DOI: 10.2478/dcse-2022-0004

sciendo

Discourse and Communication for Sustainable Education,
vol. 13, no. 1, pp. 37–47, 2022

Sustainable Instrument Development in Educational Research

Ediyanto Ediyanto, Asep Sunandar,
Risa Safira Ramadhani and Thalsa Syahda Aqilah
Universitas Negeri Malang, Malang, Indonesia

Abstract

The current study presents an overview of studies investigating educational research instruments development. This study only discusses similar topics in instrument development. The instrument discussed is the assessment of perspective on inclusive education. This research adopted a literature review approach. There are seven research stages: beginning the article, relevant literature identification, review structuring, tone structuring, tense structuring, theoretical development, and evaluating. The current study indicates four main steps in the research and development method: data collection, planning, initial product development, and validation. Simultaneously, the revision or feedback process must be integrated with each step. Research and development is a cycle, so the product development results must be continuously reviewed to remain appropriate and solve current problems. Thus, with the sustainable instrument development method, ideas and innovations in education can be realized.

Key words: development research, educational research, instrument development, research instrument

Introduction

Progress in the world of education is in line with the developments that have been created previously. The development aims to produce new products or promote existing products to improve all aspects of education. The results of the development and improvement of educational products cannot be separated from the existence of development research. With proper development research, new products will be accountable and valuable. The product (in education) can be in learning models, multimedia learning, or learning tools, such as lesson plans, books, student worksheets, questions. It can also be the application of learning theory by combining the development of learning tools (Munawaroh, 2015).

Conducting development research needs to pay attention to the development research method that will be used. The development research method has three main components that are important to study, namely 1) Development Model, 2) Development Procedure, and 3) Product Trial. There are several models of development research put

forward by a number of experts. Each expert has different procedures or stages, but the three main components in development research are listed in these stages. With the implementation of development research in education, innovations can be introduced with advances in the field of education that focus on sustainable development. The research context and methodology greatly influence educational research, particularly Educational Development for Sustainability (Pipere, Reunamo & Jones 2010).

In particular, the instrument must be valid and reliable. Valid and reliable instruments are needed in developing research instruments. The role of research and development in developing an instrument needs to pay attention to briefness, simple administration, flexibility, validity, and reliability (Mahat, 2008). Furthermore, the measuring instrument developed must meet the criteria to be declared as a good measuring instrument. These criteria include valid, reliable, standard, economical, and practical measures. According to Gronlund (2009), the main characteristics that a measuring instrument must possess can be classified into the character of validity, reliability, and level of usefulness. Briefly and clearly, in making development research instruments, Setyosari (2013) and the Ministry of National Education (2008) state that validity and reliability are two things that must be considered.

The research instrument is a tool to determine the data source. The influential aspect of the data source is the data type, data collection technique, data collection instrument, and the steps for preparing the research instrument. Furthermore, it can also identify the validity, difficulty level, reliability, discriminatory power, and distractors of the research data. The instrument has a crucial role because the quality of a study can be known with the instrument. If the developed instrument has good criteria, then the quality of the research is also good, while a poor instrument results in dreadful research quality. As the instrument reveals a fact into data, the adoption of an excellent instrument that is valid, reliable, has a good level of difficulty, distinguishing power and distractor/detractor, will obtain data that represents the facts or actual conditions in the field. However, a poor instrument with low validity and reliability will reveal a level of difficulty, discriminatory power, and distractor/detractor influences. In that case, the data obtained is also invalid or does not follow the field's facts resulting in a wrong conclusion.

Based on these explanations above, comprehensive information about conducting instrument development in education research is essential. Concerning those issues, the current paper discusses the steps of research and development methods. It presents an overview of the research discussing the instrument development in education research. Therefore, the limitation of this paper only discusses a similar topic in the instrument development for assessing attitudes on inclusive education.

Methods

The literature review model used in this study is a seven-step writing literature review by Webster and Watson (2002). The steps used are: beginning the article, relevant literature identification, review, tone, and tense restructuring, theoretical development, and evaluation. The first step is beginning the article. In this step, the topic must be selected from previous studies, elaborated to set key variables (concept) definitions. The key variable selected in this study is the educational instrument development. The second step is identifying the relevant literature. In this step, the paper needs to be selected based on the key variables, completed and focused on the concept. Based on searching

on the ERIC Database, eight articles were found and used. Then the next step: structure the review. In this step, eight articles are needed to organize the framework by determining the concept, author-centric approach, with summaries relevant to a key concept in developing an instrument in education. The following step is tone and tense. In the toning step, eight articles need to explore by modelling the pattern. The tense step shows that eight articles more immediacy, in line with our concept-centric approach to literature review. Theoretical development entails identifying critical knowledge gaps and motivating researchers to fill them. The result of the review is the new theory (such as a new model). The last step is evaluating. After the new theory is created, it is essential to evaluate it by expert comment and suggestion.

Results

This study develops an instrument following all of the required criteria. A particular methodology is implemented in the instrument development process. An instrument measuring teachers' attitude toward inclusive education involves a) collection of data, b) planning, c) development of the initial product, d) process validation, e) first and (f) second pilot study.

Information Gathering

The ITAIE Scale (Ediyanto, 2020) was developed because no instruments were adapted to the Indonesian context. In line with this, TATIS (Cullen, Grogory, & Noto, 2010) was developed for context (and four other reasons). Meanwhile, SACIE-R was developed in improving SACIE, which is the rationale for supporting the practice of inclusive education (Forlin et al., 2011). On the other hand, TAIS (Monsen, Ewing, & Boyle, 2015) revised the ORMS (The Opinions Relative to Mainstreaming Scale) is deemed no longer suitable. They reasoned that ORMS should be adjusted in line with government regulations regarding terms in special education.

Table 1

Development of Attitudes Toward Inclusive Education Instrument

Instrument developer(s)	Name	Information gathering	Planning	Establishing the initial product	Validation process by the expert	Pilot Study I	Pilot Study II
Ediyanto (2020)	ITAIE Scale	Yes	Yes	Yes	Yes	Yes	Yes
Forlin et al. (2011)	SACIE-R	Yes	Yes	Yes	Yes	Yes	Yes
Gregory and Noto (2012)	ATTAS-mm	Yes	Yes	Yes	Yes	Yes	Yes
Cullen et al. (2010)	TATIS	Yes	Yes	Yes	No	Yes	No
Stoiber et al. (1998)	MTAI	Yes	Yes	Yes	No	Yes	No
Monsen et al. (2015)	TAIS	Yes	Yes	Yes	No	Yes	No
Mahat (2008)	MATIES	Yes	Yes	Yes	No	Yes	No
Sharma and Desai (2002)	CIES	Yes	Yes	Yes	Yes	Yes	No

In contrast to Mahat's (2008) reasoning in developing the MATIES, he wanted to develop an instrument that includes effective multidimensional aspects in inclusive education. Therefore, aspects that appear on the instrument are affective, cognitive, and behavioral. In line with Mahat (2008) in developing MATIES, Gregory and Noto (2012) also did the same thing in developing Attitudes Towards Teaching All Students (ATTAS-mm) and must have multidimensional aspects, but in this study, added SEM analysis to increase validity and reliability items. Finally, the scale of Concerns about the Integrated Education (CIE) argues that the previous item does not provide an overview of validity and reliability, so it is necessary to develop valid and reliable instruments (Sharma & Desai, 2002).

Planning

After all the instruments (see Table 2) reviewed in this paper explained the reasons for developing the instrument, they carried out planning.

Establish Initial Product

Indonesian Instrument Attitudes toward Inclusive Education Scale (ITAIE Scale) (Ediyanto, 2020)

The ITAIE scale was created by combining seven previous studies consisting of new items relevant to Indonesia current inclusive Education (Cullen, Gregory & Noto, 2010; Forlin, Earle, Loreman, & Sharma, 2011; Gregory & Noto, 2012; Monsen, Ewing, & Boyle, 2015; Stobier, Gettinger & Goetz, 1998; Mahat, 2008; Sharma & Desai, 2002). The seven previous studies examined instrument creation measuring teachers' attitudes on Inclusive Education.

Sentiments, Attitudes, and Concerns about the Inclusive Education Revised Scale (SACIE-R) (Forlin et al., 2011)

The scale of SACIE-R has 15 questions with components of attitudes, sentiments, and concerns. Five questions were provided for each component. The item responses follow a four-point Likert scale, ranging from 'strongly disagree' to 'strongly agree.' The strongly disagree signifies a pessimistic attitude, while the strongly agree represent possitive attitude to inclusive education.

Table 2

Planning Step of Instruments Development

Instrument developer(s)	Name	Planning
Ediyanto (2020)	ITAIE Scale	Conducting a literature review, Planning, Develop Initial Instrument, Experts instrument validation (also revision), Two pilot study in the field (also revision).
Forlin et al. (2011)	SACIE-R	Initial review, Testing the refined 15-item SACIE, Revision and additional Testing of the SACIE Scale, Final validation.

See next page for continuation of table

Continuation of Table 2

Gregory and Noto (2012)	ATTAS-mm	Gathering component of attitude, Planning, Initial product, Validity to expert, Pilot Study.
Cullen et al. (2010)	TATIS	Initial review, Rationalization, Development Product, Validity.
Stoiber et al. (1998)	MTAI	Literature Review, Planning, Development Product, Pilot Study.
Monsen et al. (2015)	TAIS	Literature Review, Planning, Development TAIS (Section1: Demographics, Section 2: Willingness to Incorporate, Section 3: Adequacy of Support, Section 4: Attitudes towards Inclusion), Validation.
Mahat (2008)	MATIES	Theoretical Framework, Measurement Framework, Development Product, Pilot Study.
Sharma and Desai (2002)	CIES	Identifying concerns, Determining the format for measurement, Developing the scale (drafting form), Reviewing the scale (which was done by an expert panel), Carrying out a pilot study, and Making final revisions to the scale.

Attitudes toward Teaching All Students (ATTAS-mm) (Gregory & Noto, 2012)

This instrument was created following the previous instruments, namely Teacher Attitudes Toward Inclusion Scale (TATIS) (Cullen et al., 2010) and SACIE (Loreman & Earle, 2007). This instrument development was motivated by the inability of the previous instrument to load the three factors described in literature review, attaining bias score. ATTAS-mm is the completely positive revision of TATIS-p (Gregory & Noto, 2015). This instrument development was started by small group testing (n = 40). Meanwhile, this instrument's question represents the affective, behavioral, and cognitive components. Further, 48 respondents were involved to retest the obtained data. The results of initial component analysis reduced 26 items to 12.

The Teacher Attitudes toward Inclusion Scale (TATIS) (Cullen, Gregory, & Noto, 2010)

This instrument encompasses the inclusion of three divisions of the children with disabilities (such as teachers' attitude toward mild to moderate (POS) disabilities students, beliefs about the inclusion efficacy (BEI), and attitude toward professional roles and functions (PRF)). The three elements are similar to the three domains of attitude (Gregory & Noto, 2012). Cognitive domains are similar with teachers' perceptions of mild to moderate disabled students, affective domains is represented with teachers' beliefs on inclusion efficacy, and behavioral domains is in line with perceptions of professional roles and functions.

My Thinking about Inclusion (MTAI) Scale (Stoiber, Gettinger & Goetz, 1998)

This scale seeks to understand the thinking, specifically parents' and teachers' beliefs domain. It consists of the expected outcomes, core perspective, and classroom practices, with 28 – 12, 11, and five items, respectively.

Teachers' Attitudes toward Inclusion Scale (TAIS) (Monsen, Ewing, & Boyle, 2015)

This scale is a revised version of the Opinions Relative to Mainstreaming Scale (ORMS) from Larrivee and Cook (1979), that determines teachers' beliefs on inclusive education. The revision of ORMS is induced by terms of integration and mainstream that are no longer relevant. Later, the term 'inclusion' is selected to replace 'mainstreaming' or 'integration' due to policy changes. Initially, TAIS consists of 30 items along with demographic data (teaching experience, sex, teachers qualifications, and contact with children and young people).

Multidimensional Attitudes toward Inclusive Education Scale (MATIES) (Mahat, 2008)

This scale combines frameworks of measurement from Wilson (2003, 2005) and De Vellis (2003). It adopts affective, cognitive, and behavioral components. Its 36 items encompass eight components.

Concerns about the Integrated Education (CIE) Scale (Sharma & Desai, 2002)

CIE scale seeks to estimate integrated education concerns in India. It is straightforward, valid, reliable, and has simple administration. In the literature review (the step of identifying concerns), 36 items were developed.

Validation

Content validation process involved a panel of inclusive education experts (Ediyanto, 2020; Sharma & Desai, 2002; Forlin et al., 2011; Gregory & Noto, 2012). The items review was carried out on their balance, clarity, overlapping responses, wordiness, negative wording, use of jargon, praxis application, technical language usage, relationship to the problem criteria, and appropriateness of responses. The expert panel review result suggests that the CIE scale (Sharma and Desai, 2002) had three indicators of assessment: each item's importance in unique socio-educational context; clarity, conciseness, and wordings; and the instruction given with clarity and conciseness.

Principal Component Analysis (PCA) (Ediyanto 2020; Cullen et al., 2010; Forlin et al., 2011; Gregory & Noto, 2012) was used in the construct validation process. Things that are seen in the analysis process using PCA are the PCA value and cumulative variance. In addition, the ITAIE scale (Ediyanto, 2020; Monsen et al., 2015) uses the Pearson product-moment correlation to test concurrent validity. Finally, all instruments in Table 1 use Cronbach's alpha to test reliability. The instrument developed was field-tested once by Stoiber et al. (1998), Cullen et al. (2010), Mahat (2008), Monsen et al. (2015), and Sharma and Desai (2002). While two field tests were carried out by Ediyanto (2020), Gregory and Noto (2012), Forlin et al. (2011).

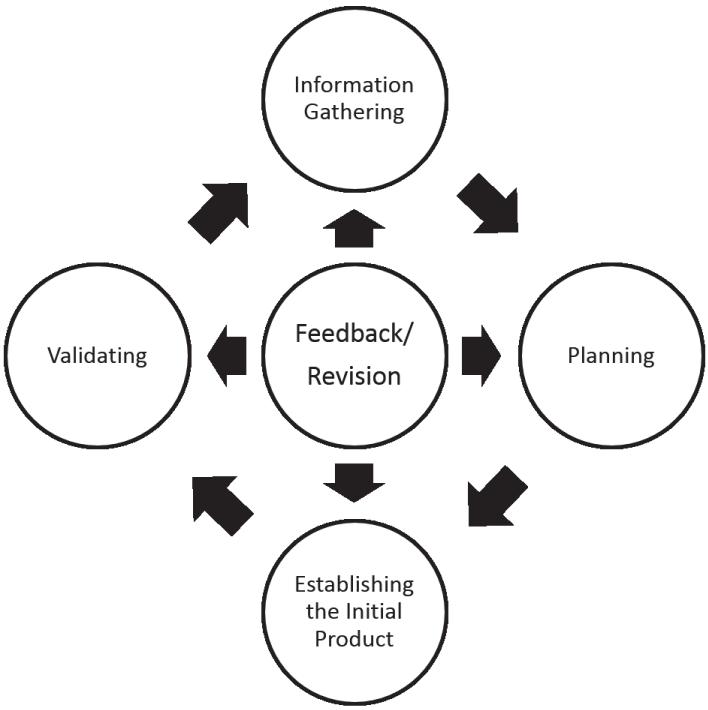
Discussion

In the current study, we propose a development research model in education, namely data collection, planning, initial product development, validation, and the feedback for every step. Thus, the instrument development model must be a cycle (information gathering, planning, initial product, validation, & feedback/revision). The proposed model is illustrated

in Figure 1. The research development process is a never-ending cycle. It means that every instrument (or anything) developed must continually be reviewed and improved. For example, new entries or information need to be added in the Information Gathering process, and the instrument needs to be reviewed. Likewise, if the instrument developed is too old or does not fit the context, then the instrument also needs to be repaired again. So it is necessary to add feedback (revision) at every step of development.

Figure 1

Sustainable Development Model in Educational Research



Based on Pipere, Reunamo and Jones (2010) and Salīte et al. (2020) study, there are not many research themes and their synergies that discuss research methodologies, especially development research and themes relevant to educational sustainable development research. There is a discussion of several development research models, such as the development research of Borg and Gall (1983), Dick and Carrey (2005), and ADDIE (2009). Of course, there are different research stages in these studies. However, from the three development research methods, there are five stages in common: information gathering, planning, establishing, validating, and Feedback/Revision. Therefore, the developmental research method study can facilitate the new models, tools, and procedures (Richey & Klein 2005). Meanwhile, according to Van et al. (1999), development research can enhance the learning curriculum, media, technology, process and instruction, along with teacher education and didactics.

Information gathering aims to identify problems, including if there are gaps and assessments to ensure actions that must be decided to resolve the problem. Information

gathering in development research can be obtained through literature studies or field observations (Borg & Gall, 1983). In instrument development research, this step is the same as factor analysis. Factor analysis was used to form homogeneous groupings of items (Anastasi, 1992; Rounds, Dawis, & Lofquist, 1987; DeVellis, 2003). Factor analysis identifies or confirms a small number of factors or latent constructs from many observed variables (or items). One of the factor analysis techniques commonly adopted is Principal Component Analysis (PCA) (Khan, 2006).

Planning aims to program the process of action or development to suit the needs. At this stage, the researchers must ensure that the purpose of a particular product or product type is genuinely capable of solving the problems and needs identified at the information gathering stage (Aka, 2019). Thus, at the planning stage, choosing the type of product needed to be developed. For example, if what is being developed is software, it needs relevant planning.

Establishing the Initial Product is an essential process. First, researchers must be able to show how the development process was carried out. After the planning stage, an initial product is established (Borg & Gall, 1983), where detailed activities, such as drafts or product-specific materials and evaluation process are carried out.

The aim of validating is to test the feasibility and reliability of the product that has been developed. The form of validating can be done in two ways, using experts and field trials. The instruments' negative wording, clarity, balance, wordiness, overlapping responses, use of technical language, use of jargon, appropriateness of listed responses, application to praxis, and relationship to the problem criteria's can be investigated (Carmines & Zeller, 1991; Fink, 1995). The requirement for the selected expert is to have relevant academic work. Meanwhile, field tests can be carried out until a sufficient degree of validity and reliability is obtained. Field tests can be carried out on a small scale and a large scale. The purpose of field trials is to obtain a qualitative and quantitative evaluation or feedback on the product by users. Users provide their opinions through interviews, observations, or questionnaires that focus on the problem of using the product and suggestions for improvement efforts. Preliminary field testing ensures that the product conforms to the specific expected performance. Furthermore, interview data, observations, or questionnaires supplement the primary field test activities (Borg & Gall, 1983). The common practice to examine validity (content validity) of the instrument development study (in counseling psychology) is to use EFA and CFA techniques (Worthington & Whittaker, 2006). On the other hand, Cronbach's alpha measures the instruments' internal consistency. A higher than 0.700 Cronbach's alpha is the minimum reliability level (Field, 2013).

In the feedback or revision stage, the field tests were used to carry out the revision process. In revising and re-planning the product, the development team can consult field test data. In addition, at this stage, revisions were also made following findings and suggestions identified at the primary field test. For example, if the quantitative data suggest that the product is ineffective, revision and another main field testing should be completed. Minimum to no development from the second main field testing indicate that product development should finish, and there is no need to continue (Borg & Gall, 1983).

Conclusions

This study indicates four main steps in the research and development method, consisting of data collection, planning, initial product development, validation, – and revision. The information-gathering stage is a step that can show the problem and the importance of the research being carried out, usually described in the introduction or background section. The planning stage aims to collect information and materials and prepare the plans needed to develop the instrument. Furthermore, establishing the initial product step is a stage that shows the process and results of the initial product development. The last stage is validation and revision. This stage differs from one researcher to another. This difference is possible because of the needs in the research process. The complete stages of validating and revising are validation by experts and field validation. Three experts can carry out expert validation with appropriate fields and field validation can be carried out in the form of a pilot study. If one pilot study is deemed insufficient, a second pilot study can be carried out. Of course, at each validation step, revisions must be made. Thus, with the sustainable instrument development method, ideas and innovations in education can be realized. The current study needs follow-up to the following research, a more in-depth explanation of each of the development research steps mentioned in this paper is needed. Besides that, it is also necessary to discuss in further research, namely: what can be developed with the Sustainable Development Model in Educational Research; How to conduct information gathering and what products can feasibly be developed using the this model; What is the scope of the planning stage in the this model; What are the development processes that need to be reported; and How to do validation and analysis.

References

Aka, K. A. (2019, October). Integration Borg & Gall (1983) and Lee & Owen (2004) models as an alternative model of design-based research of interactive multimedia in elementary school. In *Journal of Physics: Conference Series*, *1318*(1), 012022, IOP Publishing.

Anastasi, A. (1992). What counselors should know about the use and interpretation of psychological tests. *Journal of Counseling & Development*, *70*(5), 610–615.

Arifin, Z. (2017). Kriteria instrumen dalam suatu penelitian. *Jurnal Theorems* [The original research of mathematics], *2*(1), 28–36.

Borg, W. R., & Gall, M., D. (1983). *Educational Research. An Introduction*. Longman Inc.

Branch, R. M. (2009). Instructional design: The ADDIE approach. Springer Science & Business Media.

Carmines, E. G., & Zeller, R. A. (1991). *Reliability and validity assessment*. Sage.

Cullen, J. P., Gregory, J. L., & Noto, L. A. (2010). The teacher attitudes toward inclusion scale (TATIS) Technical Report. *Online Submission*.

Depdiknas. (2008). *Panduan Pengembangan Bahan Ajar* [Development Guide Book of Learning Meterial Development]. Jakatra: Ministry of National Education Directorate General of Primary and Secondary Education Management.

DeVellis, R. F. (2003). *Scale development: Theory and applications* (2nd Ed.). Sage.

Dick, W., Carey, L. M., & Carey, J. O. (2001). *The Systematic Design of Instruction* (6th Ed.). Pearson.

Ediyanto. (2020). *The development of an instrument to measure Indonesian teachers' attitudes toward inclusive education*. Hiroshima University, Japan. https://ir.lib.hiroshima-u.ac.jp/00049557

Field, A. (2013). *Discovering statistics using IBM SPSS Statistics* (4th Ed.). London: Sage.

Fink, A. (1995). *How to measure survey reliability and validity*, 7. Sage.

Forlin, C., Earle, C., Loreman, T., & Sharma, U. (2011). The sentiments, attitudes, and concerns about inclusive education revised (SACIE-R) scale for measuring pre-service teachers' perceptions about inclusion. *Exceptionality Education International*, *21*(3), 50–65.

Gregory, J. L., & Noto, L. A. (2012). Technical manual for attitudes towards teaching all students (ATTAS-mm) instrument. *Online Submission*.

Gronlund, S. D., Carlson, C. A., Dailey, S. B., & Goodsell, C. A. (2009). Robustness of the sequential lineup advantage. *Journal of Experimental Psychology: Applied*, *15*(2), 140–152.

Mahat, M. (2008). The development of a psychometrically-sound instrument to measure teachers' multidimensional attitudes toward inclusive education. *International Journal of Special Education*, *23*(1), 82–92.

Monsen, J. J., Ewing, D. L., & Boyle, J. (2015). Psychometric properties of the revised teachers' attitude toward inclusion scale. *International Journal of School & Educational Psychology*, *3*(1), 64–71.

Munawaroh, I. (2015). Urgensi Penelitian dan Pengembangan. *Studi Ilmiah UKM Penelitian*.

Pipere, A., Reunamo, J., & Jones, M. (2010). Perceptions of research in education for sustainable development: An international perspective. *Discourse and Communication for Sustainable Education*, *1*(2), 5–24.

Richey, R. C., & Klein, J. D. (2005). Developmental research methods: Creating knowledge from instructional design and development practice. *Journal of Computing in Higher Education*, *16*(2), 23–38.

Rounds, J. B., Dawis, R., & Lofquist, L. H. (1987). Measurement of person-environment fit and prediction of satisfaction in the theory of work adjustment. *Journal of Vocational Behavior*, *31*(3), 297–318.

Salīte, I., Fjodorova, I., Iliško, I., Ivanova, O., & Meihami, H. (2020). JTES for sustainable development: An action research environment for the development and sustainable future of the journal identity. *Journal of Teacher Education for Sustainability*, *22*(1), 1–5. https://doi.org/10.2478/jtes-2020-0001

Setyosari, P. (2013). *Ranah Kognitif dalam Pembelajaran* [Cognitive domain in learning]. Unmal.

Sharma, U., & Desai, I. (2002). Measuring concerns about integrated education in India. *Asia & Pacific Journal on Disability*, *5*(1), 2–14.

Stoiber, K. C., Gettinger, M., & Goetz, D. (1998). Exploring factors influencing parents' and early childhood practitioners' beliefs about inclusion. *Early Childhood Research Quarterly*, *13*(1), 107–124.

Van den Akker, J., Branch, R. M., Gustafson, K., Nieveen, N., & Plomp, T. (Eds.). (2012). *Design approaches and tools in education and training*. Springer Science & Business Media.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *26*(2), xiii–xxiii.

Worthington, R. L., & Whittaker, T. A. (2006). Scale development research: A content analysis and recommendations for best practices. *The Counseling Psychologist*, *34*(6), 806–838.

Correspondence concerning this paper should be addressed to Ediyanto Ediyanto, Department of Special Education, Faculty of Education, Universitas Negeri Malang, Malang, Indonesia. Email: ediyanto.fip@um.ac.id