia Computer Science*, vol. 172, no. 2019, pp. 965–972, 2020, doi: 10.1016/j.procs.2020.05.140.
- [45] O. Chernikova, N. Heitzmann, M. Stadler, D. Holzberger, T. Seidel, and F. Fischer, "Simulation-based learning in higher education: a meta-analysis," *Review of Educational Research*, vol. 90, no. 4, pp. 499–541, Aug. 2020, doi: 10.3102/0034654320933544.
- [46] F. Rahmawati, "E-learning implementation: its opportunities and drawbacks perceived by EFL students," *Journal of Foreign Language Teaching and Learning*, vol. 1, no. 1, 2016, doi: 10.18196/ftl.111.
- [47] T. Doleck, P. Bazelais, D. J. Lemay, A. Saxena, and R. B. Basnet, "Algorithmic thinking, cooperativity, creativity, critical thinking, and problem solving: exploring the relationship between computational thinking skills and academic performance," *Journal of Computers in Education*, vol. 4, no. 4, pp. 355–369, 2017, doi: 10.1007/s40692-017-0090-9.
- [48] J. Hu and R. Yu, "The effects of ICT-based social media on adolescents' digital reading performance: A longitudinal study of PISA 2009, PISA 2012, PISA 2015 and PISA 2018," *Computers & Education*, vol. 175, Dec. 2021, doi: 10.1016/j.compedu.2021.104342.
- [49] S. Mohammadyari and H. Singh, "Understanding the effect of e-learning on individual performance: The role of digital literacy," *Computers & Education*, vol. 82, pp. 11–25, 2015, doi: 10.1016/j.compedu.2014.10.025.
- [50] P. Reddy, B. Sharma, and K. Chaudhary, "Digital literacy: A review of literature," *International Journal of Technoethics*, vol. 11, no. 2, pp. 65–94, 2020, doi: 10.4018/IJT.20200701.oal.
- [51] J. Jeon and S. Kim, "The mediating effects of digital literacy and self-efficacy on the relationship between learning attitudes and Ehealth literacy in nursing students: A cross-sectional study," *Nurse Education Today*, vol. 113, 2022, doi: 10.1016/j.nedt.2022.105378.
- [52] I. Blau, T. Shamir-Inbal, and O. Avdiel, "How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self-regulation, and perceived learning of students?," *Internet and Higher Education*, vol. 45, 2020, doi: 10.1016/j.iheduc.2019.100722.
- [53] I. Cetin and E. Dubinsky, "Reflective abstraction in computational thinking," *The Journal of Mathematical Behavior*, vol. 47, pp. 70–80, 2017, doi: 10.1016/j.jmathb.2017.06.004.
- [54] J. M. Wing, "Computational thinking and thinking about computing," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, vol. 366, no. 1881, pp. 3717–3725, 2008.
- [55] S. Monchaux, F. Amadiou, A. Chevalier, and C. Mariné, "Query strategies during information searching: Effects of prior domain knowledge and complexity of the information problems to be solved," *Information Processing & Management*, vol. 51, no. 5, pp. 557–569, 2015, doi: 10.1016/j.ipm.2015.05.004.
- [56] C. Yu and D. L. Prince, "Aspiring school administrators' perceived ability to meet technology standards and technological needs for professional development," *Journal of Research on Technology in Education*, vol. 48, no. 4, pp. 239–257, 2016, doi: 10.1080/15391523.2016.1215168.
- [57] H. O. Bolaji and R. O. Ajape, "Information and communication technology as a veritable tool for administrators in university: from teaching perspectives to challenge in education," *Indonesian Journal of Teaching in Science*, vol. 2, no. 2, pp. 183–192, 2022.

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