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Characters and values in mathematics teaching and learning: A review of researches in Indonesia

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Abstrak: Artikel ini bertujuan mengulas secara kritis penelitian terkait karakter dan nilai dalam pembelajaran matematika. Data untuk ulasan merupakan artikel hasil penelitian yang ditulis oleh peneliti pendidikan matematika Indonesia dan diterbitkan di jurnal daring yang sudah melalui ulasan sejawat. Artikel dicari melalui basis data ilmiah nasional, DOAJ, dan Google Scholar. Pencarian menghasilkan 40 artikel yang bertujuan membangun karakter dan nilai siswa dalam pembelajaran matematika. Artikel dianalisis secara kualitatif melalui lima langkah yaitu interpretasi teks, penyusunan kode, analisis, diskusi, dan pertimbangan kembali. Ulasan menunjukkan bahwa artikel tersebut memiliki kekurangan dasar teoritis dalam konseptualisasi karakter/nilai, pengembangan karakter/nilai, dan aspek pengukuran. Dua puluh enam artikel yang membahas karakter tidak mendefinisikan istilah tersebut dengan jelas, sedangkan artikel yang lain hanya mengutip beberapa definisi tetapi tidak membuat definisi operasional. Karakter memiliki makna yang bervariasi sehingga membutuhkan definisi operasional untuk mengukur perkembangan pada diri siswa. Dalam mengembangkan karakter dan nilai, beragam strategi digunakan tetapi kebanyakan penulis tidak menjelaskan analisis teoritis and rasionalisasi kenapa strategi tersebut dapat digunakan dan berkaitan dengan konseptualisasi karakter/nilai. Semua artikel tidak memberikan penjelasan apakah instrumen yang dikembangkan sesuai dengan karakteristik perkembangan karakter atau nilai dan memenuhi kriteria psikometri. Dalam hal ini, penelitian terkait karakter/nilai tersebut belum fokus dan berskala kecil. Dalam artikel ini, beberapa teori yang relevan dan hasil penelitian sebelumnya dijelaskan secara mendalam untuk memberikan arah penelitian topik tersebut. Penelitian lebih lanjut yang berkaitan dengan program pendidikan karakter di Indonesia juga dibahas.

Kata kunci: *Analisis, Karakter, Nilai, Pembelajaran Matematika*

Abstract: This article aims to critically review researches on characters and values in mathematics teaching and learning. Data for the review was the research articles authored by Indonesian mathematics education researchers and published in the online peer-review journals. The articles were searched in national scientific databases, DOAJ, and Google Scholar. The searches resulted in forty articles which aim to develop students' character and values through mathematics lesson. Five steps, i.e., text interpretation, coding, analysis, discussion, and reconsideration, are employed to analyze the articles qualitatively. The review reveals the articles lack of theoretical basis in the conceptualization of character/values, the development of character/values, and their measurement. Twenty-six articles on character did not define the notion clearly; meanwhile, the other articles only cite some definitions, but no operational definition was made. Character is a multifaceted construct which requires an operational definition to measure its development. In developing character and values, various strategies were utilized, but the most authors have not addressed theoretical analysis and rationale on their feasibility and relations the conceptualization of the notions. All articles did not provide any explanation on whether the instruments used were developed with respect to the nature of character or values development and fulfill psychometric properties. In this case, we argue that the researches were unfocused and not extensive. In this article, related theories and prior works

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are thoroughly discussed to shed light on the researching topics. Further research which relates to character education program in Indonesia is also elaborated.

Keywords: *Review, Character, Values, Mathematic teaching*

A. Introduction

Character education (CE), which relates to other names such as values education or moral education (Halstead & Taylor, 2000a; Berkowitz, 2011), is one of the most attractive educational topics worldwide. Educational policy in some countries (e.g., Ontario Ministry of Education, 2008; GoI, 2010) has included CE as a national education program. In Indonesia, CE has received massive attention from educators, researchers, teachers, and even parents since the implementation of curriculum 2013 (K13) in which the students' attitude becomes one of the three basic competences the teachers strive in the classroom (MEC, 2016). Besides school and community level, CE should also be implemented in the classrooms, for example, inculcating characters in mathematics teaching (MEC, 2017a). CE through classroom practices arises one interesting question, how students' character can be developed through school subjects, e.g., mathematics?

Inculcating characters and embedding (religious) values through instructional practices have attracted the interest of Indonesian researchers in the field of mathematics education. The latter has a similar objective to CE, namely developing students' positive attitude, which refers to (religious) values. Some researches (Fauziyah & Jailani, 2014; Ellan, Hobri, & Nurcholif, 2013; Syafitri, Dafik, & Hobri, 2014) developed the character-based instructional design, and the findings showed that the designs are effective in the learning process. The other researches (e.g., Pasani & Pramita, 2014; Salafudin, 2013) developed character-based mathematical learning models and concluded that the learning models are capable of improving students' character and learning achievement. Hasratuddin (2013) and others (e.g., Fadillah, 2013) theoretically analyzed the inculcation of character through mathematics learning. Pertiwi and Marsigit (2017) focused on how to implement character education and identify the barriers and supporting factors in mathematics learning. Kurniati (2015) theoretically formulated mathematics learning embedding with (Islamic) values. Meanwhile, Salafudin (2015) developed a model of mathematics learning which integrate and inculcate (Islamic) values.

In a wider scope, studies which do not link mathematics education with common focus (cognitive and affective) such as moral education (Falkenberg, 2006), values (Bishop, Seah, & Chin, 2003), social justices (Gutstein, 2006), broader educational purposes (Heymann, 2003) and citizenship education (Skovsmose, 1998) received less attention and rarely found in the literature (Falkenberg & Noyes, 2010). We searched related keywords (character, morals, values, mathematics education) in International reputable mathematics education journals published by Springer (e.g., ZDM, Educational Studies in Mathematics), JSTOR (e.g., Journal for Research in Mathematics Education), and Elsevier (e.g., The Journal of Mathematical Behaviour). We have not found any articles which directly relate character with mathematics education. We think some points: the different philosophical perspective of mathematics and mathematics education (Falkenberg & Noyes, 2007), the methodology of research (Clarkson, Bishop, Fitzsimons, & Seah, 2000), multifaceted interpretation and its complexities (Nucci, 2017; McGrath, 2017), and the measurement issue (Card, 2017) can be the reasons why character education or other uncommon topics do not achieve more attention from mathematics educators. In this case, researching cognitive (e.g., problem-solving, HOTs) and some affective topics (e.g., beliefs, motivation, attitude) in mathematics education is still a priority.

A growing interest of research on character and integrating (religious) values in mathematics teaching in Indonesia is in contrast to the minor attention paid by mathematics

educators worldwide on the topics. The findings on related researches (Fauziyah & Jailani, 2014; Pasani & Pramita, 2014; Kurniati, 2016) have also shown that students' character can be developed through mathematics teaching. Some earlier papers have also noted the opportunity to develop students' positive characters and personalities (Swadener & Soedjadi, 1988; Lim, 2012). This fact as the departure point, we argue that it is important to critically review the findings of researches which develop characters and integrate (religious) values in mathematics teaching in Indonesia. This review will shed light on how the notion character or values as other notions (moral, social justices, and citizenship education) in a different educational context is attached in mathematics classrooms. It will be examined through related theories from which the notions like character and values originate and conceptualized (e.g., Bloom's affective domain, Nucci, 2017; Seah, 2016). As far as our concern, this is the first review on the character-related researches in mathematics education. The review provides a thorough analysis of how the related researches conceptualize, implement and measure the development of students' characters or values in mathematics teaching.

B. Methods

The sources of data for this review are the articles authored by Indonesian mathematics education researchers written in English or Bahasa and published in the online scientific journals. Thus, we excluded articles from conference proceedings, books, and chapter. We used journals since the published articles have gone through peer-review (open, blind, or double-blind). However, excluding other sources such as conference proceeding provides the limitation in this review pertaining to the number of articles and the variety of content. To make sure about the peer-review, we read each journal publication policy. The articles published in the journals which do not specify peer-review policy were not included. The articles reported on empirical or field researches and theoretical or literature review on inculcating characters and values in mathematics teaching and learning. We do not set any criteria for publication time of the articles and the journal, e.g., the quality of the journals, publishers, place published or indexing sites. It aims to trace the publication trend and cover all the published articles on the theme.

We searched the articles on national scientific databases (Science and Technology Index, Indonesia One Search, Moraref, Garba Rujukan Digital), DOAJ, and Google Scholar. The national databases indexed all online scientific journals in Indonesia, including mathematics education journals. DOAJ and Google Scholar were used to complement the searches and trawl articles published in foreign journals (open access or subscription-based journals). We did not use popular and leading databases such as Scopus and Web of Science since we did not have access to those databases. In case of related articles published in the journals indexed by the databases, they were highly possibly found in the Google Scholar. The keywords for the search were both in English and Bahasa in the form of phrases, i.e., *character-based mathematics learning*, *character education in mathematics learning*, *character education and mathematics*, *mathematics learning integrated with Islamic values*, and *values in mathematics learning/education*. The keywords were chosen purposively conforming to the emerging interest of mathematics education research in Indonesia.

We drew from the work of Hart, Smith, Swars, and Smith (2009) for qualitative data analysis of the articles, i.e., text interpretation, coding, analysis, discussion, and reconsideration. In the first step, we thoroughly read the metadata (titles, abstracts, and keywords) of the searched articles which provided information on the type of research and the notions used in the research. In this step, we only included articles which aim to inculcate specific character or values in mathematics teaching. In the second step, we coded the metadata as: literature review (LR) and empirical research (ER) for the type of research; and characters in mathematics teaching and learning (CMT) and values in mathematics teaching and learning (VMT) for the notions. In this case, we grouped the articles into LR/ER with CMT and VMT topics. We define the literature review in this research as an analysis of existing literature or prior findings pertaining to the

topics of character or values in mathematics education. Field or empirical research is the research which collects and analyzes primary data from the field, for example, in the classroom. In this case, we had, for example, theoretical analysis-character article or empirical research-values article. The inclusion of theoretical or library research aims to capture the authors' ideas or even proposed the framework as the result of analysis on literature or prior findings to define, implement, and measure the notions. We think it is likely to happen the theoretical articles give insight to the empirical research.

In the third step, we respectively analyzed the grouped articles to uncover four main points: the objective of the researches, the definition or conceptualization of the character/values, the teaching of character/values, and the measurement of the notions. These questions led us in the analysis: *How is the notion of character or values defined and drawn from prior research or existing literature? How character or values embedded in mathematics teaching? How character or values is measured?* The answers of three questions were analyzed through the lens of relevant theories from which the notions are conceptualized. For example, character or characterization in Bloom's affective domain is the result of internalizing values and built up from four preceding steps. Thus, measuring the development of students' character should not disregard the hierarchy. In the last two steps, the answers to three questions from each author were discussed thoroughly. The discussion aimed to compare the results of the authors' analysis, which lead to the final answers of the questions. The answers were then reconsidered by looking back to the possible gaps of each author's analysis. The inferences were made from the discussion and reconsideration.

We noted some limitations in this review regarding the source of data, the search of articles, and analysis of the articles. Not all popular indexing sites or scientific databases are used, such as Researchgate or Academia.edu. The sites did not include all journals in Indonesia. There might be articles which personally uploaded by the Indonesian authors but not found in the used sources. Although we used national scientific databases, DOAJ and google scholar, a missing search is likely to exist. For example, some related articles at the time of searching might not be submitted to DOAJ or national indexing sites and not appeared in the googles scholar list either. The analysis of the articles depends solely on the capability and experiences of the authors on research. The factors will possibly affect the analysis. A similar further review could have external experts to be involved in the discussion and reconsideration to examine the authors' analysis independently.

C. Findings and Discussion

The searches resulted in 40 articles from the selected databases. The articles were published in various mathematical educational journals in Indonesia, e.g., Journal on Mathematics Education, Infinity, Jurnal Riset Pendidikan Matematika, Al-Jabar: Jurnal Pendidikan Matematika, UNNES Journal of Mathematics Education. However, we have not found any articles published in journals outside of Indonesia. Of the 40 articles, 9 articles (22,5%) are literature review (LR) and 31 articles (77,5%) are empirical research (ER). Two emergent topics from the articles are mathematics learning to develop or improve characters (34 articles or 85%) and integrating (Islamic) values in mathematics learning (6 articles or 15%). Table 1 summarizes the articles in the category of research types and topics.

Table 1. The number and percentage of articles based on the type and topic of research

Types of research	Research topics	Number of articles	Percentage
LR	CMT	6	15%
	VMT	3	7,5%
ER	CMT	28	70%
	VMT	3	7,5%

Table 2 highlights the content of the grouped articles which reveal research objectives, theoretical frameworks, methods, and results of the research. The theoretical framework column points out how the authors define the character/values, develop character/values, and measure character/values drawn from prior researches or existing literature. The method seeks to reveal the research methods used and the underlying theories. Research objective and the result are used to evaluate its consistency. Overall, table 2 aims to show the construction of all articles, especially the theoretical framework used by the authors as the departing point.

Table 2 (third column) shows that more than half of the articles (26 articles) did not have a clear definition of the notion character within mathematics learning. Five articles refer to Lickona (1991) who theorized character education in schools. For example, Musfiqi and Jailani (2014) mentioned three components which establish character in their research, i.e., moral knowing, moral feeling, and moral action. Palinussa (2013) referred to a definition of character as the continuous development of human being as a virtuous man. Dwi, Dafik, and Susanto (2012) alluded to character as a set of attitudes, behaviors, motivations, and skills. In all articles, the examples of character were provided, e.g., respect and responsibility (Musfiqi & Jailani, 2014); religious, responsibility, honesty, tolerance, peace and other fifteen characters (Kurniati, 2013); discipline (Wahyuni, Isnarto, & Wuryanto, 2015).

In four articles of (Islamic) values, the notion had not been defined. The articles only gave examples of values, e.g., self-confidence, creativity, and self-supporting (Yuniati, 2018), which are taught within mathematics lesson. The other two articles (Salafudin, 2015; Nihayati, 2017) categorized (Islamic) values into three; faith, sharia, and moral value. However, only Nihayati (2017) referred to the definition of values as the principles which determine someone's choice of actions.

Most of the articles did not explain the underlying theories employed in inculcating character in mathematics learning. Thus, the question of how is the character inculcated has not answered yet. Three articles draw from Lickona (1991), Kemdiknas (2011), Treffers, De Moor, and Feijs (1989), and Dimermen (2009). For example, Musfiqi and Jailani (2014) used cooperative learning, as Lickona (1991) proposed and student's worksheet in order the students had direct experience, as Dimermen (2009) suggested. The other articles utilized various methods of developing character, but the authors have not addressed theoretical analysis in proposing the feasibility of the methods. Dwi et al. (2012) attached motto in student's worksheet to inculcate character meanwhile Masduki et al. (2014) put a text-related character in the hint part of the student's worksheet. The other methods are to inculcate character through mathematics learning activities, verbal advice and motivation by the teacher, and a role model by the teacher such as dressing style and discipline (Mertiana, Kusmayadi, & Riyadi, 2014).

In integrating (Islamic) values, six articles used various ways, i.e., linking the Qur'anic verses with mathematics topics (Nihayati, 2017), exploring the nature of mathematics content which has (Islamic) values (Kurniati, 2015), modifying a learning model to include (Islamic) values (Yusnita et al., 2016), and embedding (Islamic values) in mathematics learning tools such as students' worksheet (Yuniati, 2018). However, only one article refers to principles of science Islamization as its theoretical basis (Maarif, 2015).

Almost all articles have not explained the theoretical basis of measuring character. The articles applied single method (questionnaire/observation) and combination of an interview with the questionnaire, interview, or observation. For example, Musfiqi and Jailani (2014) developed a questionnaire which draws from Lickona's (1991) ideas of moral knowing, moral feeling, and moral action. For measuring (Islamic) values, all of the articles did not refer to any theories. The articles employed several methods to measure character, i.e., interview (Hendikawati, Sunarmi, & Mubarok, 2016), observation and interview (Wahyuni et al., 2015), questionnaire and

interview (Masduki et al., 2014). The measurement of (Islamic) values has not had any explanations (Salafudin, 2015; Yuniati, 2018).

We have portrayed the findings which concern the definition of character or values, the integration of character or values in mathematics teaching, and the measurement of the notions. In this part, we will discuss the three points to shed light on the findings and future research regarding the topics. In the discussion, we try attaching relevant theories or prior works such as Bloom taxonomy (Krathwohl, Bloom, & Masia, 1964) which regard the notion of characterization, character education (e.g., Card, 2017; NASEM, 2017; Nucci, 2017; Lickona, 1999), values education (Halstead & Taylor, 2000a; 2000b), values in mathematics teaching (Bishop et al., 2003; Chan & Wong, 2019), and affects in mathematics education (McLeod, 1992; Hannula, 2011).

Defining the character/values

Two questions are essential to be asked, i.e., what is character/values? Are values and character two different notions? Does the notion exist in mathematics education research? The first is a fundamental question to be answered before researching the notion. The second question will be discussed in the closing part of this session. Meanwhile, the latter helps to trace the prior works on the topics from which we could refer.

The answer to the first question is rather complex since it is a multifaceted notion and does not has a shared definition amongst social scientists and educators (Nucci, 2017; NASEM, 2017). It is getting more complex when no definitions provided in the twenty-seven (27) articles which researched the notion. Card (2017) argued that clarity in the operational definition of character is one of the critical aspects to measure the notion. Referring to a general definition of character is also problematic when some authors (Dwi, et al., 2012; Musfiqi & Jailani, 2014) did not contextualize it in their researches. In this case, a contextualized definition is required since many views from experts (Kohlberg & Mayer, 1972; Lickona, 1999; Nucci, 2017) about the character. We mean contextualized definition as an operational definition from which the authors are drawn from the related theories and used for clarifying the position of the research. The absence of conceptualization of character in the articles perhaps reflects an assumption that it is common or well-known construct, so the readers will take it granted through the given examples. In the following paragraph, we summarize the contrasting views of the character, which is necessary to be clarified and contextualized in the research.

Good character is made up of virtues we possess. Virtues are objectively good human qualities like wisdom, honesty, kindness, and self-discipline. They do not change since virtues are intrinsically good. It transcends time and culture, although their expression may vary culturally (Lickona, 1999). Character encompasses the cognitive, emotional, and behavioral aspects of the moral life. Therefore, the goal of character education in schools is to help students know the good, value it, and act upon it (Lickona, 1996). Character as the virtues is called as the traditional view (Nucci, 2017). Kohlberg and Mayer (1972) criticized this view and termed it as a bag of virtues. The attempt to define the character as the virtues ran against the fact that people were inconsistent in their applications of virtues (Hartshorne & May, 1928; Kohlberg & Turiel, 1971). Nucci (2017) asserted that character is a dynamic system which comprises four components, namely moral cognition, emotional development or moral mental health, performance, and moral (critical) social engagement. Nucci's view about character refer to Berkowitz (2012, p. 248) as "*the composite of those characteristics of the individual that directly motivate and enable him or her to act as a moral agent*" and is on the basis of two ideas, i.e., moral agency and interaction between individuals and contexts. From the theories and the exam-

Table 2. A highlight of the searched articles' content

Topics	The objectives	Theoretical frameworks	Methods	Research results	Total	%
CMT	Develop character-based mathematics learning models	- Twenty-six (26) articles did not define character clearly. The examples of character are provided. The other eight (8) articles cited various definitions. Mostly cited work (5 articles) is Lickona (1991). However, no authors formulate the operational definition of a character drawn from cited literature - Thirty-one (31) articles did not refer to any theories in developing character. The remaining refers to Lickona (1991); Kemdiknas (2011), Treffers, De Moor, and Feijs (1989); dan Dimermen (2009) - Thirty-three (33) articles did not have the theoretical framework in measuring character. One article cites Lickona (1991)	- Development research (R & D), qualitative, experimental, mixed-method - Seventeen (17) articles did not have clear-cut strategies in developing character. The others did it through learning activity (discussion, working in groups), an analogy of mathematics topics, the motto on worksheets, role model and verbal motivation from the teachers - The measurement of character was done through observation (10 articles), observation and interview (3 articles), questionnaire (1 articles), questionnaire and interview (1 article), questionnaire and observation (1 article), and 12 articles did not explain the aspect of measurement (theoretical review and development research articles)	The learning model developed is able to improve the character of students	14	35
	Develop character-based mathematics learning tools			The learning tools developed increase or emerge character	14	35
	Study the development of character through mathematics learning theoretically			Produce ideas or theories to inculcate characters through learning mathematics	6	15
VMT	Develop mathematical learning model/tools that integrates and inculcate Islamic values	- Four (4) articles did not clearly define (Islamic) values. The samples of values are given. - Five (5) articles did not have a theoretical basis to integrate (Islamic) values in mathematics learning. 1 article referred to Muslim scholar (Ismail al Faruqi) who propose science Islamization - All articles which aim to inculcate (Islamic) values did not have the theoretical framework in measuring the values	- Quantitative, research and development (R & D), and literature review - One article integrated (Islamic) values by linking the Qur'anic verses to mathematics topics, 1 article inserted verses/hadith in learning and Islamic context of mathematics problems, 1 articles integrated (Islamic) values through Islamic story and role model, 2 articles linked the similarity between Islamic values and mathematical principles, and 1 article did not explain the integration.	The developed mathematics learning model/tools involves Islamic values and was able to develop students' character	2	5
	Develop mathematical learning model/tools which integrate Islamic values			Mathematics learning model/tools include Islamic values and are effective to be applied in the learning	1	2,5
	Study the integration of Islamic values in mathematics learning theoretically			Produce ideas or theories on how to integrate Islamic values in mathematics learning	3	7,5

ples of character used in the research, the searched (34) articles seem to regard character as the virtues in mathematics teaching.

Value is one of the research topics in mathematics education (Bishop, 1999; Chin, 2002; Dede, 2006; Seah & Wong, 2012a). Seah and Wong (2012a) categorize it as the third approach aside to cognitive and affect, which is called volitional approach or best reflect the socio-cultural aspect of mathematics education (Bishop, 1988). Although some researchers (Bishop et al., 2003; Hannula, 2011; 2012; Seah & Wong, 2012b; Seah, 2019) have different views about the notion and a critique to the understanding of values (Cai & Garber, 2012) but values has a 'clearer' position than character in general (Raths, Harmin, & Simon, 1987; Halstead & Taylor, 2000a) and within mathematics education in specific (Chin & Lin, 2000; Bishop, et al., 2003). The four (4) articles which integrated (Islamic) values in mathematics teaching just provided examples of values, e.g., self-confidence, without contextualizing the notion. The intended values provided could be the virtues (character) or the general education values (Bishop, 2007). The values could also be viewed as personal constructs and sociocultural constructs (Bishop, 2014). The articles on values could be also be viewed from one of the three categories of values by Seah (2016), namely *values through* mathematics education. It relates to the roles of mathematics teachers which teach not only subject content but also as moral educators (Warnick & Stemhagen, 2007; Ernest, 2019). In this perspective, mathematics teachers inculcate the values through mathematics education (Seah, 2016).

Over three decades, the researches of values in mathematics education have undergone different focus (Seah, 2019). Three categories of values proposed by Seah (2016) depict the foci. In the 1990s, the foci were *values of* mathematics education (Bishop, 1996). Following this, in the 2000s, some researchers identified values which were espoused by the mathematics textbooks (Seah & Bishop, 2000; Dede, 2006) and extended to *values through* mathematics education (Clarkson, et al., 2000) and *values for* mathematics education (Chin, 2002; Leu, 2005). In the 2010s, the focus was much devoted to *values for* mathematics education (Lim & Kor, 2012; Seah & Wong, 2012b; Chan & Wong, 2014) and some concern on *values through* mathematics education (Clarkson, Bishop & Seah, 2010; Seah, 2019). The six (6) articles lead to the *values through* mathematics education, which attempts to inculcate students' values such as persistence in mathematics teaching and learning.

Unlike values, the notion character is well-known in the context of character education and has not found in the domain of mathematics education research. It has been coming into mathematics education research in Indonesia since the emergent of character education as the main feature of K13. In this circumstance, we lack foundational works of the notion for mathematics education. In mathematics education research, two domains have been widely studied, i.e., cognitive and affect (McLeod, 1992; Hannula, 2011). Which domain does character include? The answer to this question requires further analysis and is not the focus of this article.

The notion of character and values might be linked to the stages of the affective domain in Bloom taxonomy (Krathwohl et al., 1964). The taxonomy is used to assess learning goals in the affective domain, which in hierarchy consist of receiving/attending, responding, valuing, organizing, and characterizing. Bishop (2014) explicated the difference and relationship between *values* and *valuing* in the educational viewpoint. *Values* represent what to be valued; meanwhile *valuing* is a behavior which has no specification what to be valued. The *values* are the result of the *valuing* process, which fulfills seven criteria proposed by Raths et al. (1987). For example, if a student *values* mathematics learning as a calculation, then it will be her/his main concern in

learning mathematics. Characterizing is an ability to internalize values (Hoque, 2016). The values are becoming the controller of behavior. For example, if a student characterizes mathematics learning as problem-solving, then she/she will consistently involve in solving mathematics problems and ignore other forms of activities such as remembering mathematics formulas. Considering the taxonomy which places valuing and characterizing in the hierarchical level, the development of character should begin with the establishment of values. It might be the reason for Lim (2012) to explain that in mathematics teaching and learning, a character could be molded by inculcating values in students.

We think the question of whether values and character two different notions are necessary to be taken into account. We sometimes talk the same word with a different meaning or different words with the same meaning. To answer the question, we will begin by presenting a lexical definition, listing the examples of characters or values, and connecting to the related theories. Oxford dictionary[2] defines values (noun) as the principles or standards of behavior; one's judgment of what is important in life. Meanwhile, character (noun) is the mental and moral qualities distinctive to an individual. In Merriam-webster[3], values (noun) is something (such as a principle or quality) intrinsically valuable or desirable. Character (noun) is the complex of mental and ethical traits marking and often individualizing a person, group, or nation; moral excellence and firmness. Referring to the lexical definition, Bloom taxonomy of affective, and conceptualization of the notions (Berkowitz, 2012; Nucci, 2017; Halstead & Taylor, 2000b), we argue that the notions are not the same construct. However, we do not have a consensus of values or characters to develop. Furthermore, we have overlapping examples of values or character, as shown in Table 3 (italics words).

Table 3. A list of examples of values and character

Sources/theories	Examples of values
Values in mathematics education (Bishop et al)	**General education values[4]:** *honesty*, fairness, equity, diversity, *empathy*, *respect* **Mathematics values:** objectivism-rationalism, control-progress. **Mathematics education values**; clarity, flexibility, consistency, open-mindedness, persistence, accuracy, efficient working, systematic working, *enjoyment*, effective organization, *creativity*, conjecturing (Clarkson, et al., 2000)
Terminal and instrumental values (Rokeach, 1973)	**Eighteen terminal values:** e.g., true *friendship*, mature love, self-respect, *happiness*, equality, etc. **Eighteen instrumental values:** e.g., *honesty*, politeness, *self-control*, *responsibility*, *obedience*, *independence*, *forgiveness*, etc.
	Examples of character
Character education (Lickona, 1999)	**Cardinal virtues:** prudence, justice, fortitude, temperance **Developmental scheme of virtues** (Isaacs, 1976): up to 7 years (*obedience*, sincerity, orderliness), 8-12 years (fortitude, perseverence, justice, responsibility, etc), 13-15 years (*respect, self-control, friendship*, etc.), 16-18 years (confidence, humility, prudence, etc) **The heart of virtue** (DeMarco, 1996): e.g., *care*, chastity, temperance, wisdom, etc.

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[2] https://www.lexico.com/en/definition
[3] https://www.merriam-webster.com/dictionary
[4] It relates to civic, ethics and moral values.

Card (2018; 2019)	**Demoractic virtues:** *respect*, tolerance, dialogue
Nucci[5] (2017)	*Forgiveness*, humility, gratitude
	Sir John Templeton virtues: *creativity*, curiosity, diligence, entrepreneurialism, *forgiveness*, future-mindedness, generosity, *honesty*, humility, *joy*, love, purpose, reliability, thrift
	From other researchers: gratitude, hope, grit, compassionate love, *empathy*, mindfulness, awe, purpose, *happiness*.
MEC[6] (2017a)	**Religious:** peace, tolerance, respect the diversity, firmness, confidence, inter-religious cooperation, anti-bullying and non-violence, friendship, sincerity, do not force the will, love the environment, protecting the minority
	Nationalism: appreciation of the nation's own culture, maintain the nation's cultural richness, willing to sacrifice, superior, achievement, patriotism, protect the environment, law obedience, discipline, respect for cultural, ethnic and religious diversity
	Self-supporting: hard work, firmness, professional, creative, courage, long-live learners
	Mutual cooperation (*gotong royong*): respect, working together, inclusive, commitment on the consensus, discussion, helpful, solidarity, empathy, non-discriminative, anti-violence, and valuntary
	Integrity: honesty, love for truth, loyal, moral commitment, anti-corruption, justice, responsibility, role model, and respect

Character/values in mathematics classroom

Besides a well-defined of the notion character or values, further significant point concerns the position of character or values in mathematics teaching and learning. We could loosely ask *what are we going to do with the character or values in mathematics teaching and learning?* In the spirit of character education, teaching and learning in the classroom could be a mean of implementing character. Thus, teaching mathematics is one of the mediums in developing students' character (MEC, 2017a). All the empirical research articles (28) aimed to develop students' character through mathematics teachings through the use of particular learning model and tools.

Six articles attempted to integrate and inculcate (Islamic) values in mathematics teaching. There are three reasons which drive the integration of (Islamic) values in mathematics teachings, i.e., tune out the dichotomy of Islam and science (Nihayati, 2017), support students' mathematics achievement, and develop students' (Islamic) values (Salafudin, 2015). Yusnita et al. (2016) found that the students' representation ability is getting increased after involving in (Islamic) values-based mathematics learning. However, they could not present a decent discussion of the findings. The question, whether the increase of students' representation ability solely affected by the integration of such values or other factors has no answers. The articles would have been better if they had discussed these questions: *(1) Why is it important to bring in (Islamic) values in mathematics classrooms? (2) How it differs from a common mathematics classroom? (3) How is its significance for the effectivity of mathematics lessons? (4) What aspect of effectivity the does it support?*

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[5] Nucci (2017) listed several virtues from various researchers and authors

[6] The main five character are made up of sub-values respectively which are similar to other values

Bishop (2014) proposed two key questions in his review of values in mathematics education and called it a challenging issue, i.e., *can desirable values developed in students through mathematics education? How should values be developed?* The same questions could be extended to the character. For example, *openness* is one of the (west) mathematics values (Bishop, 2007), and *honesty* is the virtue (Lickona, 1999). How are *openness* and *honesty* developed through mathematics teaching and learning? The answer to this question could not be found in thirty-one (31) empirical research articles.

Pasani and Paramita (2014) implemented cooperative learning with a think pair share (TPS) format to improves students' character (self-support). The answer to how TPS can develop students' self-support in the research does not exist. Musfiqi and Jailani (2014) aimed to develop students' respect and responsibility through students' worksheet, which bases on problem-based learning (PBL). They argued that PBL enables the students to work in small groups as cooperative did and to share responsibility in learning. For this circumstance, PBL could develop students' intended character. The question which has no elaboration in the article is that to what extent the students work with PBL worksheet develop respect and responsibility. Hasratuddin (2013) theoretically explained the ways to inculcate critical thinking through three principles; constructive, interactive, and reflective (Treffers et al., 1989). He asserted that learning interaction would create *a taste for learning with a heart* and thus develop positive character. A missing detail in the article is how the interaction support the students to be critical? Overall, the authors have not elaborated how the strategies are in line with the nature of students' character development. Two articles (Salafudin, 2015; Yuniati, 2018) on (Islamic) values also have quite similar cases. Salafudin (2015) explicated eight strategies to inculcate (Islamic) values in mathematics teaching, e.g., visual illustration.

The definition of character proposed by Lickona (1999) and Nucci (2017) delineates the natures of character development. Character is made up of three dimensions termed as moral knowing (knowing the good), moral feeling (desiring the good), and moral action (doing the good). Each dimension has psychological components. The cognitive includes six components: moral alertness, understanding the virtues, perspective-taking, moral reasoning, thoughtful decision-making, and moral self-knowledge. The emotional aspect comprises conscience, self-respect, empathy, loving the good, and humility. The last aspect consists of moral competence, moral will, and moral habit (Lickona, 1999). From Nucci's perspective, which proposes four building blocks of character, i.e., moral cognition, emotional development, performance, and moral (critical) social engagement. In this case, the approach to trace the development of character should comprehensively acknowledge the building blocks. We argue that the strategies to develop character should be thoroughly analyzed and implemented to adjust the classroom context of mathematics teaching and cover all components of character. Lim (2012) proposed mathematical activities in group or individual to mold students' character via inculcating values. For instance, the teachers could inculcated respect through mathematics activities on set topics. However, there is no further elaboration on how to link the inculcation of values to the development of students' character.

Frameworks have been proposed to attain effective practice of character education in the schools, e.g., eleven principles (11P, Lickona, 1996), SAFE criteria (CASEL, 2005), and PRIMED (Berkowitz, Bier, & McCauley, 2017). However, the frameworks are school-based implementation, not classroom-oriented. A part of 11P, Lickona (1999) also proposed nine strategies for teachers to develop character in the classroom. The frameworks should have to be

referred, adopted, or synthesized by the authors of the reviewed articles for its use in mathematics teaching. In values education, the different ways of effectively teaching values have been reviewed, e.g., direct instruction, the use of stories, discussion, the establishment of just communities, circle time and narrative approach (Halstead & Taylor, 2000a; Halstead & Taylor, 2000b).

Raths et al., (1987) eludicated seven criteria for value, i.e., choosing freely, choosing from alternatives, choosing after thoughtful consideration of the consequences of each alternative, prizing and cherishing, affirming, acting upon choices, and repeating. The criteria were also adapted on the researches of values in mathematics education (Chin, Leu, & Lin, 2001). It is clear that to teach and track down the development of values in students, the strategies used by the teachers should embrace the criteria. For example, Lim and Kor (2012) studied teachers' values of effective mathematics lessons. They found that the teachers shared five common characteristics of so-called effective mathematics lessons, which were espoused and enacted in the classroom practices. When a mathematics teacher teaches persistence as one of mathematics education values (Clarkson et al., 2000), the student makes persistence as her/his value if she/he enacts the value repeatedly in mathematics activities.

In mathematics teaching and learning, values are transmitted to and internalized by the students. Teaching the values directly without any context or by weakening the opposing values might not be an effective way (Seah, 2019). One crucial point to be noted in teaching or developing students' values, as Raths et al. (1987) argued that values are a personal attribute. It is not easy to be developed in the social context of a classroom. Lim (2012) also noted that teaching and developing values in mathematics teaching is a difficult endeavor since it takes a long time and enormous efforts from the teachers. We believe that character is also in the same condition. Seah (2019) proposed the-4 step process to develop values in students, i.e., justifying, essaying, declaring, and identifying. He argues that the steps could be easily integrated into the normal mathematics lessons. The results of JEDI approach are worth to be waiting.

Cai and Garber (2012) synthesized two ideas when reviewing articles from the Third Wave project, namely *teaching values* and *valued teaching*. The first refers to the values used in the mathematics classroom with a goal in mind. It is product-oriented, and the mathematics teachers have a specific outcome in mind. *Teaching values* and *values through* mathematics education are the same ideas. The latter is a part of the approaches or teaching strategies. It is the process of teaching mathematics rather than a goal. These ideas are relevant to depict the reviewed articles on character (34) and Islamic values (6). The twenty eight (28) empirical research articles on character mainly aim to develop students' character. For instance, Musfiqi and Jailani (2014) developed responsibility, critical thinking, and teamwork through cooperative learning and students' worksheet. It is included in teaching character since the teachers had three *virtues* as the intended outcome. The six (6) articles which tried integrating and inculcating (Islamic) values in mathematics teaching could be in both *teaching values* and *valued teaching*. For example, Hasanah and Hidayati (2014) utilized the Islamic context in mathematics problems as the process of teaching mathematics.

Measuring character/values

The definition of character or value determines the strategies to support its development in mathematics teaching. It also specifies the means of measurement. The fundamental question is how to measure the notion? For example, a mathematics teacher plans to teach fairness (the

virtues) so that his/her students has the character. How to measure the fairness which inculcated and developed in the students? The thirty-three (33) articles on the character had not explained any theoretical basis in measuring the character. One article referred to Lickona (1991). In the method session, some articles employed observation (10 articles), questionnaire (1 article), observation and interview (3 articles), questionnaire and interview (1 article), and questionnaire and observation (1 article) to measure the intended character. However, a rationale for the methods had not been addressed. Of 6 articles on the integration of (Islamic) values in mathematics teaching, two articles set an objective to not only present the integration but also aim at inculcating the values. The article did not have any explanation of the measurement aspect.

Musfiqi and Jailani (2014) used a questionnaire to measure students' respect and responsibility, which refers to Lickona's (1991) conceptualization of character as moral knowing, moral feeling, and moral action. However, no examples of the questionnaire item which can be matched to three aspects of the character. There is no information on the psychometric properties of the questionnaire. The authors used a simple statistics (percentage) to analyze the character development. The other articles also missed an important aspect of measurement in the research. For example, Wahyuni et al. (2015) conducted participatory observation in five lessons and in-dept interview to measure students' discipline. In the methods, the authors did not specify what they observe and ask in the interview. On the whole, the articles which employ questionnaire, interview, and/or observation did not provide any explanation to convince the readers that their measurement of character development has met standard such as the validity of the instrument or trackability of its process.

There are two critical aspects of measuring character development, namely the clarity in the operational definition of the construct and the selection or the development of measures that correspond to the definition (Card, 2017). As it has been discussed, the character is highly diverse, multifaceted notion, and has fuzzy boundaries of definition (Nucci, 2017; NASEM, 2017; Card, 2017). Once the operational or contextualized definition was set, a careful selection of prior measures or development of a new measure should be made. The measures should include psychometric properties such as reliability, validity, and equivalence. The detailed discussion on the three properties could be read in Card (2017).

Furthermore, Card (2017) pointed out three challenges to assess and establish psychometric properties of the measure. Firstly, the notion has multiple definitions, and even in many cases has extremely vague boundaries of operational definitions. Secondly, character includes the varied populations and contexts in which its development is researched. In this case, the notion should be assessed equivalently across development and context. Thirdly, measuring character development involves naturalistic studies which quantify the character's strengths and behaviors and intervention studies aiming to change the notions. Overall, Card (2017) expounded the quantitative aspect of measuring character without addressing the importance of qualitative or mixed methods approach.

The main aims of six (6) searched articles about (Islamic) values in specific and related researches in Indonesia are twofold, i.e., integrating the (Islamic) values and inculcate the values for the students in mathematics classrooms. The aims relate to what termed as valued teaching and teaching values (Cai & Garber, 2012). In particular, the second aim refers to the category of values through mathematics education (Seah, 2016). As for the character, the question is how to measure the values inculcated and developed in the students? The answer to this question will

depend on the operational definition used in the research. If we refer the definition of values to what proposed by Halstead and Taylor (2000a) and values criteria by Raths et al. (1987), then the measure could be developed accordingly. For example, a teacher plans to develop persistence through mathematics activities. The students could be said they have developed the values if the seven criteria have been fulfilled. The methods to examine the developed values could be purely qualitative such as continual observation or students' diary, quantitative (e.g., questionnaire) as addressed by Card (2017) for the character, or mixed methods. We believe that the mixed methods could provide a convenient way of measuring the construct and a fruitful result.

Prior studies have developed theories of values (moral) development, which guides the instruments to measure the values. Besides value clarification (Raths, Harmin & Simon, 1978; Simon, Howe & Kirschenbaum, 1972) which has many critics (e.g., Harrison, 1976), a very popular theory is moral development stage with its Heinz dilemma (Kohlberg & Hersh, 1977; Ísaksson, 1979). The other developed instruments are Rokeach value survey (Rokeach, 1973), Defining Issue Test (Rest, Narvaez, Thoma & Bebeau, 1999), Moral Judgement Interview (Colby et al., 1987), and Socio-moral Reflection Measure (Gibbs et al., 2013). The theories and instruments are mostly in the domain of psychology, but they could be adopted in the context of mathematics education as Chin et al. (2001) did for value clarification. However, it requires relentless effort to translate the works.

The *values through* mathematics education and its measurement aspect have not achieved much attention. We mean the measurement aspect as the methods used to measure the values which are taught by the teachers and inculcated in students. Methodological issues were addressed only concerning the investigation of values in research (Clarkson et al., 2000; Chin, Leu, & Lin, 2001; Chan & Wong, 2019). For example, Clarkson et al. (2000) utilized classroom observation and interview to reveal what values the mathematics teachers nominated and taught in the classroom. Chin, Leu, and Lin (2000) used values clarification to disclose teachers' pedagogical values in mathematics teaching. Chang and Wong (2019) in their studies employed various methods, from interview to hypothetical situations to discover both students and teachers' values in the mathematics classroom. Lim (2010) used an innovative photo-voice as a basis for a post-lesson interview with students to identify their enacted values in learning mathematics. The aforementioned examples relate to the investigation of *values for* mathematics education, from teachers and students' perspectives.

Cai and Garber (2012) explicated three inter-related issues concerning the teaching of values, i.e., understanding of values, assessment, and individual and collective nature of values. Some possible reasons why the assessment of values remains the issue are: the position of values are not clear relating to affective or cognitive aspect of learning goals (Cai & Garber, 2012), the nature of values which is hidden and not easily unfolded (Chan & Wong, 2019), and values as learning process or leaning purposes.

We think that the hierarchical stages of affective Bloom taxonomy (Krathwohl et al., 1964) could be utilized to measure character or values in mathematics classrooms. In this case, mathematics teachers design a mathematics activity which explicitly involves character or value. For example, the intended character is honest. The teachers could develop an observation sheet used to thoroughly observe the targeting students in the school and work together with parents to observe at home. The instrument used in the classroom observation refers to the five stages of the taxonomy which assess students' attending, responding, valuing, organizing, and characterizing to the character-laden mathematics activities. The instrument for parents aims to

measure the students' character (honesty) in a different context. Besides the observation sheet, other instruments or methods such as questionnaire for the students, interview, teachers' field notes, and students diary will be very supportive of investigating the development of students' character.

Further research and character education in Indonesia

The national policy of Indonesia's government has mandated the agenda to develop the nation's character (GoI, 2010), one of which implemented in the schools through character education. Following this, the attitude has been one of the three basic competences (knowledge and skills) in K13 (MEC, 2016) to be achieved in the learning process. CE has been proposed to be implemented in three areas, i.e., school, community, and classroom (MEC, 2017a). In the classroom, CE is integrated with school subjects such as mathematics. There are five main characters with sub-values (Table 3), which will be developed through CE. The ministry of education and culture had launched a main program of CE, namely *Penguatan Pendidikan Karakter*[7] (PPK, The strengthening of character education). The thirty-four (34) reviewed articles attempted to support the CE program in the mathematics classroom. The other six (6) articles which integrated (Islamic) values and aimed to inculcate students' values are also part of the program. Although the reviewed articles have some critical issues about the theoretical basis, classroom implementation, and measurement, they have initiated the research to bridge the gap between theories in the books (e.g., MEC, 2017a) and the practices. We argue that the more research on the implementation of CE in the classroom, which involves schools subjects in general and mathematics in specific, the more clear the way we proceed to support the program. In this case, the gate for communication and sharing between the mathematics education researchers and the ministry should be wide open. For example, an annual seminary which focusses on discussing and disseminating the results of researches on how the students' character could be inculcated and developed and its measurement in the mathematics classroom is a promising agenda.

MEC has published various documents[8] to sustain PPK program and supported 188.646 schools[9] in 2018 for the workshop, training of trainers, seminary, etc. There are three documents which attract our attention to be shortly highlighted in this article concerning the classroom-basis implementation and its measurement, i.e., *The concept and handbook of the strengthening of character education* (MEC, 2017a), *Practical guides on the implementation of strengthening character education in the classroom* (MEC, 2018), and *The assessment guide on the strengthening of character education* (MEC, 2017b).

The first book nominates six ways of implementing CE in the classroom; (1) curriculum integration, (2) classroom management, (3) teaching and learning methods, (4) thematic learning, (5) literacy activities, and (6) counseling. The book possibly presents a general idea, so it misses the details on the nature of the character and its development to associate with the strategies. Although point (2) and (3) refer to specific classroom implementation which could be employed by school subjects but we think there should have been an explanation on applying character education within school subjects or Bills and Husbands (2005) termed as subject-specific classroom practice, for example, mathematics (Warnick & Stemhagen, 2007; Ernest,

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[7] https://cerdasberkarakter.kemdikbud.go.id
[8] https://cerdasberkarakter.kemdikbud.go.id/?page_id=159
[9] https://cerdasberkarakter.kemdikbud.go.id/?p=1256

2019). The second book presents short explanation and examples as a supplementary to the six ways in the first book. For example, a list of character (curiosity, critical thinking, working together, self-support, honesty, and communicative skills) that will be developed through discovery learning. The book also provides short ideas to assess character development through five ways; (1) develop a measure (instrument) to assess character based on the analysis of competence, (2) do authentic assessment, (3) objectively process the results of assessment, (4) report the results to the parents and teachers in the next grade, and (5) follow up the results. The five ways are not an easy task for the teachers, especially the 1st and 2nd point. We might have doubts about the teachers' ability to develop a measure which complies the psychometry properties (Card, 2017). The reviewed articles also have issues regarding the measurement of character. The third book focusses on the assessment aspect of the CE in the school. However, it does not relate to the assessment in the classroom context.

In three books, we found that the conceptualization of character is not clear since the character (collection of virtues) overlapped with values, as shown in Table 2. The first book explicitly uses the term values, e.g., peace, tolerance, etc. to establish the main character religious. Also, another issue is many virtues which will be the focus of the CE program. It will imply the complexity of the assessment. Overall, CE in the classroom challenges, if it is not a burden, all the teachers especially mathematics teachers to realize a comprehensive objective of education as a moral agent (Warnick & Stemhagen, 2007) and content delivery. In mathematics teachers education program, as far as our concern, the CE has not achieved much attention, for example, in the form of specific credit. For in-service mathematics teachers, the MEC provided short-term program such as training for a limited number of teachers to implement the CE in the classroom. The researches on the character in mathematics education might be staying the journal or other publications, inaccessible by the teachers, and could not inform the teachers' practices. In these circumstances, could the teachers face the challenges to develop students' character in mathematics teachings?

Extensive researches on developing students' character or values in mathematics teaching and learning are direct support for the CE program. The findings of the review on the related articles imply several essential notes for further researches. **Firstly**, character or values could not be treated as *common* or *taken as granted* notions. They are multi-faceted constructs which required to clearly define and refer to the prior researches and theoretical basis. The examples of the notions are somehow overlapped (Table 2). If we research values, three categories of values in mathematics education (Seah, 2016) could be a starting point. If we want to inculcate one specific value such as persistence in mathematics teaching, then we refer to values through mathematics education. **Secondly**, on the basis of operational definition, we proceed to the nature of values or character development, which entails the strategies utilized to inculcate the values or mold the virtues. Designing a mathematics lesson which target mathematics content and values/character is a difficult job. Despite one of the goals achieved, both of the goals could dismiss. **Thirdly**, the most problematic one is the assessment aspect. Measuring the development of the character of values is not only enough with a single questionnaire and interview within two to three months in the school. A comprehensive approach should be employed, e.g., a questionnaire which has fulfilled internal consistency (reliability), validity and equivalence, continual and careful observation from teachers or parents, regular interview, and students' diary. **Fourthly**, multidisciplinary of the research team is required to face the complexity of the research, e.g., mathematics education, psychometry, psychology, and teachers. **Lastly**, a

longitudinal research program is needed to yield fruitful results. The program certainly demands proper funding and support from the government. Current research, which represents the five agenda, is promoting active citizenship in mathematics teaching (Maass, Doorman, Jonker, & Wijers, 2019).

D. Conclusion

This article reviews the empirical and literature studies on developing characters and the integration of (Islamic) values through mathematics teaching and learning. The review is not only descriptive in its nature but also involves critics to the articles. It shows that in researching the notions, all articles have issues regarding the conceptualization of character/values, the development of character/values, and their measurement. For example, 26 articles on character did not present a clear definition of the notion. Some articles cited the definition of characters, such as a set of attitudes, behaviors, motivations, and skills. However, the operational definition for the research is not synthesized. The examples of character or values are provided in the articles, e.g., respect, honesty, etc. Giving the examples without clear definition places the character or values in a taken as granted; meanwhile, the notions have multifaceted (Nucci, 2017), fuzzy boundaries of definition (Card, 2017). The essential issue of all articles is about the measurement aspect. The articles which used a questionnaire to measure the character did not provide any explanation on whether the questionnaire items were developed with respect to the nature of character or values development and have psychometric properties. The findings figure out that the researches were unfocused and in small scale. It is one of the limitations of this review that we could not find extensive research.

Despite the critical review, we try shedding light on related theories and prior works with which further researches on the topics could consider and synthesize. For example, the *values through* mathematics education (Seah, 2016; 2019) and the measurement of character/values (Raths et al., 1987; Kohlberg & Hersh, 1977; Card, 2017). In this case, we do not either present specific answers to three emergent questions about the definition, implementation, and measurement of the notions. Further research should have an evident theoretical basis and robust conceptualization for the character/values, the development of character/values in mathematics teachings, and its measurement. A multidisciplinary team of researchers is necessarily required to have the fruitful results. For instance, the development of the mixed approach in measuring character in mathematics teaching and learning need expertise in psychology, psychometry, and mathematics education.

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