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EXPLORATORY FACTOR ANALYSIS OF ACTION RESEARCH CAPABILITY SCALE (ARC-SCALE) FOR TEACHERS

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ABSTRACT

In a period where evidence-based teaching practices are increasingly valued, action researches serve as a potent method for teachers to systematically investigate and improve their instructional strategies. However, the absence of a uniform assessment tool poses challenges in gauging teachers' proficiency in this domain. Henceforth, this study established the validity and reliability of the Action Research Capability Scale (ARC-Scale) for teachers, which aims to measure the action research capability of teachers, specifically anchored to the prescribed elements of DepEd Order No. 16, s. 2017 in action research writing. The scale was subjected to refinement phases and assessment of psychometric properties, particularly content validity, internal consistency, and factor structure. Through proportional allocation sampling, the scale was pilot tested to a total of 374 select elementary and secondary teachers in the Division of Tuguegarao City. The study has generated 43 items with an acceptable content validity. Also, the scale had a very high internal consistency as measured by Cronbach's alpha (0.987). Lastly, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to explore the factor structure of the scale. Results from the EFA revealed that the eight-factor model developed by Unicruz et. al (2023) had five items with low loading values; therefore, were progressively deleted. Overall, both EFA and CFA have supported the eight-factor structure of the ARC-Scale. Hence, ARC-Scale is a valid and reliable instrument to measure the action research capability of teachers.

Keywords: *Exploratory Factor Analysis, Action Research Capability*

INTRODUCTION

In today's rapidly evolving educational landscape, teachers are increasingly recognized as key agents of change who can drive educational innovation and improve student outcomes. One approach that has gained considerable attention worldwide is action research (AR), a collaborative and reflective process that empowers teachers to investigate and address educational challenges in their own classrooms. Also, it enhances the lives of those professionals who work within educational systems. As Hine et al. (2013) stated, capabilities of AR bring an increased sense of professionalism in education. Therefore, in an increasingly complex and challenging profession, indeed, the need for teachers, administrators, and school systems to become involved in professional development (PD) activities is ever present. And pursuing this path, however, needs a concrete and complete development of skills, which in turn calls for a growing need for a comprehensive measurement tool to assess teachers' AR capabilities.

In the Philippines, education is hailed as the central strategy for human capital development, poverty reduction, and building national competitiveness (Philippine Development Plan 2011-2016). Therefore, the Philippine Qualifications Framework (PQF) directs the Commission on Higher Education (CHED) to lay out policies, standards, and guidelines for higher education academic programs and help basic education teachers by providing them with appropriate PD programs. In line with this, the Philippine Higher Education Institutions are also with these national efforts per mandate of the PQF to help the basic education system by providing timely and appropriate PD programs. One of the programs referred is training them to reflect on their professional practices by means of AR. In fact, as a means of PD, incentives are even given to teachers who complete an AR project. However, PD programs about AR are not well documented although several needs-assessments have been reported (Morales et al., 2016).

The feasibility of using AR for teacher training and professional growth and development already swamped the literature with ways and means. With this idea of professional teacher development in mind, it is a necessity that researchers are provided with baseline data on the Philippine teachers' concepts of and needs on AR for teacher professional development design and customization. Consequently, several studies have focused on the development of instruments specifically tailored in determining the Philippine teachers' AR capabilities. For instance, Morales et al. (2016) proposed a descriptive survey to explore Filipino teachers' conceptions of and needs on AR which may be barriers to implementing AR in their classrooms. Similarly, Cortes (2020) developed and validated a scale called Teacher's Competence in Action Research (TCAR), which measures teachers' specific competencies in AR, namely

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— analyzing and presenting AR data, reflecting on and communicating results, planning an AR project, integrating ethics, selecting topic for professional growth and integrating technology in writing literature and analyzing data. Another survey questionnaire was introduced by Cagaanan & Gosadan (2018) to assess the level of research competencies among elementary school teachers. The instrument comprised of subscales focused on framing research questions and capability of developing instrument, critical review of the literature and comprehensive theoretical knowledge, and data collection related competencies and data analysis related competencies. These instruments were temporarily used to determine the underlying needs and challenges faced by teachers in conducting AR.

The Philippines needs to continuously improve the quality of education in the country for it to compete with neighboring countries as well as on the global stage (The ASEAN Post, 2022). Henceforth, the transition of the country's basic education curriculum has put the national and local initiatives on teacher trainings about AR into our peripheral vision as it continues to emerge as a powerful methodology for promoting continuous improvement and innovation across educational settings.

While numerous studies have examined the outcomes and impacts of AR, relatively few have focused explicitly on the measurement of teachers' AR capability. It is, however, evident as there are little to no valid and reliable instrument to measure teachers' AR capabilities, if any, those are pure perceptual and survey type. This absence hinders the ability of teachers and researchers to accurately gauge teachers' proficiency in this area, thereby limiting the support that can be provided and impeding their professional growth and advancement in this area. Consequently, there is an urgent need to develop a robust and validated measurement instrument that comprehensively captures the multifaceted nature of teachers' AR capability, enabling targeted support and the identification of the actual needs and challenges of the teachers in conducting such.

The ARC-Scale for teachers serves as a comprehensive framework designed to assess and enhance educators' proficiency in employing AR methodologies within the educational context. Grounded in the principles of reflective practice and continuous improvement, this scale aims to evaluate teachers' abilities to systematically investigate and address classroom challenges, thereby fostering a culture of ongoing professional development. The scale encompasses a spectrum of competencies prescribed by DepEd in AR writing. By providing a structured assessment of educators' AR capabilities, the scale not only offers valuable insights into individual strengths and areas for growth but also contributes to the broader advancement of teaching methodologies and student learning outcomes. As teachers navigate the dynamic landscape of education, the ARC-Scale becomes an invaluable tool for empowering them to be proactive agents of positive change within their classrooms and the educational community at large.

To ensure the reliability of the ARC-Scale, Unicruz et al. (2023) conducted a Content Validity Index (CVI) evaluation of it, which consists a set of 48 items. It is comprised of six items from each of the eight dimensions prescribed by DepEd in conducting and writing AR, namely — 1) title formulation, 2) research questions and data analysis, 3) intervention, innovation, and strategy, 4) research methodology, 5) work plan and timeline, 6) cost estimate, 7) plans for dissemination and utilization, and 8) references. The CVI was determined through the five panel of expert reviewers. The experts were asked to critically review and rate the relevance and clarity of each item on a 4-point ordinal scale, namely: (1) not relevant, (2) needs more revision, (3) relevant but needs more revision, and (4) very relevant.

The evaluation of teachers' capability in conducting AR poses a significant challenge due to the existing condition where there is shortage of instruments. Thus, the significance of this research lies in its potential to bridge the gap in the existing literature by offering a standardized tool for assessing and comparing AR capabilities among Filipino teachers of the basic education sector.

METHODOLOGY

Research Design

Quantitative design was utilized in the study since its main focus is to establish the credibility of the developed ARC-Scale through numerical validation procedures. Specifically, the content validity of index, internal consistency, and factor structure of the scale was ascertained. These indices and values were substantial in establishing the efficiency of the ARC-Scale as a norm-referenced test.

Locale of the Study

The pilot test was conducted to select elementary and secondary teachers from the different schools of Tuguegarao City. The Division of Tuguegarao City has four districts, namely: West, East, North, and Northeast.

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Respondents and Sampling Technique

To determine the sample size, it has to be five times greater than the number of variables. With 48 items in this study, the minimum required sample size was calculated to be 240 respondents. Hence, the study involved 374 respondents to ensure robustness.

Meanwhile, proportional allocation sampling was employed to distribute respondents among the schools. In this method, the number of respondents selected from each school was proportional to the school's size category. This approach ensured that each school was represented in the sample according to its importance in the overall population, thus providing a representative sample for analysis.

Therefore, the respondents of this study comprised of select 374 elementary and secondary teachers from small, medium, large, and mega schools from the Division of Tuguegarao City.

Research Instrument

The designed ARC-Scale was conceptualized and content validated by Unicruz et al. (2023). It is comprised of 48 items measuring the eight dimensions as prescribed by the DepEd in AR writing. Each item has a scale of four to indicate the teachers' level of competency in conducting AR. The ARC-Scale descriptively determines the teachers' level of competency as follows ─ (1) beginning, (2) approaching proficiency, (3) proficient, and (4) highly proficient.

Data Gathering Procedure

The following procedures were followed in the conduct of the study.

1. Planning of the ARC-Scale and Item Generation. Unicruz et al. (2023) have planned the scale by identifying the essential competencies that measure teachers' capability in AR writing. The items of the ARC-Scale were based from the prescribed elements of DepEd Order No. 16, s. 2017 in AR writing. With this, a total of 48 items were generated. The ARC-Scale items were improved and written in concise and easily understandable manner.

2. Writing phase. Unicruz et al. (2023) have focused on refining the ARC-Scale based on expert feedback and initial validation results. The ARC-Scale went through further refinement to enhance the scale's clarity, relevance, and comprehensiveness, thereby accurately capturing the targeted constructs of AR capability. In this refinement phase, a meticulous examination and reassessment of each scale item was conducted, considering suggestions for clarification, rephrasing, and elimination of ambiguous items. The ultimate goal was to improve the overall effectiveness of the ARC-Scale as a measurement tool. By iteratively refining the scale, its validity and reliability were strengthened, ensuring its utility in accurately measuring and assessing individuals' AR capabilities.

3. Conduct of content validation by experts. The 48 items were validated by the research group and the extension team of the Graduate School. After which, it was validated by competent and relevant individuals in the AR field. Moreover, the comments and suggestions of the content validators were used in improving the items of the ARC-Scale. Improvements of the items were either simplification or rephrasement of the items.

4. Administering of the first try-out test. The try-out test was administered among the faculty members of the Annafunan Integrated School. Free and prior informant consent was attached to the questionnaire to ensure the respondents were given an opportunity to join in the survey with their own free will. The test was administered with the permission of the Principal of Annafunan Integrated School.

5. Conduct of the pilot test. The pilot test was administered along the Division of Tuguegarao City to examine the feasibility of the test in terms of time requirement and mechanics implementation. It included the assessment of the psychometric properties of the scale, including content validity of index, internal consistency, and factor structure of the ARC-Scale. This has served as basis in retaining, revising, and rejecting items.

6. Computation of CVI. In the computation of CVI, all the data needed for the content validation process were gathered by Unicruz et al. (2023). This includes the ratings provided by the five experts on the relevance of items. The degree of relevance of the items were rated as follows ─ 1 (not relevant), 2 (needs more revision), 3 (relevant but needs revision), and 4 (very relevant).

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7. Analysis of Internal Consistency of the ARC-Scale. To ensure the reliability of the scale, analysis of internal consistency is essential. This analysis enhances the quality of research and decision-making based on its results. In this study, Cronbach's Alpha coefficient was used.

8. Evaluating the Adequacy of Data for Factor Analysis. Factor analysis is a statistical technique used to identify underlying dimensions (factors) that explain patterns of correlations among observed variables. However, for factor analysis to yield meaningful results, various analyses were conducted to determine the suitability of the dataset for further analysis. Key among these were the Kaiser-Meyer-Olkin (KMO) measure and Barlett's Test of Sphericity.

9. Conduct of Exploratory Factor Analysis. This was conducted to explore and uncover the underlying structure of variables, aiming to identify latent factors without specifying a prior hypothesis about their relationships. It involved factor extraction using Principal Component Analysis (PCA) method, resulting in the extraction of five items. Subsequently, factor rotation was performed using the Oblimin method. These steps were undertaken to ensure that the factors accurately represent the underlying constructs being observed.

10. Assessment of Fit Measure Indices. In this process, various statistics and criteria were used to assess how well the extracted factor model fits the data. These measures include, namely the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardized Root Mean Square Residual (SRMR). These indices serve as critical indicators of how well the model aligns with the observed data, providing insights into its adequacy and appropriateness.

11. Conduct of Confirmatory Factor Analysis (CFA). The second-order CFA was conducted to assess the validity of the proposed 8-factor model, aiming to ascertain if these factors collectively encapsulate the overarching concept of action research capability. It provides valuable insights into the validity of the measurement model and the relationships between observed variables (indicators) and latent constructs (factors).

12. Reporting Findings. Finally, the findings are reported in research papers and presentations. Recommendations were discussed as well.

Data Analysis

CVI was employed in the calculation of the content validity of ARC-Scale. This statistical method was used to evaluate the relevance and clarity of items in a scale or instrument, based on expert judgment. For studies involving three to five content expert validators, a CVI value of 1 is considered acceptable, as drawn on references provided (Polit et al., 2007). Otherwise, the item is subject for revision.

Cronbach's alpha coefficient was utilized to measure the internal consistency of the ARC-Scale. This coefficient quantifies the extent to which items in the scale are correlated with each other. It ranges from 0 to 1, where values closer to 1 indicate greater internal consistency.

A higher Cronbach's alpha value indicates stronger internal consistency, with a threshold of 0.70 generally considered acceptable. A Cronbach's alpha below the acceptable threshold may suggest poor internal consistency, indicating that the items within the scale are not highly correlated. Table 1 presents the interpretation of the obtained cronbach's alpha coefficient as noted by Bartels & Koria (2012).

Table 1. Cronbach alpha cutoff value

Cronbach's Alpha	Interpretation
$\alpha \geq 0.9$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

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In assessing the adequacy of data, KMO and Barlett's Test of Sphericity were utilized. KMO measure assesses the proportion of variance among variables that might be common variance. It ranges from 0 to 1, with values closer to 1 indicating better suitability for factor analysis. Table 2 shows the interpretation of KMO values as recommended by Kaiser (1974).

Table 2. KMO cutoff value

KMO Value	Adequacy of the Correlations
0.90 and higher	Marvelous
0.80-0.89	Meritorious
0.70-0.79	Middling
0.60-0.69	Mediocre
0.50-0.59	Miserable
Below 0.50	Unacceptable

Conversely, Barlett's Test assesses whether the correlation matrix significantly differs from an identity matrix. The Barlett's Test of Sphericity should be significant ($p<0.05$) for factor analysis to be suitable (Rusuli et al., 2013).

To identify the factor structure of the ARC-Scale, initial factor loading through EFA was conducted. Two criteria were established for the selection of items. First, items with low loading values (below 0.40) were progressively removed from the scale. Second, items with loading values above 0.40 in more than one component of the matrix, and therefore not specific to a single factor, were progressively deleted. The items with factor loading of .40 and above have been classified as substantial (Floyd & Widaman, 1995) and loadings above .50 have been considered as "very significant" (Hair et al., 1988). In this process, PCA was used for factor extraction and Oblimin for factor extraction. Meanwhile, eigenvalues and scree plot inspection were also utilized as the criteria in determining the number of factors to retain, where values greater than one indicate that these factors explain a significant amount of variance in the data. On the other hand, factors with eigenvalues below the elbow point contribute less to the variance and may be considered less important.

To ensure the adequacy of the initial measurement model, four key goodness-of-fit-indices, namely — RMSEA, CFI, TLI, and SRMR were performed. RMSEA assesses how well the model fits the data, with lower RMSEA values indicating better fit. CFI compares the fit of the hypothesized model with that of a baseline model (usually the null model). It ranges from 0 to 1, with values closer to 1 indicating better fit. TLI, also known as the Non-Normed Fit Index (NNFI), evaluates the improvement in fit of the hypothesized model relative to a null model. Like CFI, it ranges from 0 to 1, with values closer to 1 indicating better fit. SRMR assesses the discrepancy between the observed covariance matrix and the model-implied covariance matrix. It provides a measure of the average standardized difference between the observed and predicted correlations. Lower SRMR values indicate better fit.

To achieve a good fit of the data to the model, the values of CFI and TLI should be over 0.95 and the RMSEA values should be under 0.8 for a reasonable fit and under 0.05 for a good fit. Whereas for the SRMR, a cutoff value close to 0.08 or below is recommended (Ortuno-Sierra, 2016). These four fit indexes were chosen because they are among the most widely used reported in the SEM literature (Kline, 2010). Table 3 shows the interpretation of fit measure indices values as suggested by Schreiber et al. (2006).

Table 3. Fit measure indices cutoff value

Fit Measure	Good Fit	Acceptable Fit
RMSEA	$0 \leq RMSEA \leq 0.05$	$.05 < RMSEA \leq 0.08$
CFI	$0.97 \leq CFI \leq 1.00$	$0.95 \leq CFI < 0.97$
TLI	$0.97 \leq TLI \leq 1$	$0.95 \leq TLI < 0.97$
SRMR	$0 \leq SRMR \leq 0.05$	$0.05 < SRMR \leq 0.10$

Lastly, the round two of factor analysis was conducted through the second-order CFA. A significant result ($p < 0.001$) of the factor loadings suggest strong associations between the items and their respective factors.

RESULTS

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Content Validity of the ARC-Scale

Table 4 presents an overview of the Content Validity Index (CVI) for each item of the ARC-Scale. Items with a CVI score of 1 are deemed to adequately represent the content and are retained without any alterations, as indicated in the "Remarks" column. However, items with a CVI below 1, such as those marked with a score of 0.8 in the table, are flagged for revision. The CVI values are crucial in determining the quality of the items, with a score of 1 typically indicating a high level of content validity.

Table 4. Content validity index of the ARC-Scale

Item Number	Content Validity Index	Remarks	Item Number	Content Validity Index	Remarks
1	1	Retain	25	1	Retain
2	1	Retain	26	1	Retain
3	1	Retain	27	1	Retain
4	1	Retain	28	1	Retain
5	1	Retain	29	1	Retain
6	0.8	Revise	30	1	Retain
7	1	Retain	31	1	Retain
8	1	Retain	32	1	Retain
9	1	Retain	33	1	Retain
10	1	Retain	34	1	Retain
11	1	Retain	35	1	Retain
12	1	Retain	36	1	Retain
13	1	Retain	37	1	Retain
14	1	Retain	38	1	Retain
15	1	Retain	39	0.8	Revise
16	1	Retain	40	1	Retain
17	1	Retain	41	1	Retain
18	1	Retain	42	1	Retain
19	1	Retain	43	1	Retain
20	1	Retain	44	1	Retain
21	1	Retain	45	1	Retain
22	1	Retain	46	1	Retain
23	1	Retain	47	1	Retain
24	1	Retain	48	1	Retain

Internal Consistency of the ARC-Scale

Table 5 reveals that the Cronbach's α coefficient of the ARC-Scale is 0.987, indicating an excellent reliability. This suggests that the items in the scale are highly correlated with each other, indicating consistency in measuring the underlying construct. In practical terms, this high reliability coefficient implies that the scale is dependable and that the items reliably measure the same construct, providing confidence in the accuracy and consistency of the scale's measurements.

Table 5. Scale reliability statistics

	Cronbach's α	Interpretation

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ARC Scale	0.987	Excellent

Factor Structure of the ARC-Scale

Table 6 shows that the value of initial KMO test of sampling adequacy is 0.97 and the significance value of Barlett's test of sphericity is $\chi 2$ () =, $p < 0.001$, indicating that the data are adequate for factor analysis.

Moreover, a model with 8 factors was found based on the eigenvalues and the scree plot. This model was explored with EFA which was conducted using the Principal Component Analysis extraction method and applying an Oblimin rotation.

Table 6. KMO and barlett's test of sphericity

Kaiser-Meyer-Olkin (KMO) Test of Sampling Adequacy		
Overall Mean Sampling Adequacy		
0.97		
Barlett's Test of Sphericity		
x^2	df	P
25841	374	$p < 0.001$

The scree plot below displays the eigenvalues for each factor extracted during the factor analysis. Eigenvalues represent the variance explained by each factor in the dataset. The scree plot is useful for determining the number of factors to retain in the analysis. The following are the key observations:

1. Initial Rapid Drop: The scree plot exhibits an initial steep decline in eigenvalues up to the first eight factors, indicating that these factors explain a significant amount of variance in the data.
2. Elbow Point: After the initial drop, the eigenvalues gradually level off, forming an "elbow" in the plot. The elbow point, often used as a criterion for factor retention, suggests a natural break in the data.
3. Factors Retained: Based on the scree plot above, it appears that the first eight factors have eigenvalues above the elbow point. These factors explain the majority of the variance in the dataset and are considered significant.
4. Diminishing Returns: Beyond the elbow point, the eigenvalues continue to decrease at a slower rate. Factors with eigenvalues below the elbow point contribute less to the variance and may be considered less important.

Considering the steep decline followed by the elbow point in the scree plot, it is recommended to retain the first 8 factors for further analysis. These factors capture the most substantial amount of variance in the dataset while avoiding overfitting.

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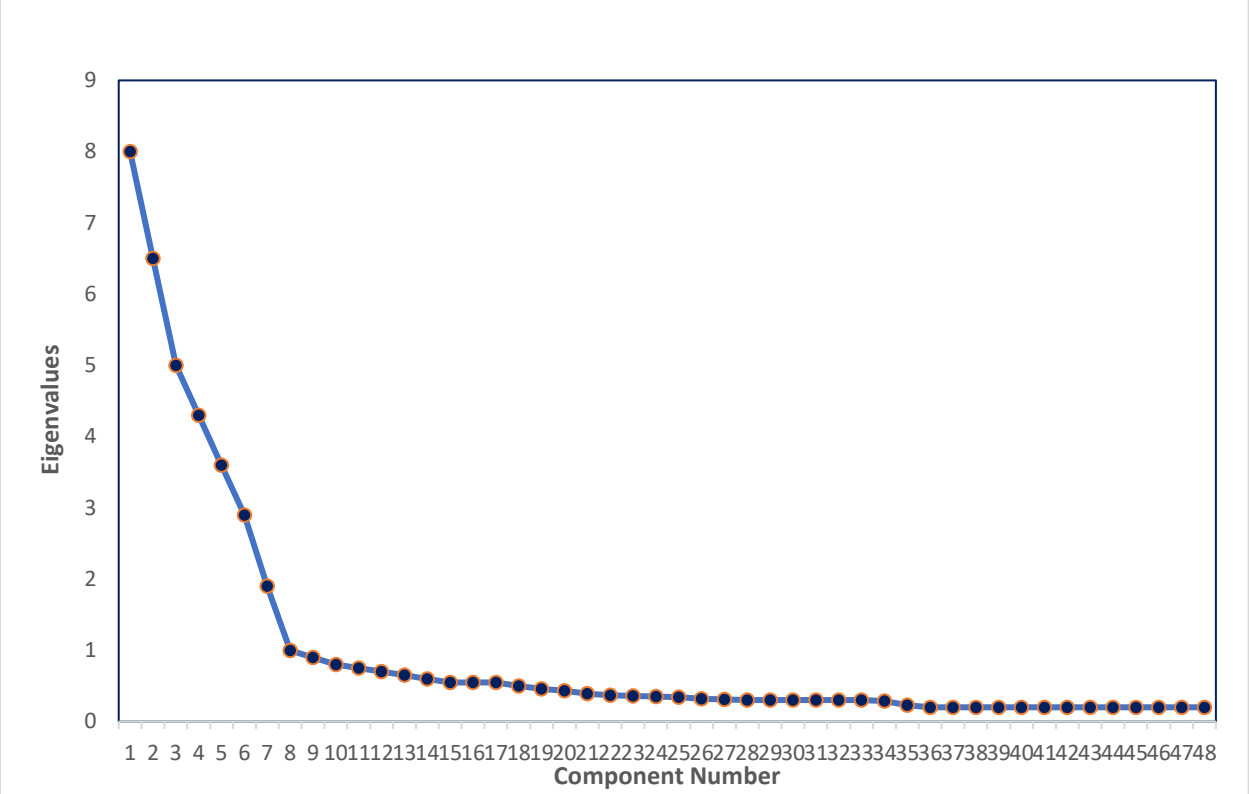

Figure 1. Scree plot of the eigenvalues

Table 7 presents the initial factor loading of the EFA. To ensure the quality of the ARC-Scale, two criteria were established for the selection of items. First, items with low loading values (below 0.40) were progressively removed from the scale. Second, items with loading values above 0.40 in more than one component of the matrix, and therefore not specific to a single factor, were progressively deleted.

Thus, the output reveals that a total of five items were deleted and 43 were preserved and subjected to round 2 of the factor analysis.

Table 7. Initial factor loading of the 48 items of the ARC-Scale

	Title Formulation	Research Questions and Data Analysis	Intervention, Innovation, and Strategy	Research Methodology	Work Plan and Timeline	Cost Estimate	Plans for Dissemination and Utilization	References
1. I can conceptualize a relevant and timely action research topic.	0.51	0.15	-0.01	0.09	-0.03	0.10	0.33	0.11
2. I can narrow the action research topic into a researchable concept.	0.43	0.06	0.17	0.02	0.14	0.19	0.07	0.03

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3. I can develop a topic which helps address an identified classroom problem.	0.47	0.01	0.05	0.08	0.24	0.10	0.12	-0.05
4. I can formulate a research title based on the least mastered competency.	0.49	-0.08	0.12	0.05	0.17	0.33	0.07	-0.05
5. I can work on a research topic based on the challenges in the teaching-learning process.	0.48	-0.05	0.12	-0.02	0.24	0.32	0.10	-0.06
6. I can identify the dependent and independent variable/s of the study as I formulate the research title.	**0.04**	**0.24**	**-0.08**	**-0.23**	**-0.07**	**0.29**	**0.13**	**0.15**
7. I can formulate descriptive research questions that are specific and relevant to the research title.	0.10	0.50	0.05	0.27	0.02	0.13	0.04	0.02
8. I can formulate inferential research questions that are specific and relevant to the research title.	0.14	0.53	0.08	0.18	0.03	0.13	0.05	0.01
9. I can analyze gathered data to answer the research questions.	**-0.10**	**-0.04**	**0.17**	**0.10**	**-0.01**	**0.28**	**-0.14**	**-0.25**
10. I can interpret data that address the research questions.	0.11	0.48	0.07	0.27	0.03	0.11	0.10	-0.05
11. I can show the results of the study through visual presentation. (e.g. tabular presentation)	0.19	0.53	0.14	0.25	0.03	0.33	0.06	0.00
12. I can choose and use appropriate statistical tool/s relative to the research questions.	**-0.03**	**-0.03**	**-0.03**	**-0.03**	**-0.02**	**-0.03**	**1.05**	**0.01**
13. I can determine the specific intervention/ innovation/ strategy to address problem or concern in my own classroom.	0.01	-0.02	0.91	0.03	0.01	0.01	0.05	-0.03

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14. I can propose an intervention/ innovation/ strategy based the least mastered competency.	0.05	0.02	0.90	-0.01	0.04	-0.05	0.01	-0.02
15. I can adopt and modify effective intervention/ innovation/ strategy founded on empirical studies and teaching experiences.	0.04	0.08	0.87	-0.04	-0.01	0.03	0.00	0.04
16. I can develop intervention materials to validate an educational theory.	0.00	-0.03	0.80	0.07	0.06	0.05	0.04	0.02
17. I can justify the proposed innovation addressing the least mastered competency.	0.16	0.12	0.73	0.04	0.03	0.05	0.03	-0.01
18. I can develop instructional intervention/ innovation/ strategy responsive to an identified classroom challenge or problem.	0.03	0.05	0.81	0.09	-0.05	0.03	0.01	0.03
19. I can choose the appropriate research design for my study.	0.10	0.14	0.01	0.56	0.02	0.17	0.07	0.04
20. I can utilize or develop suitable data gathering research instrument for my study.	0.10	0.19	0.06	0.46	-0.02	0.23	0.08	0.00
21. I can choose the correct sampling technique for the respondents of my study.	0.04	0.20	0.08	0.57	0.07	0.06	0.03	-0.01
22. I can develop a procedure to ensure an effective and efficient implementation of the study.	0.12	0.13	0.10	0.48	0.12	0.06	0.10	-0.02
23. I can observe ethical protocol in the conduct of the study.	0.17	0.08	0.04	0.53	0.13	0.03	0.07	0.00
24. I can apply the correct procedure in selecting the group/s of my study.	0.18	-0.03	0.16	0.57	0.19	-0.02	0.04	0.03

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25. I can create a clear and realistic time frame in undertaking the study.	0.13	0.16	0.04	0.27	0.43	0.03	0.02	0.05
26. I can plan series of logical activities to accomplish the study within the time frame.	0.11	018	0.07	0.20	0.44	0.05	0.04	0.00
27. I can regularly monitor my work plan.	0.21	0.14	0.08	0.14	0.51	-0.03	0.00	0.04
28. I can determine the needed resources for my study.	0.11	0.18	0.06	0.06	0.52	0.11	0.10	0.01
29. I can identify responsible and competent persons to provide assistance for the completion of the study.	0.13	0.22	0.03	0.06	0.49	0.11	0.08	0.02
30. I can complete the study within the time frame stipulated in the research management guidelines.	0.00	0.13	0.16	0.22	0.45	0.11	0.01	0.02
31. I can allocate a sufficient budget for the conduct of my study.	-0.04	0.03	-0.01	0.07	0.02	0.87	0.04	-0.04
32. I can list all the eligible expenses in accordance to BERF guidelines/set of criteria.	0.07	0.04	0.07	0.04	-0.01	0.82	-0.01	0.01
33. I can estimate the possible expenses of all items in my study.	0.08	-0.05	0.03	0.01	0.05	0.83	0.05	0.00
34. I can strategize to reduce resource costs without compromising the quality of the study.	0.06	0.08	-0.01	0.01	-0.05	0.58	0.01	0.00
35. I can use the resources in the most efficient manner.	0.07	0.05	0.05	0.00	0.08	0.78	-0.01	0.00
36. I can liquidate on time the cost spent in the study.	-0.01	-0.05	0.07	0.05	0.17	0.72	0.03	0.02
37. I can easily identify who shall utilize the results of my study.	0.01	0.16	0.04	0.08	0.32	0.09	0.48	0.08

38. I can disseminate the results of my research to the Appropriate fora.	-0.04	0.19	0.17	0.16	0.25	0.11	0.47	0.08
39. I can publish my study in refereed journals and/or other acceptable means of publication by the DepEd.	**-0.11**	**-0.02**	**0.37**	**0.12**	**-0.04**	**-0.19**	**0.19**	**-0.28**
40. I can effectively present the findings of my study to relevant stakeholders, especially to the community.	0.02	0.29	0.10	0.00	0.16	0.16	0.47	0.02
41. I can have others utilize the results of the study in enhancing learning outcomes.	0.05	0.31	0.10	0.02	0.16	0.15	0.48	0.02
42. I can provide specific and realistic recommendations to utilize the findings of the study.	**-0.01**	**0.31**	**0.34**	**0.06**	**0.18**	**0.17**	**0.02**	**-0.02**
43. I can list all the references used in my study to avoid plagiarism.	0.22	0.09	0.10	0.05	0.14	-0.01	0.07	0.50
44. I can list the references following the American Psychological Association Style (7th Edition).	0.05	-0.04	0.15	0.04	-0.01	-0.02	0.05	0.76
45. I can determine valid and reliable references.	0.19	0.05	0.26	0.06	0.01	0.01	0.02	0.56
46. I can do cross-referencing in the conduct of my study.	0.17	0.08	0.05	0.08	0.03	0.01	0.03	0.66
47. I can easily detect erroneous and incomplete references.	0.13	0.09	0.05	0.09	0.01	0.12	0.03	0.59
48. I can select references from journals with Digital Object Identifier (DOI) published for the last 10 years.	0.09	0.14	0.15	0.12	0.02	0.07	0.06	0.59

Table 8 presents the results of a confirmatory factor analysis (CFA) with factor loadings for various indicators across eight factors: "Title Formulation", "Research Questions and Data Analysis", "Intervention, Innovation, and Strategy", "Research Methodology", "Work Plan and Timeline", "Cost Estimate", "Plans for Dissemination and Utilization", and "References". Each factor includes several indicators. Each indicator's factor loading, standard error, z-score, p-value, and standardized estimate are detailed across different factors. Taking, for example, indicator 2,

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which evaluates the capacity to narrow the action research topic into a researchable concept and its association with the latent construct "Title Formulation", the estimated factor loading of 0.715 (SE = 0.0333, z = 21.46, p < 0.001) indicates a robust positive relationship between the indicator and its latent factor. This strong correlation is further supported by the high standardized estimate of 0.899, underscoring the coherence between the indicator and the "Title Formulation" factor. Likewise, all other indicators along the latent factor “Title Formulation” demonstrate significant factor loadings and standardized estimates, reinforcing the validity and the consistency between observed variables and underlying construct.

Similarly, in the "Research Questions and Data Analysis" factor, the four indicators show factor loadings ranging from 0.716 to 0.780, with the highest loading attributed to the indicator assessing the ability to formulate descriptive research questions. Conversely, the lowest loading is associated with the indicator evaluating the ability to interpret data addressing research questions.

Within the "Intervention, Innovation, and Strategy" factor, loadings range from 0.784 to 0.822, with the highest loading observed for the indicator assessing the ability to determine specific interventions. Conversely, the lowest loading pertains to the indicator evaluating the ability to develop instructional interventions.

In the "Research Methodology" factor, loadings range from 0.742 to 0.795, with the highest loading associated with the indicator assessing the ability to observe ethical protocols. Conversely, the lowest loading is attributed to the indicator evaluating the ability to choose appropriate research designs.

For the "Work Plan and Timeline" factor, loadings range from 0.774 to 0.828, with the highest loading observed for the indicator assessing the ability to identify responsible and competent persons. Conversely, the lowest loading pertains to the indicator evaluating the ability to plan logical activities.

Within the "Cost Estimate" factor, loadings range from 0.806 to 0.856, with the highest loading attributed to the indicator assessing the ability to use resources efficiently. Conversely, the lowest loading is associated with the indicator evaluating the ability to allocate a sufficient budget.

In the "Plans for Dissemination and Utilization" factor, loadings range from 0.796 to 0.823, with the highest loading observed for the indicator assessing the ability to identify who shall utilize research results. Conversely, the lowest loading pertains to the indicator evaluating the ability to have others utilize research results.

Finally, in the "References" factor, loadings range from 0.406 to 0.852, with the highest loading associated with the indicator assessing the ability to list all references used in the study. Conversely, the lowest loading is attributed to the indicator evaluating the ability to determine valid and reliable references.

Overall, the factor loadings for all indicators are significant (p < .001), suggesting strong associations between the items and their respective factors. These factor loadings provide insights into the extent to which each indicator contributes to its underlying factor. Higher factor loadings indicate stronger relationships, implying that the items are more representative of their respective factors.

Table 8. Confirmatory factor analysis: Factor loadings

Factor	Indicator	Estimate	SE	z	P	Stand. Estimate
Title Formulation	1. I can conceptualize a relevant and timely action research topic.	0.458	0.0436	10.50	<.001	0.532
	2. I can narrow the action research topic into a researchable concept.	0.715	0.0333	21.46	<.001	0.899
	3. I can develop a topic which helps address an identified classroom problem.	0.792	0.0360	21.96	<.001	0.911
	4. I can formulate a research title based on the least mastered competency.	0.785	0.0361	21.76	<.001	0.906
	5. I can work on a research topic based on the challenges in the teaching-learning process.	0.798	0.0341	23.37	<.001	0.944

Research Questions and Data Analysis	7. I can formulate descriptive research questions that are specific and relevant to the research title.	0.780	0.0330	23.66	<.001	0.950
	8. I can formulate inferential research questions that are specific and relevant to the research title.	0.763	0.0336	22.69	<.001	0.928
	10. I can interpret data that address the research questions.	0.716	0.0335	21.39	<.001	0.897
	11. I can show the results of the study through visual presentation. (e.g. tabular presentation)	0.745	0.0334	22.30	<.001	0.920
Intervention, Innovation, and Strategy	13. I can determine the specific intervention/ innovation/ strategy to address problem or concern in my own classroom.	0.822	0.0359	22.85	<.001	0.931
	14. I can propose an intervention/ innovation/ strategy based the least mastered competency.	0.814	0.0351	23.20	<.001	0.939
	15. I can adopt and modify effective intervention/ innovation/ strategy founded on empirical studies and teaching experiences.	0.808	0.0343	23.52	<.001	0.945
	16. I can develop intervention materials to validate an educational theory.	0.787	0.0343	22.96	<.001	0.933
	17. I can justify the proposed innovation addressing the least mastered competency.	0.795	0.0341	23.30	<.001	0.941
	18. I can develop instructional intervention/ innovation/ strategy responsive to an identified classroom challenge or problem.	0.784	0.0339	23.13	<.001	0.937
Research Methodology	19. I can choose the appropriate research design for my study.	0.745	0.0340	21.90	<.001	0.909
	20. I can utilize or develop suitable data gathering research instrument for my study.	0.742	0.0330	22.45	<.001	0.922
	21. I can choose the correct sampling technique for the respondents of my study.	0.746	0.0331	22.52	<.001	0.923

	22. I can develop a procedure to ensure an effective and efficient implementation of the study.	0.765	0.0331	23.11	<.001	0.937
	23. I can observe ethical protocol in the conduct of the study.	0.795	0.0357	22.25	<.001	0.917
	24. I can apply the correct procedure in selecting the group/s of my study.	0.789	0.0346	22.83	<.001	0.930
Work Plan and Timeline	25. I can create a clear and realistic time frame in undertaking the study.	0.797	0.0346	23.00	<.001	0.934
	26. I can plan series of logical activities to accomplish the study within the time frame.	0.774	0.0329	23.56	<.001	0.946
	27. I can regularly monitor my work plan.	0.821	0.0349	23.56	<.001	0.946
	28. I can determine the needed resources for my study.	0.812	0.0345	23.51	<.001	0.945
	29. I can identify responsible and competent persons to provide assistance for the completion of the study.	0.828	0.0359	23.06	<.001	0.935
	30. I can complete the study within the time frame stipulated in the research management guidelines.	0.794	0.0347	22.89	<.001	0.931
Cost Estimate	31. I can allocate a sufficient budget for the conduct of my study.	0.806	0.0353	22.85	<.001	0.930
	32. I can list all the eligible expenses in accordance to BERF guidelines/set of criteria.	0.816	0.0347	23.54	<.001	0.946
	33. I can estimate the possible expenses of all items in my study.	0.837	0.0355	23.56	<.001	0.946
	34. I can strategize to reduce resource costs without compromising the quality of the study.	0.835	0.0346	24.14	<.001	0.959
	35. I can use the resources in the most efficient manner.	0.856	0.0354	24.21	<.001	0.960
	36. I can liquidate on time the cost spent in the study.	0.855	0.0364	23.46	<.001	0.944

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Plans for Dissemination and Utilization	37. I can easily identify who shall utilize the results of my study.	0.823	0.0363	22.69	<.001	0.927
	38. I can disseminate the results of my research to the Appropriate fora.	0.811	0.0348	23.32	<.001	0.942
	40. I can effectively present the findings of my study to relevant stakeholders, especially to the community.	0.808	0.0335	24.09	<.001	0.958
	41. I can have others utilize the results of the study in enhancing learning outcomes.	0.796	0.0337	23.59	<.001	0.947
References	43. I can list all the references used in my study to avoid plagiarism.	0.852	0.0371	22.96	<.001	0.933
	44. I can list the references following the American Psychological Association Style (7th Edition).	0.691	0.0415	16.63	<.001	0.761
	45. I can determine valid and reliable references.	0.406	0.0470	8.63	<.001	0.446
	46. I can do cross-referencing in the conduct of my study.	0.843	0.0350	24.08	<.001	0.958
	47. I can easily detect erroneous and incomplete references.	0.828	0.0348	23.81	<.001	0.952
	48. I can select references from journals with Digital Object Identifier (DOI) published for the last 10 years.	0.823	0.0343	24.00	<.001	0.956

The Action Research Writing Capabilities Model delineates a comprehensive framework for understanding individuals' proficiency in conducting action research. Comprising eight latent factors, namely "Title Formulation," "Research Questions and Data Analysis," "Intervention, Innovation, and Strategy," "Research Methodology," "Work Plan and Timeline," "Cost Estimate," "Plans for Dissemination and Utilization," and "References," the model captures various dimensions of expertise essential for effective research writing. Each latent factor is intricately linked to a set of observed indicators, reflecting the alignment between theoretical constructs and empirical measurements.

In the pathway diagram, connections are illustrated between the latent factors and their corresponding indicators, highlighting the interdependence among different aspects of action research writing capability. Moreover, pathways depict the relationships between latent factors, demonstrating the synergistic interactions shaping individuals' capabilities in action research writing.

Interpreting the model, each latent factor represents a distinct dimension of action research capability. For instance, "Title Formulation" encompasses the clarity and relevance of research titles, while "Research Questions and Data Analysis" reflects individuals' skills in formulating precise research inquiries and analyzing data effectively. The interrelationship among latent factors underscores the holistic nature of action research writing capabilities, with proficiency in one area influencing others.

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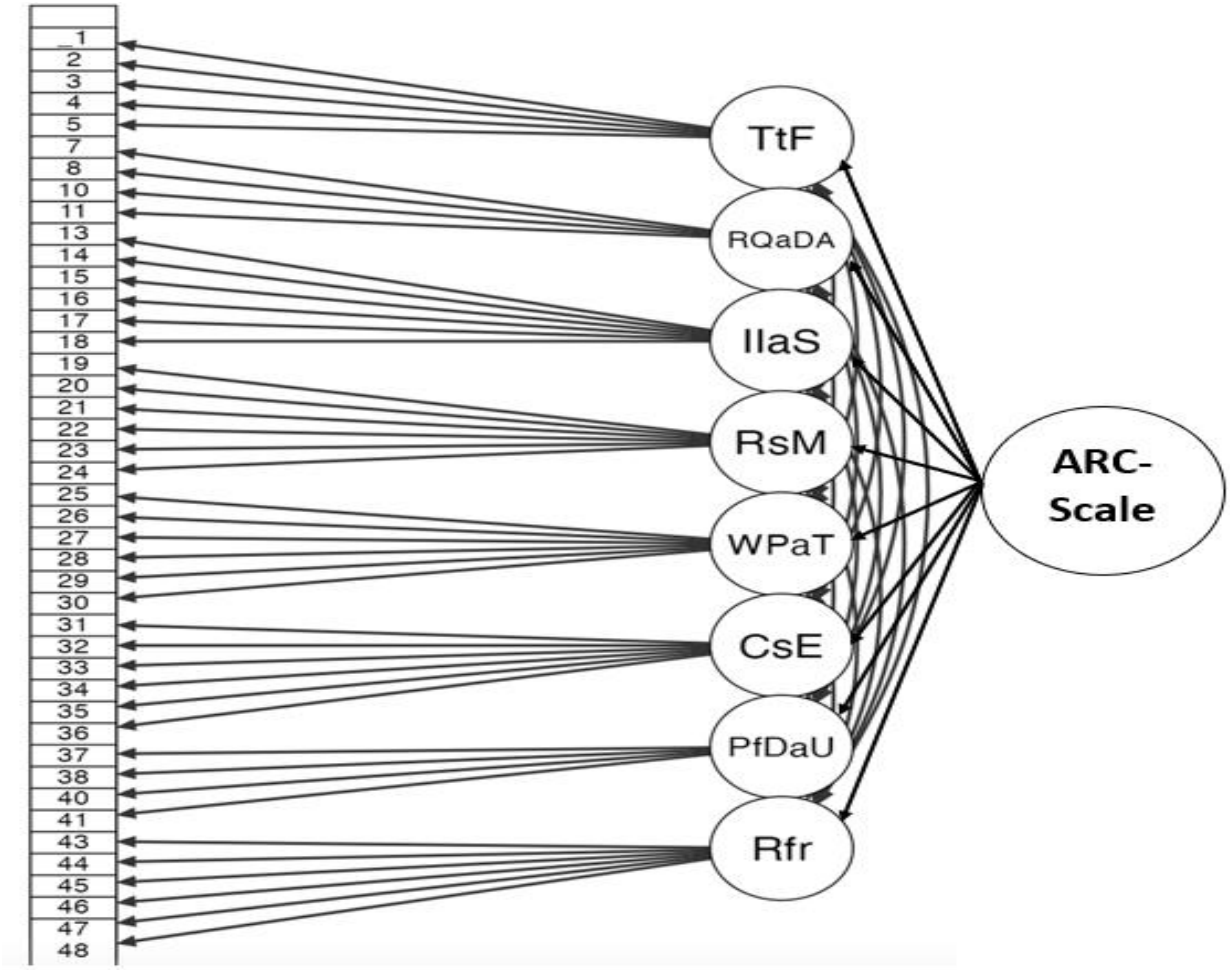
The implications of the Action Research Writing Capabilities Model are significant for educators, researchers, and practitioners alike. By identifying key dimensions of action research capability and their interconnectedness, the model informs targeted interventions and curriculum development efforts aimed at enhancing individuals' competencies in action research writing. Ultimately, the model offers valuable insights into fostering comprehensive expertise essential for advancing research and practice in the educational field.



*Items 6, 9, 12, 39 and 42 were deleted.

Figure 2. Action research capabilities model

DISCUSSION

Broadly put, a scale or test is valid if it exhibits good psychometric properties and measures what it is intended to measure (de Von et al., 2007). To measure the content validity of the ARC-Scale, the CVI was used. The CVI is a pivotal statistical tool used to gauge the relevance and comprehensiveness of items within the ARC-Scale. It is a method widely recognized and utilized in reports of instrument development, highlighting its relevance and applicability across various research domains (Zamanzadeh et al., 2015). Furthermore, Polit (2007) concluded that the widely-used CVI has advantages with regard to ease of computation, understandability, and focus on agreement of relevance rather than agreement per se. The CVI reveals that the ARC-Scale has an acceptable value of 1. It is worthy to note that for studies involving three to five content expert validators, a CVI value of 1 is considered acceptable, drawing on references provided (Polit et al., 2007). Otherwise, an iterative process involving item revision or elimination may be necessary to bolster content validity.

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Also, to establish the reliability of ARC-Scale, the scale's internal consistency was tested. As we expressed in the literature, there are different tests to achieve reliability analysis. And, in measuring the internal consistency of a research instrument, the Cronbach's alpha is one of the commonly used methods for evaluation of reliability (Taber, 2016). Also, John & Soto (2007) stated that this is true in part because it is so convenient — whenever a multi-item scale is administered, alpha can be easily calculated. Using the Cronbach's Alpha, the computed value of the ARC-Scale is 0.987. As reflected from the cutoff values presented by Bartels & Koria (2012) for cronbach's alpha, a value of >0.7 indicates an acceptable level of reliability. Moreover, most of the provided rule-of-thumb, agreed that 0.9 indicated high level of reliability. This result indicates good strength of association; hence, the instrument is acceptable and reliable in measuring the action research capability of teachers.

Lastly, the factor structure of a scale, performed through factor analysis, a statistical technique that analyzes the relationships between a set of survey items to determine whether the participant's responses on different subsets of items relate more closely to one another than to other subsets, that is, it is an analysis of the dimensionality among the items (Bandalos, 2018). In practical terms, this statistical technique unveils the latent dimensions, or factors, that explain the correlations among observed variables. Factor analysis can broadly be performed through EFA and CFA.

Prior to the extraction of the factors, several tests should be used to assess the suitability of the respondent data for factor analysis. These tests include KMO measure (0.97) and Barletts's Test of Sphericity ($p < 0.001$). This aligns with the established recommendations from prominent researchers in the field, who emphasize the importance of these tests in ensuring robust EFA outcomes. In this regard, Kaiser (1974), who introduced the statistic, recommends a set of threshold values for KMO, as presented in Table 2. Tabachnick et al. (2007) further noted that the KMO index ranges from 0 to 1, with 0.50 considered suitable for factor analysis. Meanwhile, the Barlett's Test of Sphericity should be significant ($p<0.05$) for factor analysis to be suitable (Rusuli et al., 2013).

EFA can be used to explore patterns underlying a data set. As such, EFA can elucidate how different items and constructs relate to one another and help develop new theories. By using EFA, the researcher can identify items that do not empirically belong to the intended construct and that should be removed from the scale. And, in performing EFA, PCA extraction method was used. Sometimes EFA is conflated with PCA (Leandre et al., 2012). On the other hand, PCA is a data reduction technique that does not assume an underlying construct.

Conversely, to determine whether the hypothesized model fit the data well, four fit indices were used. RMSEA (0.0702), is an absolute fit index, in that it assesses how far a hypothesized model is from a perfect model. On the contrary, CFI (0.959) and TLI (0.953) are incremental fit indices that compare the fit of a hypothesized model with that of a baseline model. Meanwhile, SRMR (0.0203), a measure of badness of fit. To achieve a good fit of the data to the model, the values of CFI and TLI should be over 0.95 and the RMSEA values should be under 0.8 for a reasonable fit and under 0.05 for a good fit. Whereas for the SRMR, a cutoff value close to 0.08 or below is recommended (Ortuno-Sierra, 2016). These four fit indexes were chosen because they are among the most widely used reported in the SEM literature (Kline, 2010).

If a researcher decides that EFA is the best approach for analyzing the data, the results from the EFA should ideally be confirmed with a CFA before using the measurement instrument for research.

Based from the series of analyses, a total of five items were flagged for deletion. Among the 48 items are the following. Item 6, "*I can identify the dependent and independent variable/s of the study as I formulate the research title*", was deleted primarily because teachers usually utilize the quasi-experimental research design and thus, this step is kinda challenging for them. As revealed from a study conducted by Gopalan et al. (2020), there is a rapid growth in the use of quasi-experimental research design across the social sciences and more specifically in education research.

Item 9, "*I can analyze gathered data to answer the research question*", was also deleted since teachers rely on the statisticians with regard to this matter. O'Connor et al. (2006) found that data analysis process was the most difficult step in action research.

In addition, item 12, "*I can choose and use appropriate statistical tool/s relative to the research questions*", was also deleted simply because this is a statistician-related work. This is supported by a study conducted by Morales et al. (2016), stating that public teachers perceived a moderate level of difficulty in some aspects of action research, such as statistics, data organization, literature searching, and writing reports.

Moreover, item 39, "*I can publish my study in refereed journals and/or other acceptable means of publication by the DepEd*", was also deleted since teachers lack access and information to the publication and utilization of their findings. As mentioned in a study conducted by Tindowen & Macanang (2019), many teachers are experiencing difficulties in the conduct of action research from the identification of their research problem until the publication of the results of the research.

Lastly, item 42, "*I can provide specific and realistic recommendations to utilize the findings of the study*", was also deleted due to the same reason — teachers lack access and information to the publication and utilization of their findings. As stated by Bullo et al. (2021), teachers perceive research as an important tool in creating and delivering instructions to students, promoting positive learning outcomes. However, teachers who love to conduct research find it hard to continue because of many factors.

CONCLUSION

The ARC-Scale is a valid and reliable instrument to measure the action research capability of teachers as it demonstrates strong psychometric properties. The instrument exudes an acceptable content validity index, a robust internal consistency, and a clear factor structure. This comprehensive validation underscores the scale's suitability for accurately evaluating teachers' readiness and competence in conducting an action research.

RECOMMENDATION

Given the findings of the study, this action is recommended:

The ARC-Scale may be subjected to second pilot test of a larger sample size, considering the regional and national levels to ensure a greater generalizability of findings.

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