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Scales of action research efficacy for secondary education teachers

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Abstract

Considering that productivity in action research relies on self-efficacy, which is a strong determinant of efforts and persistence, it is vital to assess teachers' action research efficacy. This study aimed to develop a scale that would effectively measure the action research efficacy of secondary education teachers. Particularly, it sought to establish the following features of the scales: content validity, construct validity, and internal consistency. The initial 120-item five-point scale was validated by six experts and completed by 177 permanently employed teachers from nine cooperating public high schools of Isabela State University – Roxas Campus who participated in the study. Exploratory factor analysis indicated that action research efficacy is effectively evaluated by a 40-item scale with two factors, the affective and the socio-cognitive factors, which can collectively explain 84.08 percent of the variance in action research efficacy. The developed scale attained an excellent internal consistency, with a Cronbach's alpha of .96. This study has provided a standardized and reliable measure of action research efficacy for secondary school teachers which can inform targeted interventions and support their professional development.

Introduction

In the dynamic field of education, a teacher's belief in their ability to influence student outcomes is paramount. Self-efficacy, a crucial element in this context, empowers individuals to engage effectively in various tasks and goals. According to Bandura (1977), self-efficacy is the individual's belief that they have the capacity to successfully accomplish a certain task by organizing the necessary actions in order to achieve it. As described by Heslin and Klehe (2006), self-efficacy is a strong determinant of efforts and persistence that drives an individual to take actions needed to be able to accomplish a certain task. Among teachers, self-efficacy beliefs affect how they view their professional responsibilities, enabling and sustaining the efforts they exert to fulfill their duties and responsibilities. Having a high sense of self-efficacy improves the way they deal with work and enables them to make sound decisions and take necessary actions to implement quality instruction.

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Meanwhile, action research (AR) provides the teachers an opportunity to seek, gather, analyze data, and implement solutions that would improve teaching-learning process and educational practices. In the Philippines, AR is viewed as a critical part of basic education. The Department of Education gives emphasis on the role of AR alongside basic research on the enhancement of basic education system in the country (Department of Education, 2016). The department even strengthens research through initiating various related efforts that will provide solutions to classroom issues and guide in making sound evidence-based decisions and policy making.

AR, however, is different from typical research approaches that aim to acquire general knowledge in a certain field. As Kurt Lewin (1946) highlights, AR involves both investigation and action to provide useful and practical solutions to an existing problem. He outlines that AR is the means of systematic enquiry for all participants in the quest for greater effectiveness through democratic participation. Additionally, AR follows a constructivist approach by focusing on specific knowledge and personal issues in the teaching and learning process to discover new ways of improving the quality of instruction (Piaget, 1954; Vygotsky, 1978; Schön, 1992) Moreover, AR is participatory as participants are actively involved in the cyclic research process, solving problems together at different pace and intensity (Pyrch, 1991). Particularly, AR promotes collaboration between the school, the teacher, the learners, and other stakeholders to raise awareness on the happenings in the learning environment (Freire, 2005).

The conduct of AR among teachers has seen to show significant positive benefits (Cabaroglu, 2014). AR serves as a means for teachers' professional growth and development (Abelardo et al., 2019; Declaro-Ruedas & Ruedas, 2020; Abie et al., 2022). Conducting AR makes teachers more reflective, analytic, problem solver, and creates a closer relationship with their colleagues (Declaro-Ruedas & Ruedas, 2020). AR may also serve as a means for the promotion of teachers to a higher position. For Master Teachers, AR is a part of their key performance areas in their performance rating (Declaro-Ruedas & Ruedas, 2020). Moreover, AR may help schools in ensuring that the teaching-learning process really shows care for the students and that effective practices and strategies are used to promote successful learning (Antonio, 2020).

Despite the advantages and impact of doing AR among teachers, some research studies describe teachers to be unmotivated and uninterested in conducting AR (Antonio, 2020). Their engagement is seen to be unsatisfactory (Abie et al., 2022) and low (Vinluan, 2012; Mapa, 2017; Kiley &Mullins, 2005; Tindowen et al., 2019). Previous researches reveal some of the reasons behind this low and unsatisfactory performance when dealing with AR. It was found that Junior High school teachers are still adjusting in embracing AR as part of educational culture (Salazar-Clemena, 2006; Hirsch, 2005; Tindowen et al., 2019); some are preoccupied with tasks (Antonio, 2020; Declaro-Ruedas & Ruedas, 2020; Abelardo et al., 2019); and others lack prior knowledge and related trainings in writing (Abelardo et al., 2019; Tindowen et al.,2019).

Research efficacy has seen to be a significant indicator of research interest and output (Büyüköztürk et al., 2011). AR efficacy is someone's confidence, perception, and judgment to his ability to successfully execute tasks and engage successfully in different components related to AR (Bieschke, 2006; Wester et al., 2019). One's opinion in research self-efficacy can be a factor to influence the engagement or subject choice in research undertakings (Bieschke, 2006).

Most of the studies conducted that involves AR focus on examining and identifying the perceptions and conceptions (e.g., Tindowen et al., 2019; Cortes et al., 2021), attitudes (e.g., Adani et al., 2022; Declaro-Ruedas & Ruedas, 2020), challenges (e.g., Aguilar-de Borja, 2018; Oestar & Marzo, 2022), and benefits of AR (e.g., Abelardo et al., 2019). However, it is also important to consider how their beliefs in this activity affect the way they deal with it. Since AR is a significant part of educational development, it is reasonable to assess and evaluate the teachers' self-efficacy in their engagement in the said activity. A proper evaluation of AR efficacy is essential to identify the factors that affect their beliefs in engaging themselves in the process. This also provides clear information on how these factors drive them to do it.

Furthermore, studies have already developed efficacy scales in several fields. An example is the 10-item General Self-Efficacy Scale (GSE) developed by Schwarzer and Jerusalem (1995) to measure one's self-efficacy and measure how an individual can deal with life demands. It has been adopted in 33 languages. There are also scales devised to assess patients' belief of coping with their medical conditions such as the *Health Specific Self-Efficacy Scales* (HSSES) by Schwarzer and Renner (2009), *Oral Health Related Self-Efficacy Scale for Patients with Cancer* (OSEC) developed by Matsuda et al. (2020), *Self-Efficacy Scale for People with Drug Abuse Disorders* by Supriyanto and Hendiani (2018), and *Self-Efficacy for Medical Communication* (SEMC) scale by Feldman et al. (2021).

Research efficacy scales were also constructed to measure students' and teachers' engagement in the said activity (e.g., RSES by Bieschke et al. (1996), SERM by Phillips and Russell (1994), FaRSES by Wester et al. (2019)). Also, self-efficacy scales for psychologists (e.g., *Psychologist and Counselors Self-Efficacy Scale* by Watt et al. (2019)), dancers (e.g., *Self-Efficacy Scale for Dancers* by Silva et al. (2015)), and for measuring strengths (e.g., *Strengths Self-Efficacy Scale* by Tsai et al. (2014)) are available. Moreover, the development of similar scales is available in the field of education. There are scales developed to assess students' and teachers' efficacy in utilizing technology in the class (e.g., *Technology Usage Scale in Education* by Doğru (2017); *Computer Self-Efficacy Scale* by Murphy et al. (1989), and *Computer Programming Self-Efficacy Scale* by Tsai et al. (2018)) and specific learning skills (e.g., *Reading Self-Efficacy Scale* by Kosar et al. (2022), *Problem-Solving Efficacy Scale in College Algebra* by Anoling et al. (2018), *Problem-Solving Efficacy Scales in Mathematics* by Dagdag et al. (2020), *English Language Skill Efficacy for Higher Education Students* by Sağlam and Arslan (2018), *Citizen Science Self-Efficacy Scale* by Hiller and Kitsantas (2016)).

Despite the existence of efficacy scales in different fields, there is still no available scale specifically designed to evaluate teachers' self-efficacy in doing AR. If it exists, self-efficacy is only a subscale of the study (e.g., Declaro-Ruedas & Ruedas, 2020) and limited to a specific group of respondents (e.g., FaRSES). Hence, this study aimed to develop an AR efficacy scale that can properly evaluate the efficacy of the secondary teachers in fulfilling the process of making AR studies. Specifically, it aimed to attain content validity, construct validity, high explanatory power, and internal consistency of the scale.

Methodology

This research and development used exploratory factor analysis (EFA) for the initial development of the Action Research Efficacy Scale (ARES). EFA is a family of multivariate statistical methods used in the development and evaluation of psychological theories and measurements (Williams et al., 2010; Watkins, 2018). Particularly, EFA is necessary in the early development of a scale as it can be used for the reduction of number of variables, assessment of multicollinearity among factors which are correlated, detection of unidimensionality of constructs, evaluation of construct validity, examination of factors relationship or structure, and development of theoretical constructs (Thompson, 2004).

Data Source

The data in this study came from randomly selected public secondary school teachers who are currently and permanently employed from the cooperating schools of Isabela State University Roxas Campus' College of Education. Out of 200 teachers who responded to the survey, only 177 teachers had fully accomplished the instrument. Hence, only 177 observations were considered for analysis. Pallant (2020) and Hair et al. (1995) assert that a sample size of at least 150 is still acceptable in factor analysis.

Item Formulation

The study developed an instrument that would measure the efficacy of secondary education teachers in doing AR. Sources of self-efficacy were reviewed from literature to build a foundation in the construction of scale items. The sources identified were anchored from Albert Bandura's (1977) Theory of self-efficacy, namely, Mastery Experiences, Vicarious Experiences, Verbal Persuasion, and Somatic or Emotional state as most of the related studies suggested. Afterwards, scale items for each identified efficacy source were collected from various related studies and existing related efficacy scales as a basis for construction.

Several concepts in the literature were studied to construct the present scale items. Scale items 1 and 2 which reflects the first step in doing AR (identifying an area of focus/problem) were based on the concept of AR and existing studies about research (Adani et al., 2022; Hewitt & Little, 2005). Meanwhile, items describing the collection, analysis, and interpretation of data (scale items 3 to 27) were retrieved from various studies and literature (e.g., Kinskey, 2018; Hewitt & Little, 2005, Oestar & Marzo, 2022, Tindowen & Guzman, 2019; Morales et al., 2016, Adani et al., 2022; Aguilar-de Borja, 2018; Albalawi & Johnson, 2022) and research instruments (e.g., Declaro-Ruedas & Ruedas, 2020; Büyüköztürk et al., 2011). Lastly, items 28 to 30, which talk about the last three steps in the process of doing AR, were constructed based from key concepts of AR. Under the vicarious experiences, verbal persuasion, and psychosomatic responses subscale, most of the items were adapted from Anoling et al. (2018) and Dagdag et al. (2020). Other items were also retrieved from the references of mastery experiences. The scale items were revised and personalized using the first person point of view ("I") and were constructed in relation to AR.

The researchers came up with 120 items. Scale items were numbered based on the self-efficacy sources they are measuring. Items 1 to 31 measure mastery experiences, items 32 to 62 measure vicarious experiences, items 63 to 93 measure social persuasion, and items 94 to 120 measure somatic and emotional states. The scale came in the form of a five-point Likert scale where each item asks respondents to indicate 1 if they strongly disagree, 2 if they disagree, 3 if they neither agree nor disagree, 4 if they agree, and 5 if they strongly agree.

Data Collection

The data gathering procedure was strictly followed in accordance to the research ethics. Request letters and consent forms were sent to the concerned people. The items were validated by consulting six (6) faculty members having expertise in research. They were asked to rate the items according to their relevance to AR efficacy using the four-point scale: 4 if highly relevant, 3 if quite relevant, 2 if somewhat relevant, and 1 if not relevant. Another round of validation was done as the researchers made changes to some of the scale items formulated at first. To further ensure the readability and understandability of the scale items, the instrument was also pilot tested on at least 6 pre-service teachers. Prior to administering the instrument personally to the target participants, Informed Participant Consent Forms (IPCFs) were provided to ensure the study's adherence to ethical principles. The participants were given adequate time to accomplish the instrument, which was retrieved only upon their consent.

Data Analysis

To establish the content validity, construct validity, and internal consistency of the scale, the data underwent three-stage analysis. Initially, Content Validity Index (CVI) was calculated to assess the scale items' degree of relevance to AR efficacy. Moreover, a series of factor analysis was conducted to test the construct validity of the scale. The Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) were utilized to test the correlation of the variables and the sampling adequacy for the study, respectively. Principal Axis Factoring was used as an extraction method. Kaiser's K1, Scree Test, and Parallel Analysis were conducted to identify the number of factors to be extracted for further analysis. Direct Oblimin rotation was performed, requesting a Component Correlation Matrix to guide whether an oblique or an orthogonal rotation could give a better interpretability of the data. Furthermore, a Cronbach Alpha Reliability was used to measure the internal consistency of the scale and the subscales.

Results and Discussion

Expert Validation

The content validity of the initial scale was evaluated by six experts. Content validity is to the degree to which the scale has an appropriate sample of items for the construct being measured (Polit & Beck, 2004). In assessing content validity, the experts scrutinized the 120 scale items to determine their relevance to measuring AR efficacy. Considering expert suggestions, seven scale items that were not so relevant to AR efficacy were removed while the other items were arranged in a sequential manner, i.e., from identifying an area of focus/problem, collecting data, analyzing and interpreting data, developing an action plan, to implementing and evaluating the action plan. Moreover, the researchers modified some items, which according to the experts were similar in thought. Finally, seven items that did not meet a content validity index of at least .78 were removed (Lynn, 1986). Hence, only 106 items were retained after this validation procedure.

Data suitability for EFA

The analysis began by assessing whether the data were suitable for Exploratory Factor Analysis. One important factor to consider when running a factor analysis is having a sufficient number of participants. However, there are varying opinions among authors about how many participants are needed for this process. In this particular study, there were originally 200 secondary teachers who responded, which was considered a fair sample size by Comrey (1973). However, only the responses from 177 teachers were used for statistical analysis because they were complete. Despite this reduction in sample size, the study still had enough participants to run a factor analysis (Pallant, 2020; Hair et al., 1995).

To determine the relationship between variables, a correlation matrix was used in this study. Tabachnick and Fidell (2019) recommended that a minimum of 0.30 or 30 percent relationship between variables should be met.

Table 1 shows that the variables were intercorrelated by achieving at least 0.30 correlation loading. The sampling adequacy of the variables was assessed using Kaiser-Meyer-Olkin (KMO), with a 0.50 sampling adequacy considered suitable for EFA (Hair, Anderson et al., 1995a; Tabachnick & Fidell, 2019). However, Netemeyer et al. (2003), suggested that a KMO correlation exceeding 0.60–0.70 is adequate for analyzing EFA output. In this study, the KMO correlation was computed to be 0.874, indicating that the variables are adequate enough for the desired analysis. Bartlett's Test of Sphericity was also used to verify the factorability of the factors, with a significant chi-square statistic, $x2 = 37820$, $p < .001$.

Table 1 KMO and Bartlett's Test

KMO Measure of Sampling Adequacy		.874
Bartlett's Test of Sphericity	Approx. Chi-square	37820
	df	6441
	p	< .001

Factor Extraction

The study utilized Principal Axis Factoring to identify the smallest number of factors to represent the AR Efficacy of Secondary Education Teachers. This method was chosen over Principal Component Analysis because the researchers were specifically interested in identifying the underlying factors related to a set item, which in this case was the AR efficacy of secondary education teachers (Burton & Mazerolle, 2011; Comery & Lee, 1992; as cited by Taherdoost et al., 2022).

Factor Retention

Subsequently, three retention methods were used to determine the number of factors to be retained in the scale items. Kaiser's K1 method asserts that factors with eigenvalues greater than 1 should be retained for analysis. Kaiser's K1 Method suggested seven (7) factors to retain as shown in Table 2. However, the method is appropriate to use for Principal Component Analysis (Gorsuch, 1983) and provides an overestimation of 66 percent correct number of factors according to Linn (1968). Moreover, it is considered to be among the least accurate methods for selection of factor retention as authors reported (Fabrigar, Wegener, et al., 1999; Ledesma and Valero-Mora, 2007, Taherdoost, 2022). Thus, it is reasonable to use other retention method for an accurate result.

Table 2 Kaiser's criterion factor retention method

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	61.357	53.822	53.822
2	23.305	20.443	74.265
3	2.885	2.531	76.795
4	1.255	1.100	77.896
5	1.160	1.017	78.913
6	1.114	0.977	79.890
7	1.012	0.888	80.778
8	0.968	0.849	81.627

Note: Extraction Method: Principal Axis Factoring.

Alternatively, Scree Test was run for a more accurate basis for factor retention. The Scree test showed the number of factors above the break to be retained. It suggested to keep three (3) factors. Zwick and Velicer (1986) show in their comparison between K1 and Scree Test that the latter is better as it provides 57 percent accuracy.

Finally, Parallel Analysis (PA) was further employed to determine an even more accurate number of factors to retain. Parallel Analysis operates by comparing the initial eigenvalues extracted from the Total Variance Explained to random eigenvalues. In this method, a component is considered important if the initial eigenvalue surpasses the random eigenvalue. Some authors (e. g., Humphreys & Montanelli, 1975; Zwick & Velicer, 1986; Glorfeld, 1995) emphasized this method to be the best to employ for factor analysis, as it gives a 92 percent correctness. PA suggested to retain three (3) factors as shown in Table 3.

Table 3 Parallel Analysis

Factor	Initial Eigenvalues	Random Eigenvalues	Decision
1	61.357	3.1244	Retain
2	23.305	2.9833	Retain
3	2.885	2.8637	Retain
4	1.255	2.7723	Reject

Factor Rotation Method

The researchers used a Direct Oblimin Rotation to determine the appropriate rotation for the factors. Rotation Method is used to determine whether a variable is related to one or more factors, and it maximizes high item loadings while minimizing the low item loadings. There are two types of rotational methods: oblique and orthogonal. Factors that have a correlation of at least 0.32 (correlated) submit them to oblique rotation, otherwise, orthogonal rotation is used. As shown in Table 4, the factors were uncorrelated ($r < .32$). Thus, an orthogonal rotation, specifically Varimax rotation, was utilized. Varimax rotation is the most commonly used orthogonal rotation for factor analysis providing a simple structure for uncorrelated factors (Osborne, 2015).

Table 4 Factor correlation matrix

Factor	1	2	3
1	1.000	-.065	.164
2	-.065	1.000	-.028
3	.164	-.028	1.000

Note: Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Factor Interpretation and Labelling

After running a rotational method, rotated factor matrix was interpreted. All factor loadings below 0.32 were suppressed. Cross-loading items were subjected for deletion. Cross loading happens when a scale item obtains a factor loading of at least 0.32 in two or more factors (Tabachnick & Fidell, 2019). Cross loading is one of the considerations of deleting items in a factor analysis. If this happens, there is a poor specificity in an item and it may not show clear association with a single factor. In this case, 12 items cross-loaded and were discarded for further analysis.

After identifying the items, 102 items were retained and categorized into two factors (as to what the rotation method revealed) contrary to what the scree plot test and parallel analysis suggested. There were 75 items from the totality of the variables that belong to factor 1 while there were 27 items retained in factor 2.

Aside from cross-loading, low communality of items is also a justifiable consideration when deciding to remove items. Low communality items are items that have coefficients less than 0.6. Items number 87 *(When others tell me that I can evaluate the result of my action plan, I am inspired to conduct action research again, 0.577)* and 109 *(I get a headache whenever I organize the data of my action research, 0.388)* were removed as they meet the criterion for deletion.

As there were still many items retained for both factors, the researchers use their autonomy in deciding the number of items to retain (Gorsuch, 1983; Marcoulides & Mueller, 2007; Spector, 1992). The items were reduced in a manner that maximizes the explanatory power and administrability of the scale, i.e., 20 items having the highest factor loadings were retained for each factor. As a result, factor 1 had factor loadings that ranged from 0.861–0.895, while factor 2 had factor loadings that ranged from 0.932–0.960.

To ensure the factorial validity of the 40 items, these were re-subjected for Exploratory Factor Analysis. The KMO value (0.942) was greater than 0.30 and the Bartlett's Test of Sphericity of 12510 was significant at .01 level, suggesting that these items were factorable. Both Scree Plot Test and Parallel Analysis suggested two (2) factors to retain. The Direct Oblimin method showed that the coefficients were less than 0.32, which meant that orthogonal rotation was needed. The Varimax rotation resulted in a Rotated Component Matrix where items remained the same, but their positions within the factors switched, i.e., the first factor became the second, and vice versa. The factor loadings in Factor 1 ranged from 0.926 to 0.962, while those in Factor 2 ranged from 0.848 to 0.906 (Table 5).

Table 5 Factor loadings and communalities of the 40 Scale Items

Indicator	Factor Loadings		h^2
	Factor 1	Factor 2	
Item 100	*0.962*	-0.043	0.927
Item 101	*0.959*	-0.041	0.921
Item 102	*0.959*	-0.037	0.921
Item 103	*0.956*	-0.056	0.917
Item 104	*0.955*	-0.056	0.915
Item 105	*0.953*	-0.056	0.911
Item 106	*0.95*	-0.047	0.905
Item 112	*0.95*	-0.043	0.904
Item 108	*0.948*	-0.05	0.901
Item 95	*0.947*	0.001	0.897
Item 111	*0.946*	-0.079	0.901
Item 99	*0.946*	-0.023	0.895
Item 94	*0.945*	0.03	0.894
Item 110	*0.945*	-0.036	0.894
Item 113	*0.944*	-0.045	0.893
Item 96	*0.939*	0.009	0.882
Item 107	*0.937*	-0.011	0.878
Item 97	*0.936*	-0.017	0.876
Item 98	*0.933*	-0.005	0.871
Item 92	*0.926*	-0.048	0.860
Item 51	-0.011	*0.906*	0.821
Item 85	0.019	*0.89*	0.792
Item 65	-0.033	*0.889*	0.791
Item 83	-0.038	*0.886*	0.786
Item 69	-0.011	*0.884*	0.782
Item 82	-0.02	*0.882*	0.778
Item 45	-0.052	*0.88*	0.777
Item 79	-0.038	*0.878*	0.772
Item 81	-0.028	*0.878*	0.772
Item 67	-0.049	*0.877*	0.772
Item 60	-0.048	*0.877*	0.771
Item 48	-0.027	*0.876*	0.768
Item 49	-0.038	*0.872*	0.762
Item 77	-0.021	*0.869*	0.756
Item 52	-0.013	*0.864*	0.747
Item 43	-0.04	*0.863*	0.746
Item 61	-0.085	*0.859*	0.745
Item 54	-0.084	*0.858*	0.743
Item 38	0.005	*0.857*	0.734
Item 37	0.009	*0.848*	0.719

Generally, a total variance explained of at least 60 percent is satisfactory (Hair et al., 2012). In this particular study, as shown in Table 6, Factor 1 accounted for 46.28 percent of the variance, while Factor 2 accounted for 37.80 percent. When combined, these two factors accounted for a total of 84.08 percent of the variance, which is a strong indication that they are able to effectively explain the construct of AR efficacy.

Moreover, the reliability of the scale items in each factors using Cronbach's Alpha were also tested. Cronbach Alpha was employed to measure the internal consistency or to describe how a set of items in a factor are closely related. Cronbach's alpha coefficients must be at least .70 to be reliable. The closer the Cronbach's alpha coefficient to 1, the greater the internal consistency of the items in the scale (Gliem & Gliem, 2003). Factor 1 has attained reliability coefficient of 0.994, while factor 2 has attained a reliability coefficient of 0.985. In general, the 40 items have gained a reliability coefficient of 0.963. These reliability coefficients show that the factors underlying AR efficacy have a high internal consistency.

Understanding the Two Factors of AR Efficacy

This study aimed to develop an instrument that would measure the AR efficacy of secondary education teachers. Analysis has shown that there are two factors describing AR efficacy. According to Pett et al. (2003), labelling a construct is a theoretical, subjective, and inductive process. It is important to take into consideration that labeling or naming constructs should reflect the theoretical and conceptual intent. Furthermore, labelling a factor should describe the scale items as a whole, which solely depends on the researchers' interpretation.

Factor 1 describes the psychosomatic or emotional experience of secondary education teachers when doing an AR. It encompasses changes in heart rate, blood pressure, perspiration, respiration rate, or other autonomic responses felt when working with AR. Hence, factor 1 was labeled as Affective factor. Affective factor relates to one of Albert Bandura's (1997) four sources of self-efficacy, Psychosomatic or emotional arousal (also termed as Physiological and affective state). This source of self-efficacy tends to indicate dysfunction during stressful situations, which affects self-efficacy beliefs negatively.

Factor 2 describes how others' action and verbal motivation influence a secondary education teacher to engage in doing AR. Factor 2 encompasses psychological processes, feedback, praise, modelling, and influences that shape one's attitudes towards learning and working with AR. Hence, this factor was termed Socio-Cognitive Factor. This factor can be linked to vicarious experiences and verbal persuasion, two of the four sources of self-efficacy mentioned by Bandura (1997). Vicarious Experiences involve observing other people's action that can generate expectations in observers that they too will improve if they intensify and persist in their efforts. Meanwhile, Verbal Persuasion deals with the words, feedback, praise that a person receives from others that affect his beliefs and self-perception. Good verbal persuasion can enhance an individual's self-efficacy especially if it comes from a credible source (Bandura, 1997).

According to Bandura (1997), the physiological state, vicarious experience, and social persuasion are weaker sources of self-efficacy compared to mastery experience. However, it is surprising that mastery experience did not emerge as one of the factors in the analysis. This implies that AR efficacy may not be dependent on mastery experience but on affective (psychosomatic and emotional experience) and socio-cognitive (vicarious experience and social persuasions) factors. In other words, self-efficacy can still be built even when someone lacks the mastery experience (Pajares, 2002) by enhancing psychosomatic and emotional experience alongside vicarious experience and social persuasions.

This scale instrument which intends to measure the self-efficacy of secondary education teachers highlights salient features. One of these is its specificity. Scale items were stated in a specific manner in which the target participants are able to easily comprehend and reflect to provide an honest assessment of their self-efficacy. Additionally, ARES targets to be used within a broader scope of participants. Compared to the existing research-related scales where participants were limited to faculty members teaching a particular subject (e.g., FaRSES by Wester et. al., 2019), ARES was intendedly created to be responded by high school teachers regardless of their subject of specialization. Existing efficacy scales were purposively created to measure the research skills

Table 6 Subscales' reliability coefficients and variance explained

Factor	Scales	No. of items	Variance Explained (%)	Cronbach Alpha
1	Affective Factors	20	46.28	0.994
2	Socio-Cognitive Factors	20	37.80	0.985
Total		40	84.08	0.963

and perceptions of the target participants (e.g., SERM by Phillips & Russell, 1994) as well as to measure one's perceived ability in performing various research-related behaviors (e.g., RSES by Bieschke et. al., 1996) whereas ARES measures a deeper aspect of dealing with research-related activities which in this case is the self-efficacy of the target participants during the AR making process. Most importantly, the development of ARES bridges the gap on the existence of a scale that would evaluate the AR efficacy of educators, since there is still no existing scale that focuses on the measurement of the construct. Lastly, it will provide more opportunities to discover and widen the knowledge about AR self-efficacy.

Conclusion and Recommendation

This study developed the ARES, which is a scale that measures AR efficacy among secondary school teachers. Through exploratory factor analysis, the study establishes that ARES has two distinct subscales: (1) the Affective Factor Scale, which measures the degree of physical responses and emotional discomfort experienced by teachers during the AR process, and (2) the Socio-Cognitive Factor Scale, which assesses the impact of verbal persuasion and modeling on teachers engaged in AR. As an assessment instrument, ARES demonstrated both validity and reliability, achieving content validity through expert validation, construct validity with two distinct factors exhibiting high factor loadings and a collective explanatory power of 84.08 percent, and a high level of internal consistency.

ARES is distinct in several ways. First, the scale items were constructed to be easily comprehensible and reflective, allowing participants to honestly assess their self-efficacy. ARES was designed for a broad range of participants, particularly secondary education teachers regardless of their subject specialization. Unlike other scales, ARES focuses specifically on the self-efficacy of teachers during the AR process, filling a gap in the existing literature where no other scales specifically measure this construct.

This study contributes to the theoretical understanding of AR efficacy by identifying two distinct factors: the Affective Factor and the Socio-Cognitive Factor. These findings add depth to the existing knowledge and theoretical framework surrounding teacher self-efficacy and engagement in AR. Unlike previous studies that may have focused broadly on teacher efficacy or research efficacy in general, this study provides a targeted exploration of AR efficacy, offering new insights into the specific challenges and supports relevant to secondary school teachers.

The development of a valid and reliable scale offers educators and practitioners a valuable tool to assess and monitor teachers' effectiveness in conducting AR. This tool can help identify areas for improvement, guide professional development interventions, and enhance overall engagement and performance in AR among secondary school teachers. Furthermore, ARES provides a means to empirically assess the impact of AR on teaching practices, potentially leading to improved student outcomes and teacher professional growth.

Additionally, this study opens doors for future research in AR efficacy. Researchers can explore the specific components and influences of the Affective and Socio-Cognitive Factors, examining their individual and combined impacts on teachers' engagement and effectiveness in AR. Further studies could investigate the relationship between AR efficacy and other relevant variables, such as student outcomes and teacher professional growth. Future researchers can also employ Confirmatory Factor Analysis to confirm the underlying factors of AR efficacy.

Conflict of Interest

The authors declare that there is no conflict of interest.

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