

Towards a learning-oriented assessment to improve students' learning—a critical review of literature

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Abstract Learning-oriented assessment (LOA), a concept coined by Carless, has emerged in Europe, Canada, the USA, and the Asia-Pacific Region as an alternative assessment methodology. LOA evolved from both summative assessment and formative assessment, and its framework comprises three integrated components, assessment for learning, assessment as learning, and assessment of learning. While a few studies have provided information about the connections among assessment for, of, and as learning, the purpose of this review is to summarize what is state of the art of LOA, and we aim to examine the history and the nature as well as the strategy of developing LOA. We conducted a transformed critical review of LOA to address these questions. To be specific, the related studies were searched between January 1971 and December 2016, using specific inclusion criteria to remove irrelevant documents. Results provide the publication types of the selected studies and the reported approaches to LOA, trace the evolution of classroom assessment from summative and formative assessment to LOA in order to clarify the historical foundations of LOA, and indicate its nature from the dimensions of components, functions, conceptual frameworks, and principles, as

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well as to illustrate strategies for using it in the classroom. The findings of a deep analysis of 48 publications were then used to define a holistic framework for LOA and a dynamic framework for its development and also yield important recommendations for practice and future research. Finally, we propose the conclusion.

Keywords Students' learning · Learning-oriented assessment · Assessment for learning · Assessment as learning · Assessment of learning

1 Introduction

In order to meet the learning needs of students and requirements of educational policies, researchers and teachers have made great efforts to reform the assessment approaches. Learning-oriented assessment (LOA) has developed against the backdrop of social change and educational reform emphasizing a learning society (Colantonio 2005) and classroom assessment (Antoniou and James 2014). In 1990, the United Nations Educational, Scientific, and Cultural Organization (UNESCO 1990) published the *World Declaration on Education for All and Framework for Action to Meet Basic Learning Needs*. Since then, countries all over the world have paid special attention to the quality of students' learning and have aimed to improve it through educational measures, especially the application and modification of classroom assessment. For example, in Australia, as a political move in 2008, a National Assessment Program was introduced to create an innovative learning environment in every school (Council of Australian Governments 2008). In America in 2010, the Common Core State Standards was introduced in an attempt to improve the quality of assessment of students' learning (The Council of Chief State School Officers, CCSSO 2010). In China in 2011, the Compulsory Education Curriculum Standards was launched, requiring policy makers, researchers, principals, and teachers to innovate new assessment approaches to promote meaningful learning (Ministry of Education of P. R. China 2011). With these developments, it seems that assessment reform has come of age.

The phenomenon under review is LOA as one emerging approach to assessment to improve students' learning. Numerous studies of the classroom learning assessment have focused on student outcomes, such as academic achievement (e.g., Klute et al. 2017), anxiety reduction (e.g., Bayat et al. 2017), writing improvement (e.g., Abdul Aziz and Yusoff 2016), deep learning (e.g., Bernauer and Fuller 2017), active learning (e.g., Bell and Kozlowski 2008; Blasco-Arcas et al. 2013), and decision making (e.g., Cox and Robinson-Pant 2008). There has also been a focus on different types of courses, including second language learning (e.g., Abdul Aziz and Yusoff 2016), geoscience (e.g., Teasdale et al. 2017), and mathematics (e.g., Duckor et al. 2017), and all levels of education: prekindergarten (e.g., Regalla and Peker 2017), preschool (e.g., Regalla and Peker 2017), primary school (e.g., Cox and Robinson-Pant 2008; Antoniou and James 2014), secondary school (e.g., Schuitema et al. 2012; Duckor et al. 2017), and higher learning institutes (e.g., Singh et al. 2017; Bayat et al. 2017). Different assessment approaches have also received attention, for example, summative assessment (SA) (e.g., Black and Wiliam 1998; Black et al. 2003) and formative assessment (FA) (e.g., Stiggins 2005a; Taras 2005). In the literature, three approaches to formative assessment are visible, i.e., assessment for learning (e.g., Martinez and Lipson 1989; Pat-El et al. 2013), assessment as

learning (e.g., Gibbons and Kankkonen 2011; Earl 2003), and assessment of learning (e.g., MECY 2006; Hume and Coll 2009).

Many studies have examined and developed a variety of assessment approaches. Specifically, some of them presented a detailed description of the values (Black and Wiliam 1998; Black et al. 2003), theories (Clark 2012; Bennett 2010), and goals (Stiggins 2005a; Taras 2005) of FA as well as the relationships between FA and SA (Embretson 2010; Taras 2005), while others emphasized assessment for learning (Martinez and Lipson 1989; Black et al. 2003), assessment as learning (Gibbons and Kankkonen 2011; Earl 2003), assessment of learning (Hume and Coll 2009), and the relationships among these three assessment approaches (MECY 2006; Klenowski 2006; Keppell and Carless 2006; Mok 2010).

Moreover, results from these studies showed that, in Europe, Canada, the USA, and the Asia-Pacific Region, an alternative methodology called LOA has been built on the FA, assessment for learning, and assessment as learning, as well as assessment of learning. Researchers in the Nordic countries investigated user participation in many assessment activities within social, healthcare, and educational sectors to present an evaluation method based on dialog and learning (Krogstrup 1997). The basis for this method was “bottom-up action learning and exploratory evaluation” (Krogstrup 1997, p. 205). In 2006, the term LOA was coined by Carless through a reflective account of a 4-year funded initiative entitled the Learning-Oriented Assessment Project (Klenowski 2006; Keppell and Carless 2006). LOA encompasses both SA and FA, and Carless et al. explored their relationships (2007). SA is used to judge students’ learning achievement, while FA promotes their ongoing learning. FA is learning-oriented, and SA may become learning-oriented when it is designed with learning as well as judging. With the proposal and development of assessment of learning and assessment for learning, researchers have compared and contrasted SA, FA, assessment of learning, and assessment for learning and concluded that SA aligns with the former and FA aligns with the latter (Stiggins 2005b; Volante 2010). And then, to help students take further responsibility for their own learning, some researchers advanced another method of assessment—assessment as learning (Earl 2003). “Assessment as learning is a process of developing and supporting metacognition for students focuses on the role of the student as the critical connector between assessment and learning” (MECY 2006, p. 13). The three main assessment approaches, which are assessment of, assessment for, and assessment as learning, serve different purposes but are all learning-oriented. As Mok (2010) argued, “Each of these three components has different focuses and each addresses a set of different but interrelated questions about students’ learning” (2010, pp. 21–22).

Today, with growing recognition of the value of LOA for teaching and learning, there has been considerable interest in exploring issues and problems relating to it. LOA can locate assessment practices in a new conceptual framework and make them more meaningful. There is a Chinese proverb that “他山之石可以攻玉” (Stones from other hills may serve for polishing our jade), which suggests that teachers can develop and use assessment in more exciting and empowering ways to enhance meaningful learning in their classrooms. Teachers and researchers have the prospective need to understand the history, nature, and methods of LOA, in order to develop, use, and examine it to improve their students’ learning. However, to our knowledge, this paper is the first review to summarize the current status of knowledge about LOA. While a

few studies have provided information about the connections among assessment for, assessment as, and assessment of learning, the results have not been pooled yet. Therefore, we conducted a transformed critical review of LOA to bridge that gap.

Fundamentally, LOA has been based on cultural philosophy in the sense that assessment is an element of Didaktik. In Didaktik, the concept of Bildung is directed by cultural philosophy (Westbury et al. 2000, p. 47). Didaktik is relevant both in research and in the actual training of teachers. The problem of how to mediate theory and practice can be regarded as a core point in the Didaktik paradigm determined by human sciences and cultural philosophy. Additionally, as Huang (2003) pointed out, teachers and researchers attend primarily to learning activities and do not place a comparable focus on learning values in the light of cultural philosophy. So, in a certain sense, there is the rationale or logics of cultural philosophy of Didaktik in LOA and its components.

Therefore, we took the theoretical framework of the cultural philosophy of Didaktik to extract the history, nature, and strategy of LOA and its components from the overwhelming amount of publications (Westbury et al. 2000, pp. 41–54). On one hand, Didaktik refers to a theory that emphasizes the reflective processes of “Bildung,” and assessment should be a central concern in teaching (Vallberg Roth 2014). “Didaktik, on the other hand, seeks to provide a framework for teacher thinking about the most basic how, what, and why questions around their work” (Westbury et al. 2000, p. 33).

In general, Didaktik underlines reflection and the essential why, what, and how questions, which can meet the need of posing questions and selecting method in the phase of research design, respectively. The Didaktik of emphasizing reflection provides a well-supported rationale to pose our general research question (GQ), and the most basic how, what, and why questions provide a framework for three related subquestions (SQs) as follows:

- SQ1. Why has LOA emerged? More specifically, how has LOA evolved from SA and FA through assessment for learning and assessment as learning as well as assessment of learning?
- SQ2. What is LOA? More specifically, what meanings does LOA have?
- SQ3. How can LOA be applied in practice? More specifically, what strategies are there for using LOA in schools and classrooms?

Below, this paper addresses the history, nature, and strategies underpinning the development of LOA. Within the scope of a single article, it is impossible to deal with all aspects of LOA, but the contribution made by this analysis will still be helpful. We begin the following section with a description of the method used to conduct a deep analysis and critical review of 48 selected publications. Then, we present the results in order to address the three SQs in order. In Section 4, we draw on our results to define a holistic framework for LOA and a dynamic framework for its development, followed by some important recommendations for practice and future research. It ends with a conclusion section.

2 Method

Based on the theoretical framework of Cultural Philosophy of Didaktik, the concept of the reflective processes of “Bildung” led us to focus on the literature review in the stage of

method determination, and the structure of the most basic why, what, and how questions guided us to concentrate on the theoretical analysis. Following prior studies (Taylor 2007; Bennett 2011), we adopted the critical review to analyze the identified studies on LOA.

According to Grant and Booth (2009, p. 93), “A critical review aims to demonstrate that the writer has extensively researched the literature and critically evaluated its quality”. It goes beyond the mere description of identified publications and contains a large number of analyses and conceptual innovations. In general, patterns identified in a critical review may “provide a ‘launch pad’ for a new phase of conceptual development and subsequent ‘testing’” (Grant and Booth 2009, p. 93). However, critical reviews are not typically as systematic as other more structured approaches to the literature. In order to overcome the limitations of the critical review, we drew on other types of reviews (i.e., systematic review) to enhance this approach.

Grant and Booth (2009) argued that an effective critical review presents, analyzes, and synthesizes material from diverse sources. Based on this argument, both the description of selected studies and the degree of analysis and conceptual innovation were mapped against a Search, Appraisal, Analysis, and Synthesis (SAAS) framework. Therefore, this transformed critical review contained five stages, as described below.

2.1 Stage I: identification of publications

In line with Carless (2006, 2007, 2015), Mok (2010, 2013), and MECY (2006), we integrated three approaches into LOA—assessment for learning, assessment as learning, and assessment of learning. In order to grasp the development of LOA, we conducted database and backward searches from relevant studies in Spring 2014. Bloom et al. (1971) were one of the first to advocate a shift in assessment from “merely judging or grading a student’s success” to “promoting learning.” Thus, we limited the search and analysis to include publications starting from 1971 and up to 2013.

The search was undertaken using the following online databases: Elsevier ScienceDirect, Springer Online Journals, ProQuest Research Library, and EBSCOhost. Specifically, we used the following search strings: (a) ti(“formative assessment”) AND ft(“classroom”) AND ft(“learning-oriented assessment” OR “assessment for learning” OR “assessment as learning” OR “assessment of learning”), (b) ti(“summative assessment”) AND ft(“classroom”) AND ft(“learning-oriented assessment” OR “assessment for learning” OR “assessment as learning” OR “assessment of learning”), (c) ti(“learning-oriented assessment”) AND ft(“classroom”), (d) ti(“assessment for learning”) AND ft(“classroom”), and (e) ti(“assessment as learning”) AND ft(“classroom”). In particular, considering that the purpose of LOA is not to promote test-based teaching or impose more large-scale assessment in the classroom context, but rather to provide a supporting framework for learning (Jones and Saville 2016, pp. 2–3), we used “classroom” as the one of search terms so that the publications focused on “classroom assessment” rather than “large-scale assessment.”

The initial search identified over 500 research documents. To narrow down the number of documents, several inclusion criteria were applied. A study was included if it was published in a peer-reviewed journal, thus ensuring rigor and scholarly significance, and was written in English. Studies not meeting these criteria were excluded. To remove any overlap among different sources, we added them to Endnote X7 for further comparison and removal, resulting in a total of 253 publications.

2.2 Stage II: updated search

After the initial analysis, as some time had passed, we updated the literature search to include books and articles published between 2014 and 2016 to identify any new developments since the initial search. First, we conducted a new search only for books and articles using the terms and databases like stage I. Second, we ensured they fit the aforementioned criteria at stage I. Third, we also searched Amazon for some books about LOA in order to ensure completeness. In doing so, we included 143 books and articles in this stage.

2.3 Stage III: filtering the publications depending on specific inclusion criteria

The authors read each paper and book and extracted information from the sections of bibliographic entry, background, problem, subjects (where applicable), methods, results, discussions, and conclusions (Flynn et al. 1990; Soni and Kodali 2012). At this stage, each author independently examined the abstracts and all texts of each publication to determine if the publication explicitly focused on “classroom assessment” rather than “large-scale assessment.” Publications identified as relevant by all four authors were retained for inclusion. Four authors met to compare answers and resolve any differences. Finally, approximately 40 at stage I and 8 at stage II (they were especially marked with an * before each reference) were subjected to deep analysis. See Fig. 1 for a flowchart describing the search and selection procedure.

2.4 Stage IV: deep analysis

After scoping searches of the literature, the authors drew on their combined experience of 38 years of having worked with both school and classroom assessment to provide a why-what-how framework, underpinned by the cultural philosophy of Didaktik. In alignment with the theoretical framework, purposes, and aims of this review, we

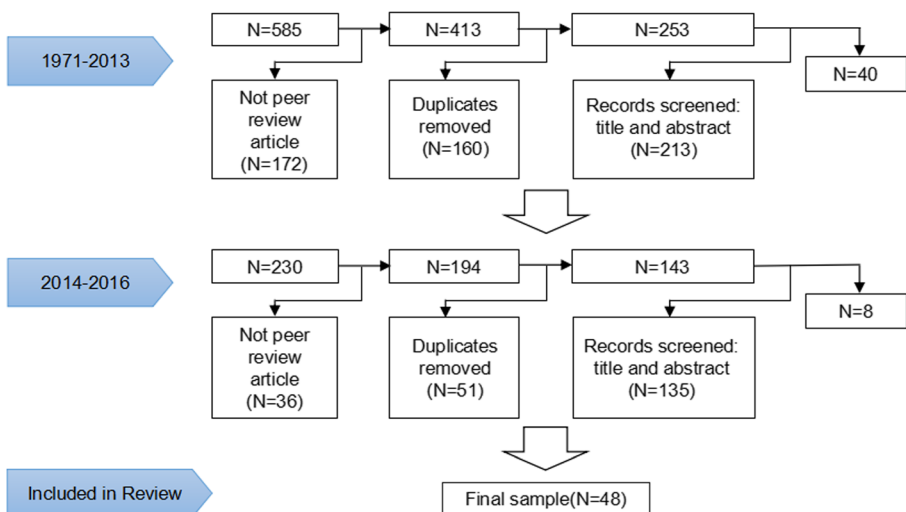


Fig. 1 Flowchart of the selection procedure

implemented “selective” quality assessment. Just as Grant and Booth (2009, p. 94) put it, a critical review provides “no formal quality assessment” and attempts to “evaluate according to contribution”. On the one hand, we absorbed and integrated the valuable contributions within the selected literature. On the other hand, we put forward the holistic framework for LOA and the dynamic framework for its development by excavating the potential value of the selected literature. Specifically, for a paper to be included, it needed to have addressed one of the following questions: (1) Why has LOA emerged? (2) What is LOA? and (3) How can LOA be developed? In particular, we examined its history (why), components, functions, conceptual frameworks, and principles (what) and strategies (how), which were to be demonstrated in Section 3.

2.5 Stage V: transcendental analysis

After data extraction, the literature was synthesized (see Section 4 for further details). In addition, we searched and used a large number of non-selected studies in order to discuss the developmental trends of LOA implicated from the data in the field of assessment, and the discussions would be illustrated in the later section of the ideas for new concepts and implications for practice and future research.

3 Results

This section reported the results of our analyses. We first summarized the publication types of selected studies and the approaches to LOA as mentioned earlier. Second, the evolution of the classroom assessment from SA and FA to LOA was reviewed to clarify the historical foundations of LOA and answer the first question. Third, we analyzed the nature of LOA from the dimensions of components, functions, conceptual frameworks, and principles. Last, strategies for using LOA in classroom were identified. Among the findings, if the opinions were based on the literature, the citations would be added; if the arguments were inferred or summarized by authors, some phrases would be added to demonstrate our views.

3.1 Overview

The main results (publication types and approaches to LOA) from the deep analyses are summarized in Table 1. As was shown clearly, the majority of the studies were published in journals (67%), followed by books or book chapters (25%), while editorials, reports, and guidelines accounted for only 4, 2, and 2%, respectively. Over 95% of the publications mentioned *FA/assessment for learning*, occupying the largest proportion. We identified studies that reported *SA/assessment of learning* ($n = 35$), *assessment as learning* ($n = 15$), and *LOA* ($n = 10$).

3.2 Why LOA developed?

Assessment is clearly of central importance in education (Taras 2005). It plays a major role in teaching and in students’ motivation and strategies for learning although classroom assessment practices are often deeply rooted in societal expectations. For a

Table 1 Summary of selective publications that refer to approaches to LOA. Sorted by the publication types and the approaches to LOA

Publication No-ASN (Y)	PT = Publication types					ALOA = Approaches to LOA			
	JA	B/BC	ED	RE	GD	LOA	SA/AoL	FA/AfL	AaL
1. Bloom et al. (1971)		√					√	√	
2. Martinez and Lipson (1989)	√							√	
3. Plake and Impara (1996)		√					√	√	
4. Krogstrup (1997)	√					√			
5. Black and Wiliam (1998)	√						√	√	
6. Black et al. (2003)		√					√	√	
7. Earl (2003)		√					√	√	√
8. Winter (2003)	√						√	√	√
9. Black et al. (2004)	√						√	√	
10. Stiggins (2005a)	√						√	√	
11. Stiggins (2005b)		√						√	
12. Taras (2005)	√						√	√	
13. Carless (2006)	√						√		
14. Carless et al. (2006a)		√				√	√	√	√
15. Carless et al. (2006b)			√			√	√	√	√
16. Keppell and Carless (2006)	√						√	√	
17. Klenowski (2006)			√			√	√	√	
18. MECY (2006)					√		√	√	√
19. Carless (2007)	√					√	√	√	
20. Hounsell et al. (2007)		√					√	√	
21. Tang and Chow (2007)	√					√	√	√	
22. Volante and Fazio (2007)	√						√	√	√
23. Taras (2008)	√						√	√	
24. Bennett and Gitomer (2009)		√						√	
25. Hume and Coll (2009)	√						√	√	√
26. O'Reilly and Sheehan (2009)				√			√	√	√
27. Stiggins (2009)	√							√	
28. Webb and Jones (2009)	√							√	
29. Bennett (2010)	√						√	√	√
30. Embretson (2010)	√						√	√	
31. Volante (2010)	√						√	√	√
32. Mok (2010)		√				√	√	√	√
33. Gibbons and Kankkonen (2011)	√							√	√
34. Gikandi et al. (2011)	√						√	√	
35. Tillema et al. (2011)	√							√	
36. Wiliam (2011)	√						√	√	
37. Clark (2012)	√							√	√
38. McLaren (2012)	√						√	√	√

Table 1 (continued)

Publication No-ASN (Y)	PT = Publication types					ALOA = Approaches to LOA			
	JA	B/BC	ED	RE	GD	LOA	SA/AoL	FA/AfL	AaL
39. Pat-El et al. (2013)	√						√	√	
40. Mok (2013)		√				√	√	√	√
41. Antoniou and James (2014)	√						√	√	
42. Baas et al. (2015)	√						√	√	
43. Carless (2015)	√					√		√	
44. Curry et al. (2016)	√							√	
45. Friesen (2016)		√						√	
46. Heitink et al. (2016)	√							√	
47. Miedijensky and Tal (2016)	√						√	√	
48. Jones and Saville (2016)		√				√	√	√	
PT/A LOA times	32	12	2	1	1	10	35	46	15
%PT/A LOA times	67	25	4	2	2	21	73	96	31

ASN (Y) author surname (year), JA journal article, B/BC book/book chapter, ED editorial, RE report, GD guideline, LOA learning-oriented assessment, SA summative assessment, AoL assessment of learning, FA formative assessment, AfL assessment for learning, AaL assessment as learning, √ which type or approach every publication belongs

long time, classroom assessment measures and tools have been developed and classified into the three approaches—assessment of learning (AoL), assessment for learning (AfL), and assessment as learning (AaL)—after psychologists focused their studies on the evaluation of learning. This paper focused on these three approaches.

3.2.1 Development of AoL for providing evidence

AoL was the earliest approach to be developed. Assessment of students' learning is a core component of educational evaluation. Formal and informal assessments of learning have always been a part of education (MECY 2006). For a long time, assessment was the mechanism for making decisions about future programs and providing information to policy makers, parents, and employers about students' learning. Thus, tests and exams took on major importance in determining students' access to higher education. Therefore, many countries instituted standardized testing programs alongside classroom assessment to ensure fair, accurate, and consistent opportunities for students. However, in the early 1990s, there was a great deal of research showing the negative impact of “high stakes” summative assessment on teaching and learning (Plake and Impara 1996). One frequently observed side effect was low-energy feedback, which normally has little or no relevance to the subsequent work (Hounsell et al. 2007). What is more, this approach has too often driven schools to be places of sorting and ranking students, which has resulted in many children failing to learn effectively (Stiggins 2005a).

To remedy this situation, Black et al. (2004) suggested that assessment should become a positive part of the learning process by using it for formative purposes. In this way, assessment began to be used not only to ascertain current level of achievement but also to provide evidence which can help students to have a better understanding of where they are and teachers to design curriculum and teaching (Mok 2010).

3.2.2 *Development of AfL for providing continuous effective feedback*

Although AoL provides evidence for students to enhance their learning, it is commonly single dimensional, summative, and assessment after learning (Miedijensky and Tal 2016). To overcome the inadequacies of tests and exams, researchers started to consider assessment during learning instead of assessment after learning, which gave rise to a shift from AoL to AfL (Martinez and Lipson 1989). AfL aligns with FA, as stated previously, but they are different in some respects. Insisting that everyone can learn successfully, Bloom et al. (1971) developed FA, which underlines assessment during learning and aims to promote, not merely judge or grade students' success. As Stiggins noted, FA has emerged as an increasingly prominent tool for school improvement (2005a). Teachers can use it for decision making that leads to better instructional practice (Curry et al. 2016). Students can use it to facilitate their learning (Antoniou and James 2014). Moreover, FA has also been used in higher education, within blended and online contexts (Gikandi et al. 2011). However, Black and Wiliam (1998) suggested that, while improving FA raised standards, there was still room for improvement, and subsequently proposed assessment for learning (AfL) to enhance FA (2003, 2004). The "improvement approach" to FA contends that students are inside the assessment process and they partner with their teacher to manage their own progress (Stiggins 2005a). In addition, students' performances are based on the continuing evidence of their mastery of achievement standards so that they can set goals for what to learn next and believe that continued success is within reach if they keep trying (Stiggins 2005a; Heitink et al. 2016).

The most important difference between FA and AfL, according to Stiggins (2005a), is that the former informs teachers about students' achievement, while the latter also informs students about their own learning. To understand the impact that assessment has on learning, we require a broader focus than the feedback intervention itself, particularly the learner's responses to the feedback, and the learning milieu in which the feedback operates by using the FA to let learners assess their own learning by developing AfL (Wiliam 2011). Timely feedback and corrective instruction can help learners to understand where they are in their learning, identify the next step in the learning process, and raise their awareness of the learning tasks they will be performing (Baas et al. 2015). AfL is used to make learning visible, thereby guiding the day-to-day learning decisions (Friesen 2016). Therefore, AfL, instead of FA, has been developed and used in many schools this century (Black et al. 2003). A review of research studies indicated that the interest in AfL has resulted in a search for new modes of assessment that are better aligned to students' learning how to learn (Tillema et al. 2011). However, with the introduction of new assessment tools, questions arise with respect to the quality of its measurement. Quality criteria are dissimilarly connected to the distinct steps of an assessment cycle, which holds as well for the attention given to student involvement in AfL (Tillema et al. 2011).

3.2.3 Development of AaL for helping students become self-directed learners

Different from AoL, AfL is first concerned with the development of student role inventory, which enables students to be both learners and assessors through undertaking assessment tasks in their learning process (Klenowski 2006; MECY 2006). It has been suggested that students learn more when they use assessments to evaluate their own learning (Stiggins 2009). Increasing the amount of time on assessment, however, does not necessarily enhance learning. Rather, only when teachers use classroom assessment to become aware of the knowledge, skills, and beliefs that their students bring to a learning task, and use this knowledge as a starting point for new instruction and monitor students' changing perceptions as instruction proceeds, can their classroom assessment promote learning (MECY 2006). When AfL is translated from theory into practice, tensions emerge (Webb and Jones 2009). LOA significantly improves students' learning motivation and engagement (Keppell and Carless 2006). However, we argue that it also requires students to spend more time on assessment and less on learning; this further results in a reduction of their learning quality, or which LOA can be blamed. Thus, to remove this tension and solve the problem, researchers have created a third assessment approach named AaL (Earl 2003; Gibbons and Kankkonen 2011). AaL refers to the active participation of students in their own assessment (Gibbons and Kankkonen 2011), which aims to explore the assessment process as a learning process, that is to say, assessment is learning. Specifically, based on the analysis of literature, we summarized three main characteristics of AaL: first, it focuses on students and emphasizes assessment as a process of metacognition (knowledge of one's own thought processes); second, it pays more attention to developing complex tasks that encourage students to show the connections they are making among the concepts they are learning as they integrate their assessment into their learning; and third, "student directedness" is also identified as an important feature of AaL, thus helping students to be autonomous learners.

There are some contradictions among the three assessment categories of AfL, AaL, and AoL. Webb and Jones (2009) identified many important contradictions in the changing system that not only produced tensions and difficulties but also provided driving forces for change. MECY (2006) argued that all three approaches serve valuable and different purposes. It was not always easy, however, to get the balance right among them. According to Mok (2013), since the turn of the century in major systems in the Asia-Pacific Region, there have been two waves of assessment reforms: one is AaL and another is the shift from AoL to AfL. Nevertheless, because many educational systems in the region have the tradition of AoL that focuses on marks and grades instead of learning, there is an urgent need to revise and redesign pedagogy to reconcile tensions among assessment *as*, *of*, and *for* learning and to glean benefits of each for teaching and learning (Mok 2013). Many studies have shown that the LOA framework offers a feasible solution to this new pedagogy (Mok 2013). Therefore, it is the scholars' responsibility to achieve the right balance among them.

In short, historically, LOA has been generated through the standard-based education that emerged during the turn of the century with the ongoing balancing and blending of the three categories of assessment. LOA has become the new trend in contemporary assessment reform, which is changing from test-based to learning-oriented.

3.3 What is LOA?

LOA's current popularity has developed from the changes that have been occurring over many years, in particular over the recent decades. As far back as the 1960s, Scriven (1967) articulated the distinction between summative and formative programs. Since 1971, when Bloom et al. extended the differentiation to various forms of assessment, SA has referred to tests administered after learning to determine whether learning has occurred. In contrast, FA is assessment conducted during the process of learning. AoL evolved from SA and both AfL and AaL from FA. Krogstrup (1997) used the term “dialogue and learning oriented evaluation method” to emphasize users' participation in quality assessment, and Klenowski (2006) cited many articles illustrating the very rich cultural settings in which assessment with a learning orientation took place. There is evidence of learning-oriented assessment in national assessment systems, as seen in research conducted in China and Vietnam, through to classroom assessment practices, as apparent in studies in Hong Kong and Australia (Keppell and Carless 2006). The Western and Northern Canadian Protocol for Collaboration in Education (WNCPE) assessment team developed a document (MECY 2006) that provided a framework for thinking about the purposes of assessment including AfL and AaL as well as AoL, and created and implemented changes to teachers' assessment practices consistent with enhancing learning for all students. Furthermore, Mok (2013) integrated self-directed learning into LOA and then developed self-directed learning-oriented assessment (SLOA). Socially and historically, LOA has emerged as an integrative and holistic assessment methodology, which, in accordance with FA philosophy, embeds AfL and AaL as well as AoL. To be more specific, it consists of balances among and integrates AfL, AaL, and AoL.

3.3.1 LOA consists of AfL and AaL as well as AoL

LOA is a holistic assessment methodology comprised of at the least three pre-existing assessment approaches discussed above, namely AfL, AaL, and AoL. At the time when Carless (2006, 2007) coined the term LOA in Hong Kong and MECY (2006) published the book *Rethinking classroom assessment with purpose in mind: Assessment for Learning, Assessment as Learning, Assessment of Learning*, Bennett and Gitomer (2009) proposed that we could have all three—assessment of, for, and as learning, and then a research initiative entitled *Cognitively Based Assessment of, for, and as Learning (CBAL)* in the USA was conducted (Bennett 2010) so as to create a model for an innovative K-12 assessment system that documents what students have achieved (of learning), helps to identify how to plan instruction (for learning), and is considered by students and teachers to be a worthwhile educational experience in and of itself (as learning). Further, a few studies explored the application of CBAL (e.g., O'Reilly and Sheehan 2009; Embretson 2010). The three approaches are distinct and interrelated for classroom assessment. Each has a different focus and addresses a set of interrelated questions about students' learning. From overviews of the related research studies, we may briefly interpret the three assessment approaches in four dimensions: meanings, purposes, and implications, as well as key words (see Table 2).

Table 2 Brief representatives of AfL, AaL, and AoL

Items	AfL	AaL	AoL
1. Meanings	Any assessment which prioritizes students' learning.	The active participation of students in their own assessment, where they are their own best assessors.	SA in nature that may enhance students' learning through feedback.
2. Purposes	To give both teachers and students information to modify and differentiate teaching and learning activities.	To focus on the role of the students as the critical connectors between assessment and learning, to develop and to support metacognition for students.	To confirm what students know and can do so as to demonstrate whether they have achieved the curriculum outcomes and to show how they are placed in relation to others.
3. Implications	To make each student's understanding visible, so that teachers can decide what they can do to help students progress or to provide descriptive feedbacks for students and decide on forward groupings, instructional strategies, and resources.	To focus on students' self-directed learning and emphasize assessment as a process of metacognition for students so that they must learn to be critical assessors who make sense of information, relate it to prior knowledge, and use it for new learning.	To provide evidence of achievement to related persons and institutions and to result in public statements or symbols about how well students are learning so as to affect students' futures. It is important that the underlying logic and measurement be credible and defensible.
4. Key words	Learning orientation; FA; feedback as feedforward; standard-referenced.	Self-directed learning; self assessor; metacognition; assessment activities as learning tasks; standard-referenced.	Sorting and ranking; norm-referenced; high stake; SA.

Stem from Earl (2003), Black et al. (2004), Stiggins (2005a), Taras (2005), MECY (2006), Mok (2010), (2013), Gibbons and Kankkonen (2011)

3.3.2 LOA as a balance of AfL, AaL, and AoL

Because assessment approaches have various purposes, LOA as a holistic methodology necessarily aims at striking a balance of AfL, AaL, and AoL. As MECY (2006) noted, it is very difficult, and sometimes impossible, to serve these three different purposes at the same time. Thus, it is important for educators to understand the three assessment approaches, recognize the need to balance them, know which one they are using and why, and use them all wisely. Volante (2010) suggested that an equal balance is important, while MECY (2006) argued that the role of AfL and AaL takes on a much higher profile than AoL.

Traditionally, the focus of classroom assessment has been on AoL—measuring learning after the fact, using the information to make judgments about students' performances, and reporting these judgments to stakeholders. Also, teachers have been using AfL when they build in diagnostic processes, FA, and feedback at various stages in the teaching and learning process, albeit often informal and implicit, while systematic AaL—where students become critical analysts of their own learning—is rare. Although some teachers traditionally incorporated self-assessment into their programs, few used assessment systematically or explicitly to develop students' capacities to evaluate and adapt their own learning.

In order to show how assessment is constructed and used, Earl (2003) announced an evolutionary trend from tradition to a restructuring of the relationships among AfL, AaL, and AoL. If the purpose is to check learning for reporting, in the traditional interrelationship of these approaches, AoL becomes the predominant focus as shown by the first traditional terrace-kink (see Fig. 2). If the purpose is to enhance learning, the assessment needs to give students opportunities to make their learning apparent. The second terrace-kink suggests the importance of a reconfiguration of the balance of these approaches, emphasizing AaL and AfL. AoL also has an important role to play but is used only when summative judgments are required.

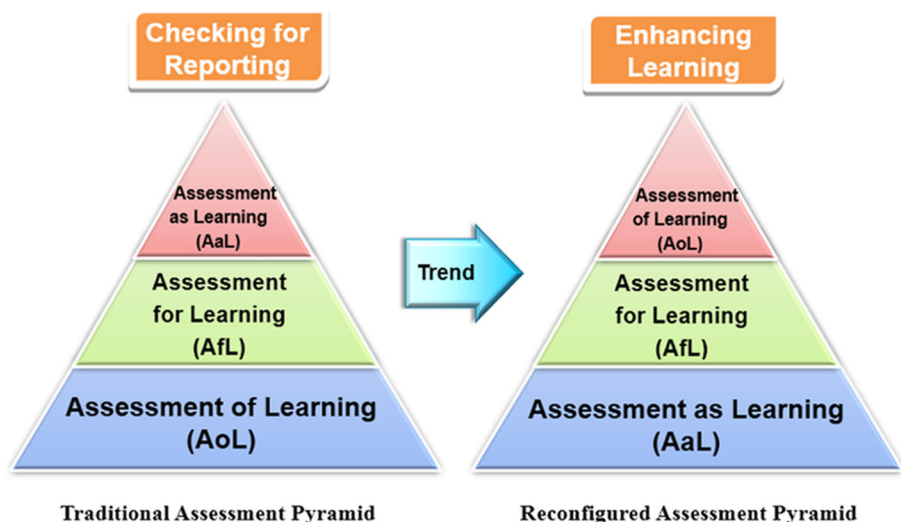


Fig. 2 Terrace-Kink model of balance in AfL, AaL, and AoL. Adapted from Earl (2003)

3.3.3 LOA integrates AfL, AaL, and AoL

Hounsell et al. (2007) used the term “integrative assessment” to represent the conception of optimal balance between the twin central functions of assessment, i.e., to evaluate and certify students’ performances or achievements, and them to fulfill their potentials as learners. There was a considerable body of research that integrated various assessment approaches to make assessment a powerful process for enhancing learning (e.g., Winter 2003; Taras 2005; MECY 2006; Carless et al. 2006a, b; Klenowski 2006; Webb and Jones 2009; Hume and Coll 2009; Mok 2010, 2013; Volante 2010; Wiliam 2011; McLaren 2012; Pat-El et al. 2013). Therefore, LOA, as a holistic methodology, not only consists of and smooths but also integrates AfL, AaL, and AoL. Mok (2010) proposed a priori conceptual framework to guide research on SLOA, which represented an integral idea of LOA. As the name implies, LOA focuses attention on assessment that can support students’ self-direction by providing active collaborative/cooperative learning environments, using metacognition and feedback/feed-forward.

First, LOA is based on active collaborative/cooperative learning (ACL), which can effectively realize self-directed learning. As long as it highlights AaL and AfL, LOA implies self-directed learning. The document recording of an attempt to understand learning-oriented individuals was made by Allen Tough (1967), who initiated self-directed learning. Knowles defined self-directed learning as “a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes” (1975, p. 18). It is known that the capacity for self-directed learning is fundamental to sustainable development in the twenty-first century, given the rapid speed of knowledge creation. Knowledge and skills that school students of today will need when they join the workforce have not yet been created. Consequently, in the new century, education has to go beyond the transmission of knowledge for students to learn what teachers know. Rather, the core mission of education is to engender in students the capacity for knowledge creation, management, and transfer as well as its acquisition. In other words, education means learning how to learn.

Facing the challenge of knowledge-based society, some researchers have developed active collaborative/cooperative learning environments (Shen and Huang 2004; Bandiera and Bruno 2006; Li et al. 2009; Blasco-Arcas 2013). The literature has highlighted key aspects of this ACL environment (Bell and Kozlowski 2008; Järvelä and Järvenojä 2011; Shi et al. 2013). And we have summarized as follows: firstly, self-directed learning is social and cultural as well as individual. Secondly, the ACL approach gives people control over their own learning; that is, the learner assumes primary responsibility for important learning decisions about goals, resources, strategies, and assessments. Thirdly, it promotes an inductive learning process, in which individuals must explore and experiment with a task to infer the rules, principles, and strategies for effective performance. In this sense, it is necessary that teachers develop ACL environments to promote students’ engagement in self-directed learning through LOA.

Second, LOA means that learners exercise the self-regulatory process of metacognition (Flavell 1979, 1985). In other words, a LOA framework, taking AaL as the most powerful approach, means an assessment process that engages students actively in learning activities, through considering and setting their own learning goals, deliberating upon and

selecting their learning strategies, monitoring and adapting their learning pace, assessing and mastering their learning progress, evaluating and using feedback information, and as a result, reaching new understandings, connecting new information with existing knowledge, or even revising learning goals or strategies. In this way, the LOA framework incorporates a range of metacognitive tools and mechanisms, including the provision of timely feedback from assessment and explicit teaching of a range of strategies to raise students' self-awareness of their own learning processes, as well as to enrich their repertoires of self-regulation skills. These skills include identifying key issues in the learning tasks, posing questions, selecting learning strategies, and monitoring progress by situating these strategies in learning tasks of curriculum subjects, as well as modeling and scaffolding the strategies (Mok 2013, pp. 8–9). As Carless discovered, feedback in general assessment is changing and developing into feed-forward in LOA (2007).

Third, many influential meta-analyses have confirmed that feedback is central to students' learning since it plays a decisive role in learning and development (Carless 2006). Feedback can have multiple functions: advice for improvement of current and future assignments, explain or justify a grade, and an act by which the tutor demonstrates characteristics, such as expertise, diligence, or authority (Carless 2006). The feedback function can also be little more than the fulfillment of a ritual which is part of academic life. Because feedback is concerned with responses to oral and written assignments presented by students, it has the potential to "feed-forward" into future tasks rather than back to completed assignments (Carless 2006). Thus, we argue that LOA attempts to merge both feedback and feed-forward into AfL, AaL, and AoL. Assessment is formative (AfL) when feedback generated from the assessment is directed towards the quality of the task or learning process, identifies misconceptions, and supports the development of more effective learning strategies. AaL can help students to get information about what and how they learn and to use the information as feedback or feed-forward for realizing their own deep learning and development of metacognition. Even for AoL, both teachers and students may try their best, by using formative strategies raised by researchers (Volante 2010), to develop formative use of SA and, furthermore, to take the extracted information as feedback or feed-forward for enhancing their teaching and learning.

We contend that the relationships among them are interlocked. Firstly, AoL in the LOA framework refers to assessment activities conducted by the teacher and his/her students that aim to generate evidence about current learning, in which the teacher and students attempt to confirm their learning outcomes. Secondly, the teacher and students should make it clear whether there is any gap between the desired learning goal and the current level of learning. To address this question, the goal should be established and clear to both parties. Consequently, in the LOA framework, AfL often begins with both goal setting and a clarification of the desired learning goal. Even though the question of the gap can be addressed by AfL, information generated from such assessment is often inadequate to address the next question, if there is a gap, how can it be closed? Then, AfL refers to assessment activities done by the teacher and students to collect evidence with the aim of feeding-forward to inform further learning in terms of direction and potential. Thirdly, AaL in the LOA framework means that the student internalizes and answers questions such as *Where am I going? How am I doing? How can I learn better? How can I keep up my motivation?* and acts upon them in a constant process of self-monitoring during learning.

3.4 How to develop LOA?

In the early 1990s, Krogstrup (1997) pointed out a problem with goal-free evaluation models; it was not clear whose and which criteria should be the basis of the evaluation. Krogstrup presented the concept of “learning-oriented evaluation” through stressing “user participation in quality assessment”. As explained above, LOA stems from growth and integration of AfL and AaL as well as AoL. We can see that LOA aims at encouraging student involvement and self-assessment in the learning process, and this will be realized only if it is carried out by teachers, administrators, parents, communities, and professional developers. It can be claimed that LOA, focusing on the process of making AfL, AaL, and AoL distinct and identifiable parts of the teaching and learning process, is one of the most significant changes in education as a form of assessment in which the primary focus is on the potential to develop productive student learning processes (Carless 2015). It requires either reforms to assessment methods or changes in the mindsets of educators, students, parents, and society. Many researchers have presented a range of strategies for developing LOA, which can be organized into two sections: effective methods (method-implementing) and strong support (mindset-changing and capacity-building).

3.4.1 Method-implementing

This research claims that the order of the three components of LOA (for, as, of) is intentional, indicating the importance of AfL and AaL in enhancing students’ learning and developing their metacognition. AoL should be reserved for circumstances when it is necessary to make summative decisions. AfL occurs throughout the learning process, focusing on students and emphasizing assessment as a process of metacognition, while AaL refers to strategies designed to confirm what students know, to demonstrate whether or not they have met curriculum outcomes or the goals of their individualized programs, or to certify proficiency and make decisions about their future programs or placements, in order to provide evidence of achievement to parents, other educators, the students themselves, and sometimes to outside groups (e.g., employers, other educational institutions). In planning, developing, and using assessment methods that are fit respectively for AfL, AaL, and AoL, teachers think about curriculum and their students as they ask themselves the following five questions (MECY 2006): *Why am I assessing? What am I assessing? What assessment method should I use? How can I ensure quality in this assessment process? How can I use the information from this assessment?* Moving around them, people have designed and implemented many types of methods and procedures of AfL, AaL, and AoL, which can be referenced easily, as summarized in Table 3.

3.4.2 Mindset-changing

Many studies have focused on the process of making AfL, AaL, and AoL distinct and identifiable parts of the teaching and learning process (Elliott 2003; Simms and George 2014), and few innovations have had any fundamental effect on what happens in classrooms (Tanner 2001). We argue that LOA provides a framework and directions for teachers, administrators, professional developers, parents, and members of the wider community as they work together to make fundamental changes in classroom assessment

Table 3 Summary of developing LOA

Questions	AoL	AaL	AoL
1. Why assess?	To enable teachers to determine next steps in advancing students learning.	To provide opportunities for each student to monitor and reflect on his or her learning and identify next steps.	To certify or inform parents or others of students' proficiency in relation to learning outcomes.
2. Assess what?	Each student's progress and learning needs related to curricular outcomes.	Each student's thinking about his or her learning, what strategies he or she uses to support or challenge that learning, and the mechanisms he or she uses to adjust and advance his or her learning.	The extent to which students can apply the key concepts, knowledge, skills, and attitudes related to the curricular outcomes.
3. What methods?	Methods that make students' skills and understandings visible.	Methods that elicit students' learning and metacognitive processes.	Methods that assess both learning products and process.
4. How to ensure the quality	<ul style="list-style-type: none"> • Accuracy and consistency of observations and interpretations of students' learning; • Clear, detailed learning expectations; • Accurate, detailed notes for descriptive feedback to each student. 	<ul style="list-style-type: none"> • Accuracy and consistency of student self-reflection, self-monitoring, and self-adjustment; • Students' engagement in considering and challenging his or her thinking; • Students record their own learning. 	<ul style="list-style-type: none"> • Accuracy, consistency, and fairness of judgments based on high-quality information; • Clear, detailed learning expectations; • Fair and accurate summative reporting.
5. How to use the information	<ul style="list-style-type: none"> • Provide each student with accurate descriptive feedback to further his or her learning; • Differentiate instruction by continually checking where each student is related with the curricular outcomes; • Provide parents or guardians with descriptive feedback about students' learning and ideas for support. 	<ul style="list-style-type: none"> • Provide each student with accurate descriptive feedback that will help him or her develop independent learning habits; • Have each student focus on the task and his or her learning (not on getting the right answer); • Provide each student with ideas for adjusting, rethinking, and articulating his or her learning; • Provide the conditions for the teacher and student to discuss alternatives; • Students report about their learning. 	<ul style="list-style-type: none"> • Indicate each student's level of learning; • Provide foundations for discussions on placement or promotion; • Report fair, accurate and detailed information that can be used to decide the next steps in a student's learning.

Stem from MECY (2006, p. 65)

practices. This, undoubtedly, is one of the most significant changes to occur in education. The literature has claimed that it represents a major shift in thinking towards assessment as a key contributor to enhancing learning for all students (MECY 2006).

However, it is only through changing the mindsets of the abovementioned stakeholders that any serious alteration to classroom practice can be embedded and sustained. In accordance with MECY (2006), critical elements in the process of mindset-changing are understanding and motivation, knowledge and skills, local leadership, support for changes, and habits of mind. *Understanding and motivation* means that related people need to think reasonably about and engage actively in changes of classroom assessment. Then, teachers should enhance their *knowledge and skills* to do LOA effectively. Changing classroom assessment depends not only on teachers' knowledge of learning theories, content knowledge, and pedagogical knowledge but also on professional skills in identifying purpose, deciding what to assess, choosing methods, ensuring quality, interpreting evidence, and using assessment for the intended purpose as well (MECY 2006). Thus, teachers need to shift their paradigm to understand how assessment can drive instruction and impact positively upon student learning and performance (Volante and Fazio 2007). Moreover, changes in classroom assessment require principals to show *strong instructional leadership and creative management* since they are the ones responsible for examining and modifying school policies, helping to prioritize teachers' time, allocating funding, monitoring changing practices, and creating a culture within the school that allows teachers to feel safe as they challenge their own beliefs and change their practices. *Support for change* mainly comes from the school and community. Last, LOA aims at making students into lifelong learners; thus, it is much more important that teachers and their students nurture inquiring mind habits. All this calls for the relevant people, particularly teachers, to improve their own capacity of dealing within changes in classroom assessment practice (MECY 2006).

3.4.3 Capacity-building

This review indicates that mindset-changing is necessarily accompanied by capacity-building. To develop LOA for enhancing classroom assessment, concerted efforts are needed to build the capacity to embed and sustain changes to classroom assessment. Many initiatives have focused on how to integrate changes in classroom assessment into other capacity-building endeavors (e.g., MECY 2006; Carless 2006; Tang and Chow 2007; Hume and Coll 2009; Mok 2010, 2013; Bennett 2010; Volante 2010; Gibbons and Kankkonen 2011; Clark 2012; McLaren 2012). From the results of these initiatives, we can see that the main capacity-building endeavors have been professional learning, leadership, and support as well as collaboration with parents and community.

First, *professional learning* can be realized in two ways: the formal (as in in-service and professional development sessions and professional growth planning) and the informal (as in close daily attention to classroom assessment practices). It can occur individually or collectively in initial teacher training or throughout teachers' careers. Some examples of strategies for building capacity through professional learning are *assessment study groups, assessment learning walks, assessment plans, assessment collaborations, assessment action research, electronic assessment conferences or*

bulletin boards, and professional reading and writing about assessment as well as assessment audits.

In addition, to provide access to these types of professional learning strategies, there is a need for a number of other possible strategies for *leadership and support*, including *boundary-spanning activities, developing critical friendships, modeling, and making time*, through which leaders can support teachers by endorsing and encouraging opportunities for LOA. All this can build a basis for having students more involved in and reporting about their learning.

Last, it is a useful way of *collaborating with parents, students, and the community* in the work of the school, in order to intentionally create a partnership when LOA is not something that is done *to* students but *with, for* and *by* them. Some strategies for developing successful school-family-community partnerships with a classroom assessment include *workshopping with parents, two-way communicating, parents and community members volunteering, learning at home, and making decisions and celebrating with the community.*

There is no doubt that classroom-based assessment has tremendous potential to promote students' learning. We believe that students improve learning quality and standard-based schools make progress, provided that LOA is designed and implemented elaborately. Obviously, this requires teachers to undertake more assessment processes and to have higher levels of assessment literacy (e.g., Plake and Impara 1996). Even though very few teachers have been given opportunities to learn and apply LOA principles and methods, they can realize both mindset-changing and capacity-building through effective professional development and strong support from relevant people and institutions and thus attain sufficiently high levels of assessment literacy.

4 Discussion

Based on a deep analysis of 48 selected literatures, we found that a few studies did provide information about concepts of AfL and AaL as well as AoL, and integrated three approaches, but the relationships among them had not been clearly clarified yet. After synthesizing the concepts reviewed in the results section, we created new knowledge about the holistic framework for LOA and the dynamic framework for its development. Furthermore, we put forward some recommendations for developing LOA.

4.1 Ideas for new concepts of LOA

Many studies (e.g., Terpstra and Rozell 1997; Beyer et al. 2010; Bowers and Ryan 2013; Mysen 2013; Palmer and Choi 2014) have described valid and credible ways to identify ideas for new concepts, future directions, and explorations. According to it, next discussions are focused on both the holistic framework for LOA and the dynamic framework for developing LOA in order to propose ideas for new concepts of future work.

4.1.1 The conceptual framework for LOA

In summary, LOA is by nature a new integrative and holistic methodology of assessment, which is based on and aims at self-directed learning that can be realized only in a

new learning environment, such as ACL, and depends on several assessment approaches such as AfL, AaL, and AoL.

To both enhance the learning elements of assessment and avoid confusion and doubt about FA processes, Carless et al. coined the term LOA (2006a, b) to denote assessment processes in which learning elements are emphasized more than measurement ones and proposed a consolidated framework of LOA. By expanding the work of Joughin (2004), Carless et al. (2006a), and Carless (2007), we have conceived a holistic framework for LOA to identify and represent contemporary thinking about assessment and learning in a productive way and to identify elements which might influence its effect on students’ learning, teachers’ pedagogical practices, and affordances which the system could provide (see Fig. 3).

The environmental foundation of LOA In this review, the foundation of the holistic framework of LOA is the innovative learning environment (ILE) (see Fig. 3). This means that, through developing an ILE, the teacher can build and use LOA effectively. We argue that the ILE is a new landscape of learning activities in the information era. In view of this perspective (Kirschner 2005; Schuitema et al. 2012; Istance and Kools 2013), after being reconceptualized, ILE refers to any generative environment as a whole, as well as each of the diverse sub-environments that has the necessary technological, social, and educational affordances to provide opportunities for everyone to learn. Affordances, such as the technological, and/or the educational, and/or the social, determine how individuals or groups interact with the different aspects of their environments and with each other. That is to say, principals and teachers need to develop and/or use an overall ILE and one or more learning approaches, such as ACL, self-

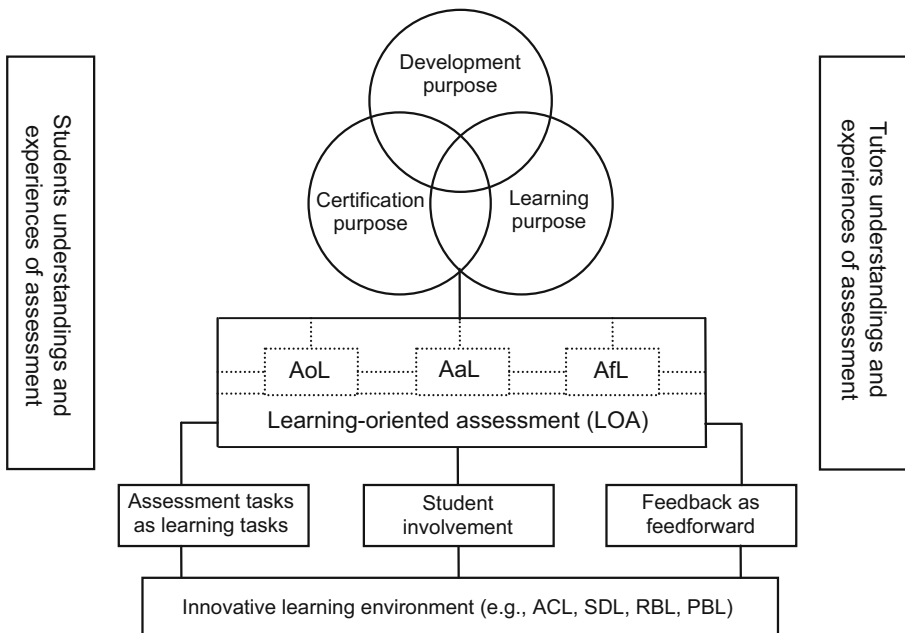


Fig. 3 Holistic framework for LOA

directed learning (SDL), research-based learning (RBL), and problem-based learning (PBL), suitable to LOA when they reform classroom assessment.

Three main purposes of LOA In this section, we summarize three main purposes of LOA (see Fig. 3). The literature has shown three main purposes of assessment in LOA: the certification element, which focuses principally on evaluating student's achievements, the learning focus on student's motivation, engagement and outcomes, and the developmental emphasis on student's metacognition, emotion, and social skill as well as career development. The intersecting circles indicate that, when assessment is functioning efficiently, there should be substantial overlap among these three functions. Hence, LOA requires every student to become an active researcher, self-teacher, and curriculum developer to strengthen both learning and pedagogical aspects of assessment.

Two mechanisms within LOA As shown on the left and right side of Fig. 3, there are two mechanisms within LOA. One can be achieved respectively through either AoL, AaL, or AfL, or all of them together, as long as a central focus is on engineering appropriate student learning so as to make LOA strengthen the learning aspects of assessment. When AfL, AaL, and AoL are all included in LOA, they contribute to the development of productive student learning in the presence of certain features described by Carless (2006). The first and most crucial of these is that the LOA is represented by the term "assessment tasks as learning tasks." The second component is students' involvement in assessment so that they develop a better understanding of learning goals and engage more actively with criteria and standards. The third is that, for assessment to promote learning, students need to receive appropriate feedback which they can use to feed-forward into current and future work.

Another critical feature is that the teaching mechanism can be realized through effective teacher professional development as long as enough attention is paid to engineering appropriate teaching that will enable the pedagogical aspects of assessment to be strengthened. It is *effective* professional development that strengthens teachers' roles in supporting LOA (InPraxis Group Inc. 2006). Thus, we suggest that the teacher needs to become a developer of ILE, establishing a sound base for LOA, and a designer of effective assessment methods. For example, Miller (2008) described a situation in which when teachers took up the challenge associated with employing assessment-driven instruction and the exploration of subject matter, pedagogy, and assessment, they found opportunities to generate knowledge about teaching and learning. In this process, we argued that the teachers' problems became a mechanism to pool their collective knowledge, to rearticulate their problems as necessarily complex, to explore possible solutions, and to connect their problems to broader issues of teaching and learning. Furthermore, according to Cognitively Based Assessment of, for, and as Learning (CBAL) (Bennett 2010), teachers thoroughly remold themselves to be researchers and explorers of subject matter, pedagogy, and assessment as well as psychology of learning and development, so they can not only generate but also represent pedagogical content knowledge (PCK). This notion was seeded much earlier at the turn of the last century, in 1888 (Bullough 2001), and coined first by Shulman (1986, 1987), and developed widely by a lot of scholars (e.g., Rovegno 1992; Fernández-Balboa and Stiehl 1995; Van Driel et al. 2001; Niess 2005; Angeli and Valanides 2009; Voogt et al. 2013; Depaepe et al. 2013).

Expanding from the above holistic framework, some meanings of LOA may be summarized succinctly by the following principles; the first three of these, interpreted by Carless (2007), are grouped as “learning principles” while the latter three are “teaching principles”:

- Principle 1: Assessment tasks should stimulate sound learning practices among students.
- Principle 2: Assessment should involve students actively in engaging with criteria, quality, their own, and/or peers’ performance.
- Principle 3: Feedback should be timely and forward-looking so as to support current and future student learning.
- Principle 4: The teacher as curriculum developer ought to provide innovative learning environments to support sound learning practices among students
- Principle 5: The teacher as assessment designer must make AoL, AaL, and AfL methods relevant enough to involve students actively in engaging with criteria, quality, and their own and/or peers’ performance.
- Principle 6: The teacher as knowledge producer needs to create an understanding of learning motivation, engagement, and outcome drive assessment feedback as feed-forward, so as to support current and future student learning.

4.1.2 Dynamic framework for developing LOA

Many scholars paid attention to the development and use of LOA in practice. Tang and Chow (2007) attempted to conceptualize LOA supervisory practices to understand the ways in which feedback is communicated in teaching practice supervision to enhance teacher professional learning within the learning-oriented field experience assessment (LOFEA) framework. According to Volante (2010), these results definitely warranted a more sustained and targeted approach to building assessment literacy within schools and districts, particularly for experienced educators, students and parents who have little training in newer self-assessment and peer assessment methods. These findings generated insights for our understandings of complex processes of using LOA that enhances learning in teaching practice and conceptualizes how to develop LOA for the building of assessment literacy.

As mentioned before, the strategies for developing LOA involve two dimensions: effective methods and strong support. The former is, by nature, a procedure of designing and implementing LOA. It refers to a detailed operation of the three assessment approaches, which forms a framework for thinking about how to select or develop assessment tasks, how to use them, and how to communicate about them with students, parents, and others. The latter comes mainly from both mindset-changing and capacity-building. Mindset-changing refers to ideas about what is needed to change and sustain LOA practices and capacity-building means using a set of strategies, structures, and processes to build capacities needed to embed and sustain changes to LOA. Systemically, we should focus on three sources of reform in relationships between these elements of developing LOA: method-implementing, mindset-changing, and capacity-building and their mix. And this should aim at building assessment literacy

(Volante 2010). In this review, the core of LOA may be imagined as a 3-D ball as it involves intertwining relationships among these elements over time (see Fig. 4).

Figure 4 shows that LOA is an organizational form that embraces arrangements of learning and assessment catering for a group of learners in context and over time. We can elaborate the concept of developing LOA as bringing together three elements in the shape of a ball to enhance the assessment literacy of all stakeholders, including administrators, principals, teachers, students, and parents. This ball provides a dynamic framework not only to analyze any such development of the LOA but also to design and redesign these three elements, in order to make LOA development more innovative, powerful, and effective for enhancing everyone’s learning and developing their metacognition.

4.2 Recommendations for practice and future research

Carless argued that LOA represents an attempt to emphasize the learning features of assessment and sought to address the issue of how assessment could be used more effectively to enhance students’ learning (2007). As Boud pointed out, LOA “is not just a new piece of educational jargon, but also a signal of the important shift in assessment thinking” (Carless et al. 2006a, p.x). LOA is getting more and more attention from those interested in improving learning quality and effectiveness. The results and ideas stemming from the research literature have implications for both practice and future research. On one hand, in response to the limitations of LOA, we suggest the potential value of supporting effective assessment practice and creating a learning culture. On the other hand, based on our deep analyses of the identified studies on classroom assessment, some implications are put forward to inform future LOA research.

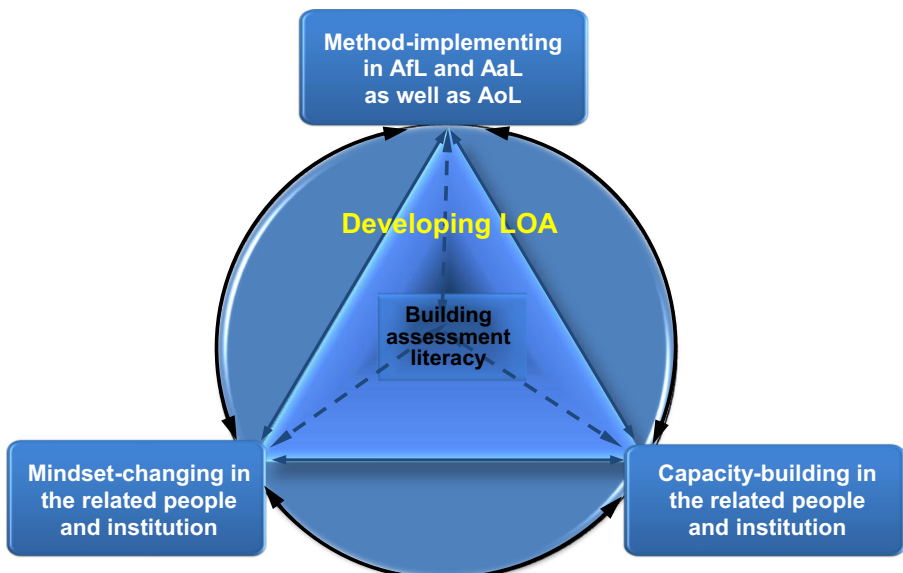


Fig. 4 Dynamic framework for developing LOA

4.2.1 Implications for practice

MECY (2006) proposed the need to provide a framework for extending thinking, to confirm and to guide changes in effective assessment practices, and to foster professional learning. The question then is how these ideas can be articulated and operationalized in different educational settings. Carless (2007) illustrated some practical possibilities inherent in the LOA model and discussed implications for practicing LOA at the module level. With the aim of integrating AfL, AaL, and AoL into teaching and learning, the effective assessment practices consist of students' learning practices, teachers' pedagogical practices, and supports for these practices, while professional learning refers to pre- and in-service teacher education practices. Based on the holistic framework for LOA summarized in Figs. 3 and 4, the next section of this paper proposes some implications for different practices, including learning, pedagogy, teacher education, and ILE practices.

Implications for learning practice Carless (2007) indicated how the LOA framework can be implemented in practice through an example of a 12-week 30-h module, with a class of 35 pre-service students in a Bachelor of education program. One student who participated in this module commented, "The module assignments allow me to practise what I learned in the module" (p. 64). Enlightened by Rushmer et al. (2004a, b), we can define the learning practice (LP) as a general practitioner (or similar) unit where individual, collective, and organizational learning and development are pursued systematically according to learning community principles, in order to enhance learning for everyone in a way that is increasingly satisfying to its related people, such as students, parents, teachers, administrators, and other stakeholders in the educational area.

The above results and discussions have implications for students' learning developing into LP. Rushmer et al. (2004a, b) outlined the nature of LP, particularly its cultural underpinnings and structural arrangements. The former requires students to construct a positive learning culture through engaging more actively in the LOA of LP. The cultural values of LP may be summarized in a series of attitudes and expectations, such as *celebration of success, absence of complacency, tolerance of mistakes, belief in human potential, recognition of tacit knowledge, prioritizing the immeasurable, openness, trust, and outward looking*. There is no doubt that such cultures can help to facilitate learning; they also need to be supported and reinforced by specific structural arrangements, which can make the appearance of the values of the culture more likely. Five structural elements that would seem to help are *flatter hierarchies, team work structures, incentives and rewards for learning, information and communication networks, research and development budgets, and programs*.

According to our critical review of available literature, stakeholders need to explore the process by which classroom learning can become LP. To enhance individual, collective, and organizational assessments, the process of moving towards a learning culture begins. Attention is given to the routines of LOA that can be established within LP to make assessment systematically become an integral part of what the learning does. We should develop a set of practical guidelines for LOA to show how LP can make students start to have an influence on the structural factors and to activate learning cultures in classroom settings in order to enhance their own learning.

Implications for pedagogical practice The message is clear: there is an urgent need to revise and redesign pedagogy to reconcile the tensions among assessment *as*, *for*, and *of* learning and to glean the benefit of each to enhance learning and teaching (Mok 2013). Following MECY (2006), Carless (2007), and Mok (2013), implications for pedagogical practices may be summarized into several aspects, including balancing the tensions, developing students' evaluative expertise, differentiating instructions, and maximizing feedback potential.

First and foremost, appropriate approaches to AfL, AaL, and AoL need to be developed to balance the tensions among assessment *of*, *for*, and *as* learning (e.g., it is very difficult to serve three different assessment purposes at the same time, MECY 2006). A major challenge to a learning-oriented perspective on assessment is the dominance of viewpoints that simply equate assessment with grading or measurement. AaL and AfL risk being drowned by the power of SA. Potential approaches appear to be contributing to productive synergies among AfL, AaL, and AoL and the kinds of SA or AoL that promote the characteristics of assessment tasks as learning tasks, student engagement in assessment, and feedback as feed-forward discussed above.

Second, it is necessary to develop students' evaluative expertise in order to realize their involvement in the assessment. Developing evaluative expertise includes teaching students to learn and use self- and peer-assessment. Another way is to encourage them to engage with criteria allied with students' self-evaluations. A further attempt to promote evaluative expertise is to use student exemplars.

Third, an emphasis on AfL and AaL in the holistic framework for LOA presented above can lead to differentiated instruction. Teachers need to tailor their pedagogical practice to address the needs of groups and individuals. They ought to plan some learning contexts that are the same for all students while offering others for groups or individuals. They should draw on a wide range of strategies, activities, and related resources to involve students in their own learning, scaffold their learning along the way, and provide experiences that give students lots of practices and supports. These plans must provide the blueprint that they and their students can use to improve students' learning for individuals, groups and whole classes. "Assessment is then the key to making on-the-spot modifications, or, if need be, proceeding in another direction" (MECY 2006, p. 72).

In addition, practitioners need to develop and then systematize assessment feedback to maximize its potential for students' action in line with the LOA framework. Carless (2007) presented a case demonstrating how feedback was designed and enacted and hence became feed-forward. Feedback must be relevant to assessment assignments in LOA. One form of feedback may come 2 weeks before the due date of the first assignment. At this stage, individual tutorials are held instead of the regular taught class. This enables students to collect feedback on the drafts of their first assignments to receive reassurance that they are on the right track. In fact, students themselves have expressed the view that feedback on drafts is more useful to them than feedback on completed assignments. To encourage engagement with feedback, students may be required to write a response to the feedback at the beginning of the second assignment. This represents attempts to fulfill two conditions under which feedback supports learning, pertaining to timeliness and feedback that can be acted upon. A further form of feedback may be provided in class before the second assignment is due. In sum, a variety of timely written and verbal feedback may be provided during the course.

Meanwhile, both the formative feedback on drafts for the first assignment and the feedback from the first assignment to the second one become, by nature, feed-forward.

Implications for innovative learning environment practices In recent years, many more researchers than previously have focused on the issue of integrating information and communication technology (ICT) into assessment. Carless (2006) argued that the Internet is also an integral part of learning for almost all students and is playing an increasingly important role in their assessment, so related people should communicate better in assessment through using technology. Keppell and Carless (2006) presented a case that used some principles of LOA within a module in a teacher education context. The module, focusing on multimedia and web authoring, was taught through blended learning with an emphasis on peer learning and project-based learning. The technology-enhanced assessment, as one of themes with relevance to LOA, was identified by Carless (2007) through a content analysis of the summaries of assessment practices. Hsu et al. (2013) exploited computerized adaptive testing (CAT) as a useful tool for implementing (S)LOA. Gikandi et al. (2011) conducted a systematic qualitative review of the research literature on online FA in higher education and argued for creating a learner- and assessment-centered learning environments (LALE).

This implies the emergence of a new trend to strongly support LOA through developing learning environments (LE). We know, informed by Fraser (1981), that scholars have been exploring themes of LE in curriculum evaluation for a long time. According to Davies et al. (2013), LE is taken to extend beyond the physical architecture of the space in which learning takes place, to encompass psychosocial and pedagogical features, and should include the influence of places and people outside the school. The role of assessment in facilitating good learning environments was highlighted by the Innovative Learning Environments Project (ILEP) (OECD 2010). ILEP reconceptualized “learning environments (LE)” in general and “innovative learning environments (ILE)” in particular. As Istance and Kools (2013) noted, ILE means that students’ assessment must be compatible with ICT-enriched learning. We conclude that there is a very mixed message being conveyed by expecting young people to be digitally literate and then assessing them in conventional ways supported by ICT. People should use assessments consistent with ILE’s aims, with strong emphasis on formative feedback or feed-forward, and technology can support FA and feedback/feed-forward. To take this idea further, Redecker and Johannessen (2013) argued for a paradigm shift in the use and deployment of ICT in assessment. They proposed that assessment strategies need to be harmonized better with twenty-first century learning approaches by re-focusing on the importance of providing timely and meaningful feedback to both learners and teachers. The e-assessment approach should go beyond the traditional “Explicit Testing Paradigm” and towards the “Embedded Assessment Paradigm” as a new assessment paradigm using ICT.

All this implies much more for LE practice. Firstly, we should build the new concept of ILE and then immerse the LOA in ILE practice. Secondly, we need to promote current ICT-enabled assessment practices, with a particular focus on the more recent developments of ICT-enhanced assessment tools that allow the recognition of twenty-first century skills. Thirdly, we should realize the embedded assessment, with an attention to advance Computer-Based Assessment (CBA) to seamlessly integrate holistic and personalized assessment into learning. Additionally, teacher education

and professional development need to emphasize technology and promote ICT literacy in all stakeholders, especially ensuring the assessment literacy of teachers and students.

Implications for teacher education practices A group of studies examined the assessment literacy of pre- and in-service teachers, found that this was an area in which they were lacking, and then developed recommendations for teacher education practices (e.g., Plake and Impara 1996; Volante and Fazio 2007; Wang et al. 2008; DeLuca and Klinger 2010; Fan et al. 2011; Koh 2011; DeLuca et al. 2013). Based on these studies, we propose some recommendations for both pre-service and in-service teacher professional development and action research in classroom assessment in the next section.

First, we recommended four strategies to cultivate teacher candidates' LOA literacy: (1) integrating the assessment literacy into the National Standards of teacher education, (2) increasing and optimizing a series of courses about evaluation and assessment in teacher education and training programs, (3) incorporating at least one innovative LOA course into the program, and (4) developing lab-based approaches to learning and teaching in a series of courses of evaluation and assessment, especially in LOA-oriented courses, so as to help students increase their experiences of assessment practices.

The second recommendation is drawn from the findings reported by Volante and Fazio (2007), that teachers mentoring pre-service teachers in field practice were also likely to have notable weaknesses in the application of effective assessment and evaluation practices. They recommended careful selection of assessment literate in-service teachers to act as mentors and that they should ideally have professional development opportunities. Furthermore, others (e.g., MECY 2006; Carless et al. 2006a, b; Carless 2007; Tang and Chow 2007; Bennett 2010; Volante 2010; Mok 2013) have emphasized the importance of all in-service teacher having access to this type of professional development. We support this recommendation that all in-service teachers should be given more professional development opportunities to learn and practice LOA as a way to change their mindsets and build the necessary capacity through receiving support from the local leadership, the work environments, and the wider community.

Third, it is well known that action research processes have been seen to be particularly suitable for exploring new assessment practices. Carless (2007) set up action research teams to explore the many themes discussed in the literature in relation to teachers' developmental work with their own classes. We recommend that action research is a suitable strategy for dealing with the development of LOA including AaL, AfL, and AoL.

4.2.2 Implications for future research

As a relatively new educational practice, LOA is worth studying in the future. As Dobson (2010) and Mok (2013) pointed out, there is a need for much more research that develops systems of theories and strategies for expanding LOA and that provides evidence of how LOA, AoL, AfL, and AaL improve students' learning. Hence, it is important for our study to provide some suggestions about the implications of the studies reviewed here for future research on LOA. Stödborg (2012) used a special framework focusing on research topics, research settings, and research methods, thus

addressing three interrelated questions: what is to be researched, who is to do the research, and how the research is to be done. To address these questions, the focus of the following discussion is the three areas of research topics, research facilitators, and research methods of LOA.

Implications for future research topics We can see that the study of LOA is a valuable and potentially fruitful area of future research. Classroom assessment is content-specific, and thus, there are countless LOA research topics in various contexts and disciplines, but many of these fall within the dimensions of education. The research topics that emerged from the analyses described in this paper can be represented with five key words: fundamentals, strategies, effects on learning, literacy, and e-assessment. These five topics might be especially appropriate for future studies in this area. *Fundamentals* include articles that analyze and interpret theoretical fundamentals and principles underpinning LOA. *Strategies* include articles introducing, examining, discussing, or evaluating methods and tools used in LOA. *Effects on learning* include articles examining or discussing all kinds of effects that LOA has on learning motivation, engagement, and outcomes. *Literacy* refers to articles concerning teachers' and learners' experiences, course development, and the use of LOA including AoL, AfL, and AaL. *E-assessment* refers to articles in which specific e-assessment referenced from LOA was developed and examined.

Firstly, related studies can be used as baselines to explore emerging philosophical, sociological, psychological, and scientific theories of LOA. We will continue to collect related theories (e.g., meta-theory of assessment, Bevitt 2015) and periodically analyze and compare them to the results of this study. Doing so will show which theoretical arguments are increasing or decreasing and help to determine if new fundamentals are emerging for LOA. The second topic that needs to be addressed is research on other strategies of LOA to make AoL, AfL, and AaL more effective. Researchers have already presented general strategies in related studies based on universality of classroom assessment, but what teachers and learners need is all kinds of effective strategies to implement LOA in specific contexts and disciplines. The third topic may be highlighted by Mok (2013), who focused on the effects of LOA on learning. Indeed, at the very start, Carless et al. (2006a) highlighted LOA in action and paid attention to how assessment supports learning so as to respond to challenges at the interface between assessment and learning. It is expected that relationships and interfaces between assessment and learning must be constant themes in research topics of LOA, and these will be valuable for future research on AoL, AfL, and AaL. The fourth area for future research is the improvement of LOA literacy of both teachers and learners. A long time ago, Stiggins (1991) coined the term “assessment literacy.” Since then, scholars have assessed and discussed teacher assessment literacy continuously (Plake and Impara 1996). Up to now, as Gotch and French (2014) pointed out, teacher assessment literacy has been viewed not only as an important characteristic of effective teachers but also as a hot topic of policy consideration. To promote learning, students' assessment literacy is as significant as the teacher's. Recently, some scholars (Smith et al. 2013) conceptualized students' capacities to understand and use assessment as assessment literacy, defined as their understandings of the rules surrounding assessment in their course context, their use of assessment tasks to monitor or further their learning, and their ability to work with the guidelines on standards in their context to produce

work of a predictable standard. We argued that the notion of assessment literacy is multi-dimensional, and dimensions of assessment literacy contribute to educational gains. This in turn means that creating a research emphasis on the development of teachers' and students' assessment literacy can enhance learning outcomes. Finally, the most significant topic for future research may be to explore the development of e-assessment. LOA not only attempts to integrate assessment into learning but also seeks to automate assessment. Related studies have shown that automation can save time for teachers and learners as assessors (Heap et al. 2004; Stöðberg 2012), which they can spend in more effective and deeper teaching and learning. It is very exciting (Yang and Tate 2012) that "cloud computing," as a term for Internet-based computing service, promises to provide on-demand computing power with quick implementation, low maintenance, fewer IT staff, and consequently lower costs, and this has become a dominant IT-related topic over the past several years. Some scholars (Lin et al. 2014) have described the design and development of education cloud platform while others (Wilmott and Knox 2012) have reported the cloud-based assessment practices used in undergraduate courses and seemed convinced that judicious use of cloud applications opens up opportunities for providing authentic and innovative assessment. Thus, we believe that future e-assessment will become alternative cloud-based assessment. Based on Stöðberg's framework of research topics relating to e-assessment (2012), we summarized five categories of emerging research themes related to cloud-based assessment referenced from LOA, namely implementation, tools, reliability, alternative learning environments, and cognitive skills. Additionally, and especially, both artificial intelligence (AI) (Youssefa et al. 2017) and the neuroscience of education (Fourie et al. 2017) are developing rapidly, and they can be integrated into e-assessment, which is undoubtedly set to become a new and exciting research topic.

Clearly, the themes contained in these research topics about LOA are so numerous that for the research to be conducted well, it needs to be done by wider groups than just researchers from universities and research institutions. In the next section, we will present some suggestions to meet this challenge.

Implications for future research facilitators The results and discussions above suggested that researchers should include teachers and learners from schools as well as mainstream academics from higher education institutes in future research on LOA.

First, every teacher, either from higher education institutions, secondary schools, elementary schools or kindergartens, could and should become a researcher and then practice teacher research on LOA. This is because either AfL, AaL, or AoL is a strategic process that cannot be separated with teachers' activities. It has been evidenced that the teacher can be curriculum developer, assessment designer, and knowledge producer. To realize the goal, teachers are required to receive training they need to competently make and carry out the research plan, interpret the results, and apply them to make important decisions concerning classroom assessment and their students. Meanwhile, through doing research, teachers are equipped with more assessment literacy knowledge, skills, and expertise to make the good use of raw data to inform and support students' learning.

Second, it seems obvious that if student teachers are placed in positions where they can learn to challenge their existing views of practice through researching their own experiences of teaching and assessing, then such learning should be both valuable and

meaningful in shaping their subsequent practice. Based on the findings of previous studies, students have multiple identities and they can be explorers, researchers, authors, and experts. For example, Loughran (2015) reinterpreted the term student teacher (or pre-service teacher) as researcher. Nelson and Bishop (2013) reported a New Zealand example researching on students as action researchers at a middle school. Participation in LOA research can enhance students' learning experience and develop their abilities in self and peer assessment, such as understanding and implementing the marking criteria (Tang and Chow 2007).

Third, to make children or students become researchers, we need to watch for the methods they are offered and use. Research with children differs from research with adults. This problem results from adults' perceptions of children and children's lower position in adult society. Generally, there are three kinds of opinions on children: just the same or entirely different from adults or on a continuum along which research with children moves back and forth in the light of multiple factors: research contexts, research questions, researchers' attitudes and behaviors, children's individuality, and so on (Punch 2002). Accordingly, adult researchers use traditional methods or develop child/ student friendly ones or combine both for children. Furthermore, students should be taught what to research, how to research, and how to respond to the information gained through research in LOA. Any LOA research techniques cannot be used by students if researchers and teachers have not tried on themselves in the past, and LOA research cannot become a chore for students.

This part discussed LOA around the idea of teachers and students as researchers. Researchers need physically go to the classroom and collaborate with teachers and students in assessment practice. Methods more sensitive to children's particular interests and abilities should be created. Thus, action research, focusing on collaboration among scholars and practitioners, is being called for LOA research.

Implications for future research methods This article has significant implications for research methods. Action research (AR) is carried out routinely by classroom teachers and students. This research paradigm assists teachers and students to find what works with or impedes their teaching and learning. Specifically, through AR, teachers can spot and solve practical problems by changing something, such as assessment methods or procedures. Students, too, can become researchers by taking part in various assessment activities to find out and prove to themselves which assessment strategies are most effective for them. In this way, they will gradually take control of their learning and become more independent. Thus, the next discussion turned on how the LOA research is to be done in terms of AR in four aspects.

First, researchers and teachers should consider an action research approach to the study of LOA. This methodological position arises in response to the challenges of a philosophy of practical knowing. The shift in philosophical and methodological stance taken by educational researchers has left their mark on LOA. This has been the case not only in terms of the seemingly diverse range of questions asked about assessment issues but also in terms of the increasing spread of new methods and techniques used in LOA and action research.

Second, action research is a highly desirable research strategy, rather than an optional extra. The basic elements and methods of action research from the 1940s have been reinvented to engage with new types of problems and goals. The previous

study showed that there are eight main AR paradigms in the new millennium: collaborative AR, participatory AR, insider AR, living theory AR, systemic AR, anticipatory AR, ethnographic AR, and network AR (Chen et al. 2017). Collaborative AR has been used to promote classroom assessment (Carless et al. 2006b), but other paradigms have not yet. They need more consideration in the study of LOA in the future.

Third, action research has been regarded as one of the most suitable strategy to renew the assessment practice in schools (Torrance and Pryor 2001), but one of the problems faced by action researchers is that their findings are not necessarily applicable to other school systems or to school children in other school classrooms. Thus, the population sampling problem must be faced and solved by researchers. Appropriate sampling strategies increase how well any findings of LOA can be generalized to a population from a smaller sample. The need for large sample sizes can be addressed in various ways, but one innovative solution is to make use of emerging technologies that have made more elegant research designs, such as multilevel modeling.

Last, with the proliferation of new research paradigms and the increasing difficulty and complexity of practical and academic questions about LOA, mixed methods research is emerging that integrates philosophical research, quantitative research, qualitative research, and action research (e.g., the combination of qualitative and quantitative research to explore how LOA affected students' writing; Kim and Kim 2017). Holistic action research or mixed research methods are becoming dominant in social science methodology. Since action research is change oriented, it requires data that helps to track the consequence of intended changes. The core of the research process derives from interpreting and making sense from these data (Elden and Chisholm 1993). Action research is not limited to or precludes any special data collection or analysis methods. Rather, it uses methodological pluralism, such as LOA Project conferences and portfolio (Carless 2007), which allows researchers to choose the most pragmatic collection and analysis method (philosophical, quantitative, and qualitative) that best suit their special research questions (Guiffrida et al. 2011). Based on empirical data, a plenty of themes related to LOA can be identified and furthered explored by teachers with their own class.

5 Conclusions

The present study was designed to determine the historical development and essential intentions of LOA and discussed the strategic measures involved in its development. Through a critical review, 48 publications were included and analyzed. The 48 studies examined portrayed why LOA emerges, what it means, and how to apply it. The significance of the study was that the findings contributed the holistic framework for LOA and the dynamic framework for its development. However, a deficiency also existed. A weakness of this review was our focus only on selective but not on systematic evaluation of the included literature. A new study is necessary to appraise these literatures and present their qualities. On the basis of our results and discussion, we would like to draw several conclusions.

The first significant finding to emerge from this study is the analysis and interpretation of the progression from SA and FA to LOA. For a long time, psychologists

focused on developing classroom assessment measures and tools. The first assessment approach they developed was SA/AoL, which provides evidence for making decisions. However, AoL has driven schools to be places of sorting and ranking students, which resulted in some children failing to learn. To overcome the inadequacies of AoL, the next wave of researchers targeted assessment during learning instead of assessment after learning, which gave rise to a shift from SA/FA to AoL/AfL. AfL provides teachers and students with continuing, effective feedback. When AfL is translated from theory into practice, tensions emerge. It causes students to spend more time in assessment and less in learning. Thus, to remove this tension, the third new assessment approach, AaL, evolved. AaL aims to help students become self-directed learners. However, there are some contradictions among the three approaches. In order to balance and further blend three categories of assessments, the concept of LOA emerged. Despite the rapid rise, growing popularity, and widespread adoption of LOA in recent years, a problem raised in the literature is concerned with the lack of conceptual clarity pertaining to the term.

The second major finding of this research is clarification and demonstration of the three types—AfL, AaL, and AoL—and their relationships. Based on this, a holistic conceptual framework of LOA was constructed. Specifically, the three approaches are distinct and interrelated for classroom assessment. From overviews of the related studies, it is evident that the three assessment approaches are different in four dimensions: meanings, purposes, implications, and key words. However, we contend that the relationships among them are interlocked. AoL, in the LOA framework, refers to assessment activities aiming to generate evidence about current learning. AfL refers to assessment activities collecting evidence with an aim to feed-forward to inform further learning in terms of directions and potentials. AaL, in the LOA framework, means that the student engages in a constant process of self-monitoring during learning.

Based on these notions, we can conceive a holistic framework for LOA, which consists of three aspects: the environment foundation of LOA, its three main purposes, and two mechanisms within it. Firstly, the “environment” foundation of LOA refers to the innovative learning environments. Secondly, “three main purposes of LOA” refer to the certification purpose, the learning purpose, and the development purpose. Thirdly, “two mechanisms within LOA” refer to learning mechanisms and teaching mechanisms.

Another contribution of this paper is a dynamic framework for LOA, which includes three components of method-implementing, mindset-changing, and capacity-building. Specifically, the strategies for developing LOA involve two dimensions: effective methods and strong support. The former is the procedure of designing and implementing LOA. It refers to a detailed operation of the three assessment approaches, which forms the framework for thinking about how to select or develop assessment tasks, how to use them, and how to communicate about them with students, parents, and others. The latter comes mainly from both mindset-changing and capacity-building. Mindset-changing refers to ideas about what is needed to change and sustain LOA practices and capacity-building means using a set of strategies, structures, and processes to build capacities needed to embed and sustain changes to LOA. Moreover, we have elaborated upon the concept of developing LOA as bringing together three elements of a 3-D ball for enhancing assessment literacy in all relevant stakeholders. This ball provides a dynamic framework, which makes LOA development more innovative, powerful, and effective for enhancing learning and developing metacognition.

Taken together, the above findings and contributions of the study suggest that, in learning practices, educators should design assessment in such a way as to ensure it is not a burden separated from learning tasks, but an integral part of the teaching and learning process. In pedagogical practices, innovative classroom teaching is needed and realized through dealing properly with the relationships among AaL, AfL, and AoL, improving students' own assessment abilities; stratifying teaching to satisfy different needs of each individual student, groups, and the whole class; and making use of feedback to further and deepen students' learning. In innovative learning environments, the new term ILE should be created, the old ICT-enabled assessment tools should be improved, and the holistic and personalized assessment and learning should be integrated. In teacher education practices, it is urgent to increase assessment literacy of pre- and in-service teachers and apply action research in the classroom assessment.

Implications for future research also can be drawn from the present study. Five potential research topics have been explored and are recommended. Currently, scholars approach LOA from very different theoretical angles and there is not yet any detailed or systematic discussion about each or all intellectual threads; thus, the first research topic pertains to following, learning, and explaining theoretical foundations of LOA. Due to the enthusiasm and efforts of researchers and teachers, multiple strategies of LOA have been built but not been reviewed; in this context, the second research topic contains sorting, comparing, analyzing, and even creating approaches to LOA. The reason for the burgeoning LOA literature and practice is its positive impacts on students' learning. Questions about the effects and how they come about are worthy of consideration, so this is the third research topic. The effectiveness of LOA strategies depends on teachers and students. That is to say, knowledge of assessment and use of assessment information and tools, which is called assessment literacy, should be explored. Consequently, this is the fourth topic. Finally, in keeping with the trends and advancement of education and society, resources of science and technology, especially, both artificial intelligence and neuroscience, should be exploited for the improvement of LOA practices.

With regard to the researchers themselves, an important implication of this study is the necessity to include teachers and learners in future research on LOA. First, every teacher, from either higher education institutions, secondary schools, elementary schools, or kindergartens, could and should become a researcher and then practice teacher research on LOA. Second, it seems obvious that if student teachers are placed in positions where they can learn to challenge their existing views of practice through researching their own experiences of teaching and assessing, then such learning should be both valuable and meaningful in shaping their subsequent practice. Third, to make children or students become researchers, we need to watch for the methods they are offered and use.

Teachers and students should have access to appropriate research methods and ongoing support to realize the goal of becoming researchers. The results of this study suggest action research as an important future research method for LOA studies. Four aspects that constitute the action research methodological system have been discussed. First, researchers and teachers should consider an action research approach to the study of LOA. Second, action research is a highly desirable research strategy, rather than an optional extra. Third, appropriate sampling strategies increase how well any findings of LOA can be generalized to a population from a smaller sample. Last, with the proliferation of new research paradigms and the increasing difficulty and complexity

of practical and academic questions about LOA, mixed methods research is emerging that integrates philosophical research, quantitative research, qualitative research, and action research.

The present study makes several noteworthy contributions to research on LOA. Firstly, it extends our knowledge of the evolution of LOA. Previous research has focused on discussions about LOA or comparisons of one or more types of assessment. These studies serve as a foundation and support for understanding and using classroom assessment but fail to draw a whole picture of LOA history. By tracking the course of evolution of assessment from the perspective of cultural philosophy and learning, this study provides a kind of blueprint of LOA. Secondly, based on historical investigation and definition analysis, a holistic framework for LOA is advanced which not only confirms the findings of AfL, AaL, and AoL studies that assessment fosters learning but also gives an innovative definition of LOA. Thirdly, the dynamic framework for developing LOA that we have offered can assist teachers and students to design and implement LOA.

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References

Items marked with an * in this reference list are selected articles of this study.

- Abdul Aziz, M. N., & Yusoff, N. (2016). Improving process writing with the use authentic assessment. *International Journal of Evaluation and Research in Education*, 5(3), 200–204.
- Angeli, C., & Valanides, N. (2009). Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: advances in technological pedagogical content knowledge (TPCK). *Computers and Education*, 52, 154–168.
- *Antoniou, P., & James, M. (2014). Exploring formative assessment in primary school classrooms: developing a framework of actions and strategies. *Educational Assessment, Evaluation and Accountability*, 26(2), 153–176.
- *Baas, D., Castelijns, J., Vermeulen, M., Martens, R., & Segers, M. (2015). The relation between assessment for learning and elementary students’ cognitive and metacognitive strategy use. *British Journal of Educational Psychology*, 85(1), 33–46.
- Bandiera, M., & Bruno, C. (2006). Active/cooperative learning in schools. *Journal of Biological Education*, 40(3), 130–134.
- Bayat, A., Jamshidipour, A., & Hashemi, M. (2017). The beneficial impacts of applying formative assessment on Iranian University students’ anxiety reduction and listening efficacy. *International Journal of Languages’ Education and Teaching*, 5(2), 1–11.
- Bell, B., & Kozlowski, S. (2008). Active learning: effects of core training design elements on self-regulatory processes, learning, and adaptability. *Journal of Applied Psychology*, 93(2), 296–316.
- *Bennett, R. (2010). Cognitively based assessment of, for, and as learning (CBAL): a preliminary theory of action for summative and formative assessment. *Measurement*, 8(2), 70–91.

- Bennett, R. (2011). Formative assessment: a critical review. *Assessment in Education Principles Policy and Practice*, 18(1), 5–25.
- Bennett, R., & Gitomer, D. (2009). Transforming k–12 assessment: integrating accountability testing, formative assessment and professional support. In C. Wyatt-Smith, & J. J. Cumming (Eds.), *Educational assessment in the 21st century* (pp. 43–61). Dordrecht: Springer.
- Bernauer, J., & Fuller, R. (2017). Beyond measurement-driven instruction: achieving deep learning based on constructivist learning theory, integrated assessment, and a flipped classroom approach. *Journal on Excellence in College Teaching*, 28(2), 111–132.
- Bevitt, S. (2015). Assessment innovation and student experience: a new assessment challenge and call for a multi-perspective approach to assessment research. *Assessment and Evaluation in Higher Education*, 40(1), 103–119.
- Beyer, B., Herrmann, D., Meek, G., & Rapley, E. (2010). What it means to be an accounting professor: a concise career guide for doctoral students in accounting. *Issues in Accounting Education*, 25(2), 227–244.
- *Black, P., & Wiliam, D. (1998). Inside the black box: raising standards through classroom assessment. *Phi Delta Kappan*, 80(2), 139–148.
- *Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: putting it into practice*. Maidenhead: Open University Press.
- *Black, P., Harrison, C., Lee, C., Marshall, B., & William, D. (2004). Working inside the black box: assessment for learning in the classroom. *Phi Delta Kappan*, 86(1), 9–21.
- Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., & Sese, F. (2013). Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. *Computers and Education*, 62, 102–110.
- *Bloom, B., Hastings, J., & Madaus, G. (1971). *Handbook on the formative and summative evaluation of student learning*. New York: McGraw-Hill.
- Bowers, P., & Ryan, S. (2013). Models of faculty assessment and review: an exploration of forty peer and aspirational institutions. *International Journal of University Teaching and Faculty Development*, 4(2), 91–100.
- Bullough Jr., R. (2001). Pedagogical content knowledge circa 1907 and 1987: a study in the history of an idea. *Teaching and Teacher Education*, 17(6), 655–666.
- *Carless, D. (2006). Differing perceptions in the feedback process. *Studies in Higher Education*, 31(2), 219–233.
- *Carless, D. (2007). Learning-oriented assessment: conceptual bases and practical implications. *Innovations in Education and Teaching International*, 44(1), 57–66.
- *Carless, D. (2015). Exploring learning-oriented assessment processes. *Higher Education*, 69(6), 963–976.
- *Carless, D., Joughin, G., & Liu, N. (2006a). *How assessment supports learning: Learning-oriented assessment in action*. Hong Kong: Hong Kong University Press.
- *Carless, D., Joughin, G., & Mok, M. M.C. (2006b). Learning-oriented assessment: principles and practice. *Assessment and Evaluation in Higher Education*, 31(4), 395–398.
- CCSSO. (2010). Common core state standards. <http://www.corestandards.org/the-standards>. Accessed 20 March 2013.
- Chen, S. Y., Huang, F. Q., & Zeng, W. J. (2017). Comments on systematic methodologies of action research in the New Millennium: a review of publications 2000–2014. *Action Research*, 147675031769110. <https://doi.org/10.1177/1476750317691103>.
- *Clark, I. (2012). Formative assessment: assessment is for self-regulated learning. *Educational Psychology Review*, 24(2), 205–249.
- Colantonio, J. (2005). Assessment for a learning society. *Principal Leadership*, 6(2), 22–26.
- Council of Australian Governments. (2008). National Education Agreement. <http://www.acara.edu.au/default.asp>. Accessed 21 March 2013.
- Cox, S., & Robinson-Pant, A. (2008). Power, participation and decision making in the primary classroom: children as action researchers. *Educational Action Research*, 16(4), 457–468.
- *Curry, K., Mwavita, M., Holter, A., & Harris, E. (2016). Getting assessment right at the classroom level: using formative assessment for decision making. *Educational Assessment, Evaluation and Accountability*, 28(1), 89–104.
- Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education—a systematic literature review. *Thinking Skills and Creativity*, 8, 80–91.
- DeLuca, C., & Klinger, D. (2010). Assessment literacy development: identifying gaps in teacher candidates' learning. *Assessment in Education: Principles, Policy and Practice*, 17(4), 419–438.
- DeLuca, C., Chavez, T., Bellara, A., & Cao, C. (2013). Pedagogies for preservice assessment education: supporting teacher candidates' assessment literacy development. *The Teacher Educator*, 48(2), 128–142.

- Depaepe, F., Verschaffel, L., & Kelchtermans, G. (2013). Pedagogical content knowledge: a systematic review of the way in which the concept has pervaded mathematics educational research. *Teaching and Teacher Education*, 34(1), 12–25.
- Dobson, S. (2010). Book review: how assessment supports learning. *Learning-oriented assessment in action. Assessment in Education: Principles, Policy and Practice*, 17(1), 105–112.
- Ducker, B., Holmberg, C., & Becker, J. (2017). Making moves: formative assessment in mathematics. *Mathematics Teaching in the Middle School*, 22(6), 334–342.
- *Earl, L. (2003). *Assessment as learning: Using classroom assessment to maximize student learning*. Thousand Oaks: Corwin Press.
- Elden, M., & Chisholm, R. (1993). Emerging varieties of action research: introduction to the special issue. *Human Relations*, 46(2), 121–142.
- Elliott, J. (2003). Dynamic assessment in educational settings: realizing potential. *Educational Review*, 55, 15–32.
- *Embretson, S. (2010). Cognitively based assessment and the integration of summative and formative assessments. *Measurement*, 8(4), 180–184.
- Fan, Y.-C., Wang, T.-H., & Wang, K.-H. (2011). A web-based model for developing assessment literacy of secondary in-service teachers. *Computers and Education*, 57(2), 1727–1740.
- Fernández-Balboa, J.-M., & Stiehl, J. (1995). The generic nature of pedagogical content knowledge among college professors. *Teaching and Teacher Education*, 11(3), 293–306.
- Flavell, J. (1979). Metacognition and cognitive monitoring: a new area of cognitive developmental inquiry. *American Psychologist*, 34(10), 906–911.
- Flavell, J. (1985). *Cognitive development*. Englewood Cliffs: Prentice-Hall Inc.
- Flynn, B., Kakibara, S., Schroeder, R., Bates, K., & Flynn, E. (1990). Empirical research methods in operations management. *Journal of Operations Management*, 9(2), 250–284.
- Fourie, M., Stein, D., Solms, M., Gobodo-Madikizela, P., & Decety, J. (2017). Empathy and moral emotions in post-apartheid South Africa: an fMRI investigation. *Social Cognitive and Affective Neuroscience*, 12(6), 881–892.
- Fraser, B. (1981). Learning environment in curriculum evaluation: a review. *Evaluation in Education*, 5(1), 1–93.
- *Friesen, S. (2016). *Assessment for learning in a math classroom*. Cham: Springer International Publishing.
- *Gibbons, S., & Kankkonen, B. (2011). Assessment as learning in physical education: making assessment meaningful for secondary school students. *Physical and Health Education Journal*, 76(4), 6–12.
- *Gikandi, J., Morrow, D., & Davis, N. (2011). Online formative assessment in higher education: a review of the literature. *Computers and Education*, 57(4), 2333–2351.
- Gotch, C., & French, B. (2014). A systematic review of assessment literacy measures. *Educational Measurement: Issues and Practice*, 33(2), 14–18.
- Grant, M., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, 26(2), 91–108.
- Guiffredi, D., Douthit, K., Lynch, M., & Mackie, K. (2011). Publishing action research in counseling journals. *Journal of Counseling and Development*, 89(3), 282–287.
- Heap, N., Kear, K., & Bissell, C. (2004). An overview of ICT-based assessment for engineering education. *European Journal of Engineering Education*, 29(2), 241–250.
- *Heitink, M., Kleij, F., Veldkamp, B., Schildkamp, K., & Kippers, W. (2016). A systematic review of prerequisites for implementing assessment for learning in classroom practice. *Educational Research Review*, 17, 50–62.
- *Hounsell, D., Xu, R., & Tai, C. M. (2007). *Integrative assessment: Balancing assessment of and assessment for learning—guide no. 2*. Gloucester: The Quality Assurance Agency for Higher Education.
- Hsu, C.-L., Zhao, Y., & Wang, W.-C. (2013). Exploiting computerized adaptive testing for self-directed learning. In M. M. C. Mok (Ed.), *Self-directed learning oriented assessments in the Asia-Pacific* (pp. 257–280). Dordrecht: Springer.
- Huang, F. Q. (2003). On curriculum for learning: review from perspective of cultural philosophy. *Peking University Education Review*, 4(90–94), 99.
- *Hume, A., & Coll, R. (2009). Assessment of learning, for learning, and as learning: New Zealand case studies. *Assessment in Education*, 16(3), 269–290.
- InPraxis Group Inc. (2006). *Effective professional development: What the research says*. Edmonton: Alberta Education.
- Istance, D., & Kools, M. (2013). OECD Work on technology and education: innovative learning environments as an integrating framework. *European Journal of Education*, 48(1), 43–57.
- Järvelä, S., & Järvenojä, H. (2011). Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. *Teachers College Record*, 113(2), 350–374.

- *Jones, N., & Saville, N. (2016). *Learning oriented assessment—a systemic approach*. Cambridge: Cambridge University Press.
- Joughin, G. (2004) Learning oriented assessment: A conceptual framework. http://www.ied.edu.hk/loap/ETL_Joughin_LOAP.pdf. Accessed 16 June 2013.
- *Keppell, M., & Carless, D. (2006). Learning-oriented assessment: a technology-based case study. *Assessment in Education: Principles, Policy and Practice*, 13(2), 179–191.
- Kim, A., & Kim, H. (2017). The effectiveness of instructor feedback for learning-oriented language assessment: using an integrated reading-to-write task for English for academic purposes. *Assessing Writing*, 32, 57–71.
- Kirschner, P. (2005). Learning in innovative learning environments. *Computers in Human Behavior*, 21, 547–554.
- *Klenowski, V. (2006). Learning oriented assessment in the Asia Pacific region. *Assessment in Education: Principles, Policy and Practice*, 13(2), 131–134.
- Klute, M., Apthorp, H., Harlacher, J., & Reale, M. (2017). *Formative assessment and elementary school student academic achievement: A review of the evidence. REL 2017-259*. Washington, DC: Regional Educational Laboratory Central.
- Knowles, M. (1975). *Self-directed learning: a guild for learners and teachers*. New York: Association Press.
- Koh, K. (2011). Improving teacher' assessment literacy through professional development. *Teaching Education*, 22(3), 255–276.
- *Krogstrup, H. (1997). User participation in quality assessment: a dialogue and learning oriented evaluation method. *Evaluation*, 2(3), 205–224.
- Li, Y., Dong, M., & Huang, R. (2009). Toward a semantic forum for active collaborative learning. *Journal of Educational Technology & Society*, 12(4), 71–86.
- Lin, H., Wang, Y., Cai, J., & Li, C. (2014). Design and development of education cloud platform. *Journal of Chemical and Pharmaceutical Research*, 6(3), 383–386.
- Loughran, J. (2015). Student teacher as researcher. In J. J. Loughran, M. L. Hamilton, V. K. LaBoskey, & T. L. Russell (Eds.), *International handbook of self-study of teaching and teacher education practices* (pp. 1231–1258). Dordrecht: Springer.
- *Manitoba Education, Citizenship and Youth (MECY). (2006). *Rethinking classroom assessment with purpose in mind: Assessment for learning, assessment as learning, assessment of learning*. <http://www.edu.gov.mb.ca/ks4/assess/index.html>. Accessed 26 March 2013.
- *Martinez, M., Lipson, J. (1989). Assessment for learning. *Educational Leadership*, 46(7), 73–75.
- *Mclaren, S. (2012). Assessment is for learning: supporting feedback. *International Journal of Technology and Design Education*, 22(2), 227–245.
- *Miedijensky, S., & Tal, T. (2016). Reflection and assessment for learning in science enrichment courses for the gifted. *Studies in Educational Evaluation*, 50, 1–13.
- Miller, M. (2008). Problem-based conversations: using preservice teachers' problems as a mechanism for their professional development. *Teacher Education Quarterly*, 35(4), 77–98.
- Ministry of Education of P. R. China. (2011). Notice of the ministry of education on the issuance of the compulsory education curriculum standards of subjects such as the Chinese language, etc. (Version 2011). http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/moe_711/201201/xxgk_129268.html. Accessed 21 March 2013.
- *Mok, M. M. C. (2010). *Self-directed learning oriented assessment: assessment that informs learning and empowers the learner*. Hong Kong: Pace Publications Ltd.
- *Mok, M. M. C. (2013). *Self-directed learning oriented assessments in the Asia-Pacific*. London: Springer.
- Mysen, T. (2013). Towards a framework for controls as determinants of export performance. *European Business Review*, 25(3), 224–242.
- Nelson, E., & Bishop, P. (2013). Students as action research partners: a New Zealand example. *Middle School Journal*, 45, 19–26.
- Niess, M. (2005). Preparing teachers to teach science and mathematics with technology: developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, 21(5), 509–523.
- *O'Reilly, T., & Sheehan, K. (2009). *Cognitively based assessment of, for, and as learning: A framework for assessing reading competency*. ETS, Princeton. <http://www.eric.ed.gov/PDFS/ED507810.pdf>. Accessed 3 March 2012.
- OECD. (2010). *The nature of learning: Using research to inspire practice*. Paris: OECD.
- Palmer, A., & Choi, N. (2014). The current state of library open source software research: a descriptive literature review and classification. *Library Hi Tech*, 32(1), 11–27.
- *Pat-El, R., Tillema, H., Segers, M., & Vedder, P. (2013). Validation of assessment for learning questionnaires for teachers and students. *British Journal of Educational Psychology*, 83(1), 98–113.

- *Plake, B., & Impara, J. (1996). Teacher assessment literacy: what do teachers know about assessment? In Phye G. D. (Ed.), *Handbook of classroom assessment: learning, achievement, and adjustment* (pp. 53–68). Cambridge: Academic Press.
- Punch, S. (2002). Research with children: the same or different from research with adults? *Childhood*, 9(3), 321–341.
- Redecker, C., & Johannessen, Ø. (2013). Changing assessment—towards a new assessment paradigm using ICT. *European Journal of Education*, 48(1), 79–96.
- Regalla, M., & Peker, H. (2017). Prompting all students to learn: examining dynamic assessment of special needs and typical students in a Prekindergarten Inclusive French Program. *Foreign Language Annals*, 50(2), 323–338.
- Rovegno, I. (1992). Learning to teach in a field-based methods course: the development of pedagogical content knowledge. *Teaching and Teacher Education*, 8(1), 69–82.
- Rushmer, R., Kelly, D., Lough, M., Wilkinson, J., & Davies, H. (2004a). Introducing the learning practice—I. The characteristics of learning organizations in primary care. *Journal of Evaluation in Clinical Practice*, 10(3), 375–386.
- Rushmer, R., Kelly, D., Lough, M., Wilkinson, J., & Davies, H. (2004b). Introducing the learning practice—II. Becoming a learning practice. *Journal of Evaluation in Clinical Practice*, 10(3), 387–398.
- Schuitema, J., Peetsma, T., & van der Veen, I. (2012). Self-regulated learning and students' perceptions of innovative and traditional learning environments: a longitudinal study in secondary education. *Educational Studies*, 38(4), 397–413.
- Scriven, M. (1967). The methodology of evaluation. In R. W. Tyler et al. (Eds.), *Perspectives in evaluation, American Educational Research Association Monograph Series on Curriculum Evaluation* (pp. 39–83). Chicago: Rand McNally.
- Shen, R. H., & Huang, F. Q. (2004). A preliminary study of cooperative-activity-based learning. *Educational Research*, 297, 60–63.
- Shi, Y., Frederiksen, C., & Muis, K. (2013). A cross-cultural study of self-regulated learning in a computer-supported collaborative learning environment. *Learning and Instruction*, 23, 52–59.
- Shulman, L. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Shulman, L. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Education Review*, 57(1), 1–8.
- Simms, M., & George, B. (2014). Approaching assessment from a learning perspective: elevating assessment beyond technique. *Educational Assessment, Evaluation and Accountability*, 26, 95–104.
- Singh, C. K. S., Lebar, O., & Kepol, N. (2017). An observation of classroom assessment practices among lecturers in selected Malaysian higher learning institutions. *Malaysian Journal of Learning and Instruction*, 14(1), 23–61.
- Smith, C., Worsfold, K., Davies, L., Fisher, R., & McPhail, R. (2013). Assessment literacy and student learning: the case for explicitly developing students 'assessment literacy'. *Assessment and Evaluation in Higher Education*, 38(1), 44–60.
- Soni, G., & Kodali, R. (2012). A critical review of empirical research methodology in supply chain management. *Journal of Manufacturing Technology Management*, 23(6), 753–779.
- Stiggins, R. (1991). Assessment literacy. *Phi Delta Kappan*, 72, 534–539.
- *Stiggins, R. (2005a). From formative assessment to assessment for learning: a path to success in standards-based schools. *Phi Delta Kappan*, 87(4), 324–328.
- *Stiggins, R. (2005b). *Student-involved assessment for learning*. Upper Saddle River: Prentice Hall.
- *Stiggins, R. (2009). Assessment for learning in upper elementary grades. *Phi Delta Kappan*, 90(6), 419–421.
- Stödberg, U. (2012). A research review of e-assessment. *Assessment and Evaluation in Higher Education*, 37(5), 591–604.
- *Tang, S., & Chow, A. (2007). Communicating feedback in teaching practice supervision in a learning-oriented field experience assessment framework. *Teaching and Teacher Education*, 23(7), 1066–1085.
- Tanner, D. (2001). Authentic assessment: a solution, or part of the problem? *The High School Journal*, 85(1), 24–29.
- *Taras, M. (2005). Assessment—summative and formative: some theoretical reflections. *British Journal of Educational Studies*, 53(4), 466–478.
- *Taras, M. (2008). Assessment for learning: sectarian divisions of terminology and concepts. *Journal of Further and Higher Education*, 32(4), 389–397.
- Taylor, E. (2007). An update of transformative learning theory: a critical review of the empirical research (1999–2005). *International Journal of Lifelong Education*, 26(2), 173–191.

- Teasdale, R., Viskupic, K., Bartley, J., McConnell, D., Manduca, C., Bruckner, M., Farthing, D., & Iverson, E. (2017). A multidimensional assessment of reformed teaching practice in geoscience classrooms. *Geosphere*, 13(2), 608–627.
- Terpstra, D., & Rozell, E. (1997). Why some potentially effective staffing practices are seldom used. *Public Personnel Management*, 26(4), 483–495.
- *Tillema, H., Leenknecht, M., & Segers, M. (2011). Assessing assessment quality: criteria for quality assurance in design of (peer) assessment for learning: a review of research studies. *Studies in Educational Evaluation*, 37(1), 25–34.
- Torrance, H., & Pryor, J. (2001). Developing formative assessment in the classroom: using action research to explore and modify theory. *British Educational Research Journal*, 26(5), 615–631.
- Tough, A. (1967). *Learning without a teacher: a study of tasks and assistance during adult self-teaching projects*. Toronto: Ontario Institute for Studies in Education.
- UNESCO. (1990). *The world declaration on education for all and framework for action to meet basic learning needs*. <http://www.unesco.org/new/en/unesco/resources/online-materials/publications/unesdoc-database/>. Accessed 20 March 2013.
- Vallberg Roth, A.-C. (2014). Bedömning i förskolans dokumentationspraktiker: Fenomen, begrepp och reglering. *Göteborgs universitet, Institutionen för pedagogik och didaktik*, 19(4–5), 403–437.
- Van Driel, J., Veal, W., & Janssen, F. (2001). Pedagogical content knowledge: an integrative component within the knowledge base for teaching. *Teaching and Teacher Education*, 17(8), 979–986.
- *Volante, L. (2010). Assessment of, for, and as learning within schools: implications for transforming classroom practice. *Action in Teacher Education*, 31(4), 66–75.
- *Volante, L., & Fazio, X. (2007). Exploring teacher candidates' assessment literacy: implications for teacher education reform and professional development. *Canadian Journal of Education*, 30(3), 749–770.
- Voogt, J., Fisser, P., Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge: a review of the literature. *Journal of Computer Assisted Learning*, 29(2), 109–121.
- Wang, T.-H., Wang, K.-H., & Huang, S.-C. (2008). Designing a web-based assessment environment for improving pre-service teacher assessment literacy. *Computers and Education*, 51(1), 448–462.
- *Webb, M., & Jones, J. (2009). Exploring tensions in developing assessment for learning. *Assessment in Education: Principles, Policy and Practice*, 16(2), 165–184.
- Westbury, I., Hopmann, S., & Riquarts, K. (2000). *Teaching as a reflective practice: The German didaktik tradition*. London: Routledge.
- *Wiliam, D. (2011). What is assessment for learning? *Studies in Educational Evaluation*, 37(1), 3–14.
- Wilmott, D., & Knox, I. (2012). A review of cloud application assessment practices. *Education for Information*, 29, 229–242.
- *Winter, J. (2003). The changing prepositions of assessment practice: assessment of, for and as learning. *British Educational Research Journal*, 29(5), 767–772.
- Yang, H., & Tate, M. (2012). A descriptive literature review and classification of cloud computing research. *Communications of the Association for Information Systems*, 31, 35–60.
- Youssefa, A., El-Telbanya, M., & Zekry, A. (2017). The role of artificial intelligence in photo-voltaic systems design and control: a review. *Sustainable Energy Reviews*, 78, 72–79.