

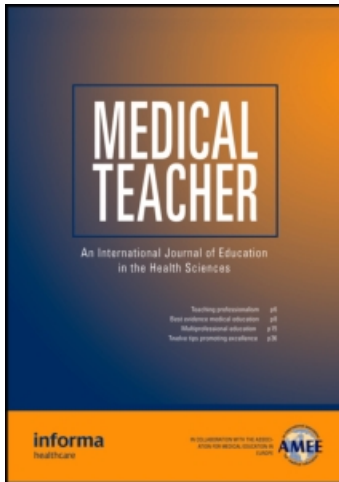
This article was downloaded by: [University of Maastricht]

On: 24 September 2009

Access details: Access Details: [subscription number 781062662]

Publisher Informa Healthcare

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Medical Teacher

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title-content=t713438241>

Portfolios for assessment and learning: AMEE Guide no. 45

Jan Van Tartwijk^a; Erik W. Driessen^b

^a Leiden University, The Netherlands ^b University of Maastricht, The Netherlands

Online Publication Date: 01 September 2009

To cite this Article Van Tartwijk, Jan and Driessen, Erik W.(2009)'Portfolios for assessment and learning: AMEE Guide no. 45',Medical Teacher,31:9,790 — 801

To link to this Article: DOI: 10.1080/01421590903139201

URL: <http://dx.doi.org/10.1080/01421590903139201>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.informaworld.com/terms-and-conditions-of-access.pdf>

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

AMEE GUIDE

Portfolios for assessment and learning: AMEE Guide no. 45

JAN VAN TARTWIJK¹ & ERIK W. DRIESSEN²

¹Leiden University, ²University of Maastricht, The Netherlands

Abstract

In 1990, Miller wrote that no tools were available for assessment of what a learner *does* when functioning independently at the clinical workplace (Miller 1990). Since then portfolios have filled this gap and found their way into medical education, not only as tools for assessment of performance in the workplace, but also as tools to stimulate learning from experience. We give an overview of the content and structure of various types of portfolios, describe the potential of electronic portfolios, present techniques and strategies for using portfolios as tools for stimulating learning and for assessment, and discuss factors that influence the success of the introduction. We conclude that portfolios have a lot of potential but that their introduction also often leads to disappointment, because they require a new perspective on education from mentors and learners and a significant investment of time and energy.

Introduction

Today's doctors find themselves confronted not only with patients who are increasingly knowledgeable and assertive, but also with pressure to apply new findings and evidence in day-to-day practice, and with the necessity to collaborate with other health professionals in ever larger teams and communities. To deal with these complexities, doctors need generic competencies to enhance effective communication, organisation, teamwork and professionalism. These generic competencies are sometimes labelled as doctors' 'soft skills' in contrast to 'hard clinical skills'. In recent years, learning, teaching and assessment of these generic competencies have gained unexpected urgency among politicians and the general public. Headlines decrying incidents involving dysfunctional doctors and hospital departments with dramatic impact on morbidity and mortality figures catapulted generic competencies to the forefront of attention as indispensable qualities for doctors. As a result, professional associations and governments began to voice increasingly urgent demands to include these generic competencies in education and assessment (General Medical Council 2000). At the same time, consistent with the general trend towards outcome-based education, the focus in medical education shifted from the educational process itself towards the competencies of doctors at the end of training and at important junctures during the training process (Norcini et al. 2008). The competencies described by professional organisations such as the Royal College of Physicians and Surgeons of Canada (1996) became the framework for assessment and, as a consequence, for the content and organisation of programmes for medical education in many countries.

Practice points

- The goals of working with a portfolio need to be clear.
- It is not problematic to use portfolios concurrently to formatively promote learning as well as for summative assessment. Summative assessment is important to ensure that portfolio learning maintains its status alongside other assessed subjects.
- The effectiveness of learning is enhanced when a mentor supports the portfolio process. Mentorship requires a substantial time investment but is crucial for the successful use of portfolios. The effectiveness of assessment can be enhanced by combining the portfolio with an interview.
- Use a flexible learner-centred portfolio format. A rigid structure in which every detail of portfolio content is prescribed will elicit negative reactions from portfolio users. Too much structure is a greater risk than too little structure, but learners do need clear directions and guidance to support the development and assessment of broad competencies. When there is too much obligatory content portfolios are bureaucratic, both failing to serve any educational purpose and forcing learners to search for content outside their direct and lived experiences.
- Working with a portfolio is time consuming both for learners and mentors. This is more of a problem in postgraduate training and continuous medical education than in undergraduate education.

However, stimulating the development of competencies (Box 1) and the assessment of its result is complicated.

Correspondence: Jan Van Tartwijk, ICLON – Leiden University Graduate School of Teaching, Leiden University, PO Box 905, 2300 AX, Leiden, The Netherlands. Tel: 31 71 527 3845; fax: 31 71 527 5342; email: jtartwijk@iclon.leidenuniv.nl

Box 1. Competence.

The concept of competence is much used and much debated (Stoof et al. 2002; Dreyfus 2004). Here, we define it as an integrated body of knowledge, skills and (professional) attitudes enabling proficient performance in certain real life settings, i.e. the 'Does' level in Miller's framework.

Box 2. Portfolio.

Portfolios that are used in education contain evidence of how learners fulfil tasks and their competence is progressing. They may be digital or paper-based and content may be prescribed or left to the learners' discretion. Despite variations in content and format, portfolios basically report on work done, feedback received, progress made and plans for improving competence (Driessen et al. 2007b).

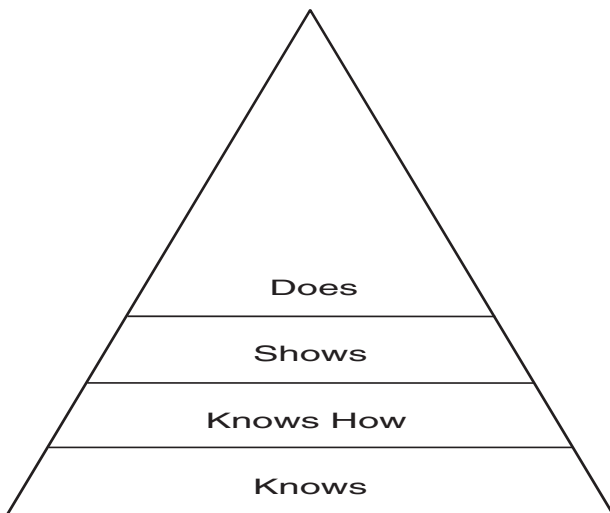


Figure 1. Framework for clinical assessment: Miller's Pyramid (Miller 1990).

Already in 1990, Miller described the challenges involved in assessing clinical competence. He presented a framework for clinical assessment, shaped like a pyramid (Figure 1), whose layers from bottom to top represent increasingly complex levels of mastery, with the lower levels providing the foundation for the higher levels (Miller 1990).

The bottom level is concerned with *knowledge*. This is the knowledge relating to the skills that learners must master for their future professional practice. This knowledge is best assessed by written tests. The next level represents application of the knowledge from level 1. Learners should know *how* to apply their knowledge when performing skills. For instance, at this level, learners are expected to know how to diagnose a patient and which aspects of a patient's presentation to attend to. The *Knows how* level can also be assessed by written tests. One level up, at level 3, the issue of interest is that learners demonstrate their ability to use their knowledge to *take appropriate action in a simulated environment*. This level combines knowledge and action (cognition and behaviour). Not only should learners know how to diagnose a patient, they should also be able to actually perform the appropriate actions, for example, a physical examination in a simulated patient (*shows how*). The top of the pyramid is concerned with *independent performance within the complex environment of day-to-day practice*. This requires integration of knowledge, skills, attitudes and personal characteristics. Performance at the top of the pyramid is manifested when learners are working independently in professional practice. Typically, adequate performance at this level requires integrated performance of different roles; not only the role of medical expert but also that

of counsellor, participant in the doctor–patient relationship, a leadership role in relation to nursing staff, etc. Good performance at the *Does* level implies competence.

In 1990, Miller observed that there were no instruments to evaluate performance consistent with the top of the pyramid (Miller 1990). At the same time, scholars in the field of teacher education and teacher assessment were struggling with the same problem (Bird 1990). Here too, the key challenge was how to assess performance in real life settings. Shulman (1998) describes the Teacher Assessment Project that was set up with the purpose of exploring and developing new approaches to the evaluation of teaching in primary and secondary education. He recounts that it was considered undesirable to assess teacher competence solely on the basis of ratings in assessment centres, because experiments showed that the information provided by assessment centres alone was not enough to identify competent and excellent teachers. Information about whether teachers succeeded in making the most of their pupils' learning opportunities *within* their own complex working environment was needed as well. It was also recognised that there can be striking variations among teaching settings. For instance, it makes quite a difference whether one teaches at an urban school in a deprived area with its myriad of social problems or at a high school in a middle class suburban environment. As part of efforts to achieve fair judgement of teacher performance in a broad array of settings and situations, the *portfolio* concept was borrowed from the arts and architecture (Box 2).

Since portfolios were introduced in medical education in the early 1990s (Royal College of General Practitioners 1993), their use as an instrument for *both* assessment and encouraging professional growth has increased enormously (Snadden et al. 1999; Friedman Ben David et al. 2001). However, the evidence to date suggests that the introduction of portfolios for these purposes has met with mixed success (Driessen et al. 2007b; Tochel et al. 2009; Buckley et al. 2009). Although potentially powerful instruments in education, the use of portfolios has proved to be vulnerable.

The aim of this AMEE guide is to help medical teachers and educators to make full use of the possibilities that portfolios offer and prevent difficulties that occur. On the basis of an analysis of what portfolios help achieve, it is our purpose to provide practical clues about the design, implementation and use of portfolios in medical education.

Firstly, we will describe how portfolio content and structure relate to the various goals that they are designed to achieve. Next, we will focus on the use of portfolios as instruments that can encourage professional growth by stimulating learning from experience and subsequently, we will elaborate on the

use of portfolios as instruments for assessment. Each of these goals requires specific content and organisation of portfolios. Finally, we will focus on the factors that are important for the successful introduction of portfolios in (medical) education.

Portfolio goals, content and organisation

Portfolios as a multipurpose instrument

Portfolios for assessment. When portfolios were originally introduced in education as instruments for authentic assessment, they closely resembled the portfolios of architects and artists, which Lyons (1998) describes as a portable case for keeping, usually without folding, loose sheets of papers, drawings or photographs. Building on the principle of triangulation (Denzin 1978; Denzin & Lincoln 2000) all kinds of evidence can be brought together in those portfolios that, in combination, give the possibility to draw valid conclusions about competence (Box 3).

However, in one of the first explorations of portfolios for teacher assessment, Bird (1990) wrote that the portfolio procedures for assessment might easily degenerate into exercises in amassing paper. He suggested that the evidence in a portfolio should be organised according to the competencies that the person compiling the portfolio wants to show. This would be helpful both for the learner compiling the portfolio and for an assessor. Instructions starting with ‘*Show how you ...*’ might clarify for portfolio owners that they are asked to provide specific evidence about their performance. A portfolio organised by tasks or competencies might be helpful for assessors, because it indicates what the material in the portfolio is supposed to show. On the basis of initial experiments with portfolios, Collins (1991) suggested that captions should be attached to the evidence in the portfolio:

One essential component of the portfolio was the document caption. The caption is a little sheet attached to each document stating what the document is (...) and why it is valuable evidence. (...) Captions proved to be essential to the portfolio development process. Documents without captions were meaningless to the raters. (p. 153)

Portfolios for learning. Soon after the introduction of portfolios in medical education, Snadden and Thomas (1998b) introduced the term ‘portfolio learning’:

Portfolio learning is a method of encouraging adult and reflective learning for professionals. Derived from the graphic arts it is based on developing a collection of evidence that learning has taken place. (p. 192)

They emphasise the importance of supervision and critical reflection for portfolio learning:

The system works well when it operates through the interaction of a learner and mentor using the material as a catalyst to guide further learning. It is essential that the portfolio does not become a mere

Box 3. Combining evidence to improve the quality of conclusions.

In the literature, combining data from various sources with the aim to improve the quality of conclusions is often referred to as triangulation. The aim of triangulation is to avoid biases and problems, such as those related to the reliability and trustworthiness of data that are derived from one single source.

Procedures for multisource feedback or 360-degree feedback use a similar strategy by stimulating learners to gather feedback from different sources. Lockyer and Clyman (2008) describe a procedure involving a questionnaire survey among medical colleagues, nurses, and patients and their families to collect data about learners’ specific competencies. The same questionnaire is completed by the learners themselves. By aggregating these data, reliability is improved.

Different types of evidence can be combined in portfolios as well, such as materials produced by learners (log books, case reports, clinical data, and research reports), mini-CEXs (Norcini & Burch, 2007), reports of direct observation of practical procedures, audits, and case-based discussions.

collection of events seen or experienced, but contains critical reflections on these and the learning that has been made from them. (p. 192)

A portfolio can also stimulate reflection, because collecting and selecting work samples, evaluations and other types of materials that are illustrative of the work done, compels learners to look back on what they have done and analyse what they have and have not yet accomplished.

In many cases, portfolios are assembled over a longer period of time. That is why they can also be used to support planning and monitoring in professional development. One way to do so is to include learning objectives in the portfolio as well as a document trail of related learning activities and accomplishments (Mathers et al. 1999; Oermann 2002).

As a consequence, reflections and overviews of personal development have secured a prominent place in many portfolios. Portfolios that are primarily geared to assessment will remain organised around all kinds of materials that provide ‘evidence’ of competencies. In portfolios that are primarily used to monitor and plan learners’ development, overviews will take centre stage. Portfolios whose primary objective is to foster learning by stimulating learners to reflect on and discuss their development will be organised around learners’ reflections.

*A multipurpose instrument*¹. Inevitably, these developments have widened the applicability of the label portfolio to a broad range of instruments. Some portfolios might equally and aptly be labelled Personal Development Plan or Reflective Essay. Owing to the tremendous varieties in portfolios, careful and critical appraisal of the strengths and weaknesses of different portfolios is advisable before deciding which one to implement in a particular setting.

The question to be answered is whether a certain portfolio is fit for its intended purpose. And just as someone else’s shoes are unlikely to fit comfortably, portfolios tailored to one particular educational setting may not fit into the educational configuration(s) of other settings (Spandel 1997). An ill-fitting portfolio will inevitably be discarded sooner or later. To assist in determining whether a portfolio is appropriate for its intended purpose the triangle in Figure 2 helps to define the nature of a portfolio. It does so by inviting positioning of a

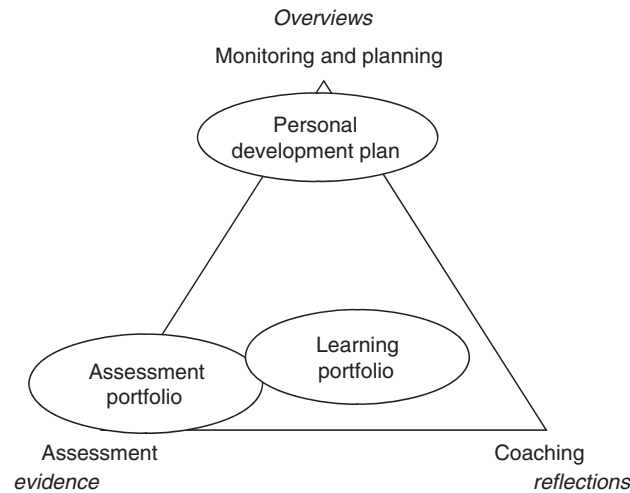


Figure 2. Purposes and content of portfolios (van Tartwijk et al. 2007).

portfolio in the area of the triangle where it is most likely to achieve its intended principal objectives.

Obviously, a portfolio can be used to achieve more than one goal. When a portfolio is to serve a combination of goals, its position in the triangle will shift towards the centre because its strengths have to be distributed more evenly over evidence, overviews and reflections. In practice, the majority of portfolios are not situated in one of the corners of the triangle (Buckley et al. 2009). A controversial issue in the literature on educational portfolios is whether it is acceptable to have one portfolio for both assessment and reflection (Snyder et al. 1998). An argument against this dual function is that assessment may jeopardise the quality of reflection thereby detracting from the portfolio's effectiveness for mentoring purposes. Learners may be reluctant to expose their less successful efforts at specific tasks and to reflect on strategies for addressing weaknesses if they believe they are at risk of having 'failures' turned against them in an assessment situation. Portfolios that are not assessed, on the other hand, do not 'reward' learners for the time and energy they invest in them. As a result, learners are likely to take the portfolio and any associated learning activities less seriously. A recent BEME review showed that most portfolios were also assessed for summative purposes (Buckley et al. in press).

An effective portfolio has a clear but flexible structure, giving individual learners' opportunities to describe their own unique development (Pearson & Heywood 2004; Driessen et al. 2005b; Grant et al. 2007). Clear instructions are important, but when the content of a portfolio is prescribed in detail, portfolios are often experienced as highly bureaucratic instruments (Davis et al. 2001; O'Sullivan et al. 2004; Pearson & Heywood 2004; Kjaer et al. 2006). Portfolios meet with stronger appreciation when learners have a certain amount of freedom to determine the content of their own portfolios (Snadden & Thomas 1998a; Driessen et al. 2005b).

Electronic portfolios

A growing number of medical schools use electronic portfolios (e-portfolios) instead of paper-based portfolios

(Fung Kee Fung et al. 2000; Lawson et al. 2004; Woodward & Nanohy 2004; van Tartwijk et al. 2007; Driessen et al. 2007a). This preference is based on a number of considerations:

- In e-portfolios, hyperlinks can be inserted to make connections between evidence, overviews and reflections. This can be useful, for instance, when learners want to illustrate reflections with evidence that is stored somewhere else in the portfolio, or want to illustrate a schematic overview of their development by making hyperlinks to materials and reflections. Hyperlinks can also be useful to make a table of contents of the portfolio. For instance, by including a list of captions in the portfolio and making hyperlinks to related materials. Mentors or assessors can browse through this list of captions, obtain a quick overview of all the evidence in the portfolio, and just click on the evidence that is relevant to their specific purpose.
- A paper-based portfolio can be cumbersome because of its bulk. Imagine an assessor who needs to take 15 paper portfolios home! Furthermore, there is generally only one copy of a paper portfolio. Whenever learners hand their paper portfolios to their mentor or assessor, the portfolio is literally out of their hands. Not only do they run the risk of the portfolio getting lost, it is also more difficult for them to prepare to discuss the portfolio with their mentor or assessor. Another advantage of e-portfolios is that they are easier to keep up to date.

Of course there are disadvantages as well.

- Mentors who do not like to read a portfolio on screen will still have to print it. In most systems it is not possible to make notes on the portfolio itself (although making notes on the learner's paper portfolio might not be desirable as well).
- E-portfolios can only be used by learners and teachers who are sufficiently skilled in using the relevant software and hardware.
- An e-portfolio requires a stable and high quality information technology infrastructure that is not always available.

Nowadays, many dedicated portfolio systems are available, which are usually user-friendly (Doran et al. 2002; www.eportfolioservice.nl). These systems can provide specific functionalities for specific portfolio goals: options to include work-based assessment instruments, such as multisource feedback or mini clinical evaluation exercises (mini-CEX) in portfolios for clinical training: to invite specific individuals to inspect the portfolio, either wholly or in part, while denying access to everyone else.

Apart from dedicated systems, learners can produce an e-portfolio using standard word-processors or HTML editors, preferably ones that they and their teachers are familiar with (Gibson & Barrett 2003). The cost of dedicated portfolio software is not the only reason to support this choice: for many purposes the hyperlink functionality of generic software is all that learners need. Furthermore, generic software allows a learner to impart his or her own flavour to the portfolio. This can enhance the learners' motivation to work with the instrument. Another reason is that many portfolio systems are limited because they are built to accommodate no more than one or two portfolio types. Finally, portfolios built with dedicated software need to be accessible with generic software for later maintenance and presentation. This may well be the case after a learner has left the setting in which the portfolio was produced, or in the event that the vendor in question ceases to do business. In summary, standard software tools have disadvantages from the perspective of managing access to the portfolio using the internet or to include work-based assessment instruments, but they usually provide all the options learners need to produce a portfolio that works well and looks great.

In a study comparing web-based and paper-based portfolios (Driessen et al. 2007a), not only did learners add more personal touches to content and form and invested more time in their portfolios, but mentors were also unanimous in their appreciation of the greater ease of use of web-based portfolios compared to the more familiar paper-based ones. Information was easy to locate without having to turn pages to find certain content and the portfolios could be accessed from different locations were the two reasons cited for preferring web-based portfolios. Other authors have also reported on the user friendliness of electronic portfolios (Fung Kee Fung et al. 2000; Lawson et al. 2004). In these studies, tutors appreciated the easy electronic access and reduction in the amount of paper used. However, the same authors also reported certain situations that make web-based portfolios less user-friendly than paper-based portfolios. For instance, limited computer access in the clinical workplace cancels out the advantages of user-friendliness and may even have an opposite effect.

Portfolios and learning from experience

Research shows that the role of the mentor is crucial to the successful use of portfolios aimed at learning from experience (Finlay et al. 1998; Snadden & Thomas 1998a; Mathers et al. 1999; Pearson & Heywood 2004; Driessen et al. 2005b; Grant et al. 2007). In this section, we focus on the strategies mentors can use to promote learning from experience with a portfolio.

Theoretical background

The contemporary view of learning, based on constructivism, is that people 'construct' new knowledge and understanding based on what they already know and believe (Bransford et al. 2000). What people know and believe can be represented as cognitive structures that guide their perception of reality. Evidently, a perception of reality based on individual cognitive structures does not afford an objective view of reality, but, by definition, an individual, idiosyncratic view. It is this personal perception of reality that guides a person's actions.

Reflection is an important concept in this framework, which relates to changing cognitive structures. Research has shown that meta-cognitive skills, such as reflection, increase the degree to which learners transfer what they have learned to new settings and events (Bransford et al. 2000). Despite considerable confusion about the precise definition of the term reflection (Hatton & Smith 1995; Mann et al. 2007) all authors writing about reflection share the constructivist view that human behaviour is guided by mental structures that are not static but flexible, evolving and changing in response to experiences. On the basis of this consensus view, reflection can be defined as the mental process of organising or reorganising cognitive structures that represent existing knowledge and beliefs and guide perceptions of experiences, situations and problems (Korthagen et al. 2001). In short, reflection means exploring and elaborating one's *understanding* of an experience (Eva & Regehr 2008). Building on van Manen's work (1977), Hatton and Smith (1995) distinguish three types or levels of reflection. The first type is concerned with the *means* to achieve certain ends. The second type is not only about means, but also about *goals*, the *assumptions* upon which they are based, and the actual *outcomes*. The third type of reflection is referred to as *critical reflection*. Here, moral and ethical criteria are also taken into consideration. Judgements are made about whether professional activity is equitable, just and respectful to persons or not. Hatton and Smith (1995) emphasise that these three types of reflection should not be viewed as hierarchical. Different (educational) contexts and situations may lend themselves more to one kind of reflection than to another.

Reflection and professional development

For medical teachers who want to help learners learn from practice, the key question to answer is: '*How can I stimulate my learners to reflect on their experiences and learn from them?*' For this AMEE guide the additional question is '*... and how can a portfolio help to improve the quality of reflection?*'

Korthagen designed the **Action, Looking back, Awareness, Creating alternative methods and Trial (ALACT)** model (Figure 3) to describe the spiralling process that effective learners go through when faced with a situation for which no routine solution is available (Korthagen et al. 2001). This model resembles the three step model described by Snadden and Thomas (1998b) which focused on evaluation, reflection and formulating a learning plan. We will describe the ALACT model, explain the potential contribution of working with a portfolio in each of the stages, and give suggestions for coaching strategies (Driessen et al. 2008).

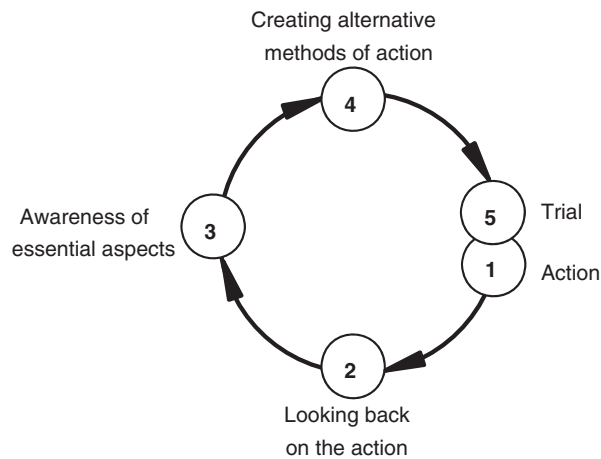


Figure 3. ALACT model showing the phases of spiral professional development (Korthagen et al. 2001).

ALACT

Action. The cycle starts with action undertaken for a specific purpose (e.g. for developing a specific competence). Learners can be helped to improve their existing routines and concurrently acquire new ones by pre-selecting experiences from which they can learn, for example a mixture of patients who are more or less easy to diagnose. Ericsson's research predicts that expertise will grow not just from the weight of experience but also from engaging in activities specifically designed or selected to improve performance (Ericsson 2006).

Looking back on action: Self directed assessment seeking. The ALACT cycle then moves to the stage where learners look back on a previous action, usually when that action was not successful or something unexpected happened. This looking back on action is assumed to be accompanied by an evaluation of whether the goals were realised and the learner's part in this. In many cases this can be regarded as a form of *self assessment*. Eva and Regehr (2008) write that most of the time self-assessment is conceptualised according to a 'guess your grade' model of which the quality is generally poor (Davis et al. 2006). As an alternative they propose *self-directed assessment seeking*, which they describe as a process by which a learner takes personal responsibility for looking outward, explicitly seeking feedback and information from external sources of assessment data, to direct performance improvements that can help them to validate their self-assessment.

The role of the portfolio – Seeking and selecting evidence (documents, feedback, work-based assessments, etc.) for inclusion in a portfolio can be regarded as self-directed assessment seeking. To improve the quality of this process, it is important to use a variety of evidence from various sources. The validity of the results of self-directed assessment seeking will be maximised if the learner's self-reflections are consistent with *all* the information that is brought together in a portfolio.

Teaching strategies – Research has shown that a mentor can play a decisive role in determining whether the use of portfolios in education is successful or not (Driessen et al. 2007b). At the very least, learners may expect their mentors

Box 4. Strategies to stimulate self-directed assessment seeking.

- Provide a safe environment by distinguishing between learners as individuals and their performance.
- Focus on description.
- Stimulate learners to be concrete in their reports. When learners give general evaluations about a situation and their performance, ask questions:
 - What went well?
 - What went wrong?
 - How did you solve this?
 - What effect did this have?
- Stimulate learners to carefully scrutinise all the information in their portfolio. Learners could be asked to go through all the available evidence and answer questions:
 - Which information in your portfolio supports your answers/evaluation?
 - Which information in your portfolio contradicts your answers/evaluation?
- Stimulate learners to take the perspective of other stakeholders. Ask questions:
 - What did you want? What do you think the patient/your colleague/the nurse wanted?
 - What did you think? What did the others think?
 - What did you do? What did the others do?
 - What emotions did you experience? What emotions did the other people involved experience?

to pay serious attention to their portfolios, for after all they did spend a lot of time and energy to put their portfolio together. But even more importantly, careful scrutiny of their own performance may be confronting for learners. Effective mentors have an important role in this respect. In Box 4, we give suggestions for a number of strategies to be used by medical teachers in this phase, derived from the work by Korthagen et al. (2002).

Awareness of essential aspects: Reflection. After conclusions have been drawn about the quality of performance and the characteristics of the situation, the next step in the ALACT model is to foster awareness of essential aspects. In this phase, learners try to develop a new and better understanding of what has happened, i.e. they reflect on their performance.

They can focus on the *means* they used to achieve a goal and try to understand why their strategy was successful or not.

They can also consider whether they had selected a suitable *goal* for this particular situation. And finally, they may consider what they want to achieve from a *moral or ethical* perspective.

The role of the portfolio – Language is important in supporting thinking. Writing down things can help to stimulate reflection (Korthagen et al. 2001). Written reflections were not a part of the original portfolios, such as the ones in which artists presented a selection from their work, but almost immediately after the introduction of portfolios in education, written reflections became a fixture of portfolios (Paulson et al. 1991). Embedding a written reflection in a portfolio has the advantage that it can be built on the self-assessment that was validated by the evidence in the portfolio. This is a form of facilitated reflection (Conlon 2003). The learner can also use the evidence to illustrate a reflection with a concrete example.

Teaching strategies – To stimulate learners to reflect and learn from their experiences, mentors do not need to have all the right answers. The most important thing for them is to ask the right questions. In Box 5 (available at www.medicalteacher.org) we give a number of examples of questions that mentors can ask.

Creating or identifying alternative methods of action: Change. Analysing previous actions may trigger a search for alternative strategies, or abandonment of original goals. It is important to explicate (new) goals and alternative strategies. A recent review showed that goal setting stimulates learning and that a mentor has an important role to play in this respect (Shute 2008). Learners who work with a mentor set more specific goals and improve more than those who do not work with a mentor (Smither et al. 2003). Very often, agreement about what should be done differently and which goals should be achieved are written down in a document that is referred to as a personal development plan (PDP).

The role of the portfolio – In many portfolios, the central goal is to keep track of the learner's development. In these portfolios, PDPs can have an important place. Snadden and Thomas (1998b) for instance, propose that when a portfolio is used for professional development and to track progress, it is important to attach some kind of learning plan to the portfolio.

Teaching Strategies – Both mentors and learners should commit to the agreements in the PDP and it should be on the agenda of their next progress meeting. The plans in the PDP are often too vague. It is important that mentors stimulate learners to be very concrete. It can be helpful to keep in mind that the learning goals in the plan should be formulated in a SMART way (Box 6, available at www.medicalteacher.org).

Trial. The last step in the ALACT cycle is trial. This is also the start of a new cycle in the spiral of professional development in this model.

Using portfolios as tools for assessment

In the introduction, we quoted Shulman (1998), who wrote that the reason for introducing portfolios in education as tools

for assessment is that in a portfolio information can be brought together about how a person performs and how his or her competencies develop in his or her own complex working environment. From the perspective of assessment, the strength of the portfolio is also its weakness. The evidence held by a portfolio is often not standardised and its meaning often depends on the context from which it originates.

Assessing non-standardised portfolios requires a different perspective on assessment than the traditional quantitative perspective that is best suited for analysing quantitative test scores or results from standardised observations. Authors like Snadden (1999) and Webb et al. (2003) all come to the conclusion that we should not try to fit non-standardised portfolios to standardised psychometric assessment criteria. They point out that portfolio assessment is primarily concerned with interpreting various forms of qualitative information and suggest that assessment procedures should be developed that are based on methods used in qualitative research.

In the following section, we will translate the insights of this literature into recommendations for portfolio assessment. We structure this section according to five questions that, according to Harden (1979), should always be asked and answered by medical teachers in relation to assessment:

- What is assessed?
- Why is this assessed?
- How is this assessed?
- Who assesses?
- When is this assessed?

What?

Although portfolios are also used in undergraduate medical education to assess reflective ability or communication skills (Driessen et al. 2003), portfolios are particularly suited to work-based assessment. In other words, they have added value at the *Does* level of Miller's pyramid (Miller 1990).

Many medical curricula are based on competency criteria developed by organisations, such as the General Medical Council (GMC), the American Council of Graduate Medical Education (ACGME) and the Royal College of Physicians and Surgeons of Canada (RCPSC). More often than not, additional detail is required to fit the competency criteria to assessment procedures. In aligning competency descriptions with assessment procedures it is of the essence to strike the right balance between very concrete but also very detailed and long lists of 'is able to' statements, on the one hand, and very global descriptions providing an overview but too little to support assessment, on the other hand. The extremes of this continuum have been referred to as an analytical versus a global approach. Both approaches have their pros and cons (Box 7, available at www.medicalteacher.org).

A way to combine the best of both approaches is to use *scoring rubrics*. A scoring rubric is a global performance descriptor that lists the criteria for a competency and articulates a limited number of gradations of quality for each criterion. Gradations can be unsatisfactory, sufficient, good and excellent. Scoring rubrics can be presented as tables, with the criteria in the rows and the grades in the columns. In each cell

of this table, performance at that particular level of competence is described. Box 8 (available at www.medicalteacher.org) provides an example.

For learners and their mentors, scoring rubrics can be a roadmap for competence development. It can help them diagnose a learner's current level of competence and point the way to further development. Assessors should not use scoring rubrics as a checklist, but as a list of arguments to underpin their assessment when they explain it to learners. Learners can also use scoring rubrics to organise their portfolio. They can organise the evidence in their portfolio in chapters corresponding to the different competencies to be assessed and use captions to explain what the evidence shows about a specific competency.

Why?

Assessing competencies can be done for three reasons: selection, diagnosis and certification.

Selection. Determining whether a person is suitable for a certain position. Assessments for selection purposes can take place before entering an educational programme, but also, for instance, before starting a new job.

Diagnosis. In the course of an education programme, the development of learners' competencies is assessed. The purpose of this type of assessment is to give feedback to learners and help them identify new learning goals. Sometimes, this assessment is also used to determine whether or not a learner is allowed to continue with a programme.

Certification. The goal of assessment at the end of an educational or training programme is to establish whether learners have attained the competencies required for graduation or certification. Obviously, the quality of any assessment is important. Poor quality of assessment for selection purposes, for instance, can harm the interests of prospective learners and waste talent. Similarly, poor quality of diagnostic assessment can cause frustration and delay in learners' development. Nevertheless, with graduation and certification decisions the quality of assessment is crucial. Learners who pass but should have failed will become (or continue to be) certified doctors and may become a risk to the community!

How?

The quality of the assessment of competencies is crucially determined by the procedure that is used. In the introduction to this section about portfolio assessment, we wrote that the standard psychometric procedures that are used to determine the quality of tests and standardised observations are not very well suited to portfolios with their non-standardised content. In medical education, Webb et al. (2003) pointed out that portfolio assessment is primarily concerned with qualitative information and they introduced the idea to use routines developed for qualitative research. Guba and Lincoln's (1989) strategies to achieve *credibility* and *dependability* of

assessment can be translated to portfolio assessment (Webb et al. 2003; Tigelaar et al. 2005).

In Box 9 (available at www.medicalteacher.org), we discuss how these strategies can be used.

The major problem with qualitative research methods *as well as* with portfolio assessment is the required substantial time investment. At Maastricht University, we developed a portfolio assessment procedure that uses many of these strategies while at the same time aiming for optimal efficiency (Driessen et al. 2005a). This procedure is described in Box 10 (available at www.medicalteacher.org).

Who?

A problem that is much debated in the portfolio literature is the feasibility and acceptability of combining the roles of mentor and assessor into one person. Tigelaar et al. (2004) interviewed nine portfolio experts about their views on the use of portfolios in education. While some of the experts agreed that the mentor is the most appropriate person to advise an assessment committee about a candidate, others argued that it is unethical for mentors to undertake the assessor role. The latter group argued that candidates must feel free to reflect on their professional development together with their mentors, knowing that the mentor will not pass any information on to others. For this reason, the majority of the experts were of the opinion that mentors should not be involved in summative assessment nor make recommendations to an assessment committee. However, there was a minority who agreed with Snyder et al. (1998, p. 59), who wrote that '*The tension between assessment for support and assessment for high stakes decision making will never disappear. Still, that tension is constructively dealt with daily by teacher educators throughout the nation*'.

Striking the right balance between support and judgement is the challenge facing assessors/mentors with whom learners talk about their portfolios. A number of scenarios can be chosen in a procedure (Box 11, available at www.medicalteacher.org). Which one is the most appropriate depends, amongst other things, on the educational context and the level of experience of the learners in question.

When?

The answer to the question 'when is this assessed?' depends on the answers to the other questions in this section.

Decisions about *selection* are made before the actual start of a programme or training period or after a first 'trial' period, in which learners are observed and can prove themselves. The important question is whether a prospective learner matches the criteria for admission and whether this learner has the potential to finish an education or training programme.

Diagnostic assessment can be a frequent occurrence during an education or training programme. In fact, every time a mentor and a learner meet to discuss the learner's progress using information from the learner's portfolio, it can be qualified as diagnostic/formative assessment. This implies that having easy access to a portfolio, for instance on-line, can be very helpful for mentors.

Decisions about *certification* are made when a learner's competencies match all the criteria or when the time available for a programme has run out. In an outcome-based programme, this means that when the learner and his or her mentor conclude that the learner's competence meets all the criteria an assessment for certification purposes can take place. The logical consequence would be that if a person meets the competency criteria on *entering* an educational or training programme, he or she is exempt from training and awarded a certificate right away.

Factors influencing the success of the introduction of a portfolio²

In the previous sections, we have argued that it is important to tailor portfolios to the intended purposes and to introduce portfolios only in situations in which they can serve a useful purpose. However, these conditions do not suffice to guarantee a successful introduction. In the literature on educational change, winning the hearts and minds of the people involved, both teachers and learners, as well as the quality of leadership are identified as key factors for lasting educational improvement (Martin et al. 2003; Hargreaves & Fink 2004).

Figure 4 presents a model in which portfolios are presented as part of the learning environment and in which three conditional factors are presented that influence whether an educational portfolio is introduced successfully or not: people (the teachers and learners), leadership and infrastructure. The importance of these three conditional factors is discussed below.

People

Educational innovations involving the use of portfolios usually imply a transfer from teacher-directed education with a strong focus on conveying knowledge, to education in which the development of students' competencies in the workplace is emphasised. In most cases, teachers are expected to invest more time and effort in coaching and assessment than they were used to. Almost inevitably, this change in roles and routines will cause uncertainty and evoke resistance (Hammerness et al. 2005). Not only does it imply that teachers need to rethink key ideas, practices and values, but for many teachers it also means that they need to invest in developing new competencies for coaching and assessment.

In discussions about these innovations, the important questions are which educational problems need to be resolved and what is the most effective and efficient way to do that. Very often however, discussions concentrate on the portfolio, which becomes the visible 'symbol' of the innovation. As a consequence, resistance to the innovation is likely to be projected onto the portfolio, while the important questions are not discussed.

Teachers are more likely to support and invest in educational changes if they acknowledge and subscribe to the educational value of the new learning approach, internalise and support the innovation, and are empowered to assume ownership of it. They are more likely to do so when it is clear to them how the innovation helps solve concrete problems that they have to cope with in their everyday teaching practice (Hargreaves et al. 1998). The risk that the important questions are not discussed can be reduced if teachers are involved in educational innovations at an early stage of decision-making. They are more likely to support and invest in working with a portfolio if the decision to work with this instrument was their own decision, based on their personal understanding and endorsement of the educational innovation and the role of the portfolio in it. From this perspective, the option should be kept of *not* using a portfolio till a better alternative is found. Teachers who have had a say in the decision to use a portfolio will feel a stronger commitment to it and will be more inclined to look for solutions and less likely to lay the instrument aside when faced with problems and inevitable design faults in the curriculum and the portfolio.

In the literature on educational change the importance of teachers as change agents is emphasised (Darling-Hammond et al. 2005) but the input of learners is crucial too. The successful introduction of a portfolio in education also depends on how much time and energy learners are willing to invest in their portfolios. In general, learners will only put effort into portfolios if this effort is rewarded in some way. The most obvious reward is that the portfolio is graded. In education, a very strong relationship exists between summative assessment and learning: assessment drives learning (Frederiksen 1984; Driessen & van der Vleuten 2000; van der Vleuten et al. 2000). Although assessment influences whether learners accept and put effort into a portfolio, assessment in itself is not enough. For learners, developing a portfolio implies putting a lot of effort into making their development visible. Thus, it is very frustrating for them if they discover that

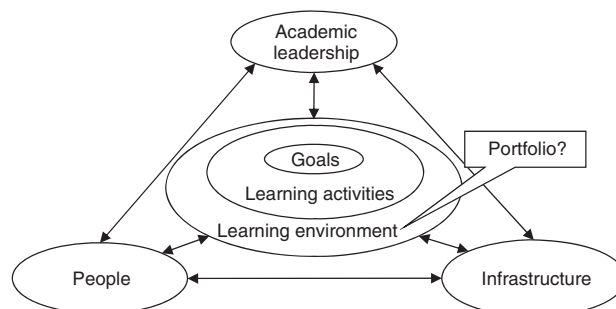


Figure 4. Model of factors influencing the successful introduction of portfolios in education (van Tartwijk et al. 2007).

nobody takes a good look at the result of all their hard work. Mentors who take an interest in learners and their portfolios have been found to be a key factor in learners' appreciation of working with portfolios (Pearson & Heywood 2004; Tigelaar et al. 2006).

The last condition for a successful introduction of portfolios related to learners and their mentors is their *understanding* of the portfolio and of what working with portfolios entails. Experience has shown that, although in theory portfolios can have a clear function in education, in practice the introduction of portfolios often leads to confusion and, consequently, frustration (Anderson & DeMeulle 1998; Pearson & Heywood 2004; Kjaer et al. 2006; Davis et al. 2009). Most students who enrol in a medical curriculum are accustomed to teacher directed education. Self-assessment, asking for feedback, reflection and identifying personal learning needs, which are fundamental to portfolio learning (Snadden & Thomas 1998b; Driessen et al. 2008), are perceived as strange and sometimes even threatening by learners for whom education is synonymous with lectures and exams. Instructions are necessary that not only explain how to work with a portfolio, but also help learners and their mentors understand what a portfolio is and why it is used in education. A study by Duque et al. (2006) demonstrated that hands-on introduction with a proper briefing of learners by staff on the portfolio's purpose and procedures had a positive effect on portfolio scores and learner satisfaction with the portfolio. We have experimented with the use of the analogy between a portfolio and a CV to help learners better understand what a portfolio is and what working with a portfolio entails (van Tartwijk et al. 2008).

Academic leadership

Commitment by educational leaders is another vital condition for the successful introduction of portfolios. In a study on perceptions of leadership in academic contexts, Martin et al. (2003) found that the quality of student learning is affected by the way leadership is constituted and experienced in academic contexts. A group of educational leaders was identified who were successful in stimulating teachers to adopt a student-focused approach to teaching. A characteristic of these educational leaders is that they discuss and negotiate these changes with the teachers. Similar findings are reported by Bland et al. (2000), who reviewed the available literature with the aim to identify a set of characteristics that are associated with successful curricular change in medical education. They write that leadership comes up again and again as critical to the success of curricular change. The literature shows that successful and less successful leaders in medical education use organisational authority at about the same rate, but also that successful leaders more often seek input from others. When educational innovations ask teachers to change their roles and routines, these teachers must know that they can rely on educational leaders who support and value their commitment in every respect (Malden 1994; van Veen et al. 2005). And finally, of course, commitment of the academic leaders is also reflected in the allocation of sufficient financial resources to ensure that the intended changes can actually be implemented.

Infrastructure

An increasing number of Faculties of Medicine are choosing to work with electronic rather than paper portfolios. In the section 'e-portfolios', we described the reasons for this choice. We also wrote that research shows that adverse conditions, such as limited computer access in the workplace may cancel out the advantages of an e-portfolio. In general we conclude that e-portfolios are vulnerable to adverse conditions, because the demands of the technical infrastructure are large. If the electronic part of the portfolio system malfunctions that is usually all the excuse that the adversaries of the use of portfolios need to drop the idea of a portfolio altogether, including the curriculum innovation for which the portfolio very often is a symbol.

Concluding remarks

In curricula with a strong focus on the development and assessment of competencies a portfolio can be a valuable instrument. They have the potential to make learning visible on the *Does* level of Miller's pyramid (Miller 1990), which describes independent performance in the workplace. However, portfolios are also vulnerable. Portfolio learning requires reflection by learners and investment in coaching by teachers. The quality of portfolio assessment depends on investing in the interpretation of and discussion about qualitative data. Not only does it require a new perspective on education from mentors and learners, many of whom are used to teacher-directed learning with a strong emphasis on the acquisition of knowledge, it also asks teachers and learners for a significant investment of time and energy. The literature shows that many conditions need to be fulfilled to enable successful introduction of a portfolio (Driessen et al. 2007b), and even then a portfolio is not a cure for all pains.

We conclude this guide for using portfolios for assessment and learning by referring to Spandel (1997) once more, who wrote:

'introducing portfolios is just like buying shoes: the best choice depends on purpose and a really good fit happens over time, with lots of use and the right give and take by the user'. (p. 573)

We would like to add that portfolios are like *expensive* shoes and even during the process of getting used to them, there will inevitably be times when one's toes are really hurting. However, for those owners who persist, the portfolio has the potential to become one of their best purchases.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Notes on contributors

JAN VAN TARTWIJK, Ph.D., works at the ICLON – Leiden University Graduate School of Teaching. In his research and teaching he focusses on teacher–student communication processes in the classroom and the use of portfolios in medical education and teacher education.

ERIK DRIESSEN, Ph.D., works at the Department of Educational Development and Research at the Faculty of Medicine of the University

of Maastricht. He specialises in assessment and the use of portfolios in medical education.

Both have a long history with working with portfolios. Jan van Tartwijk started experimenting with portfolios in teacher education and faculty development in 1994. In 1999, he joined Erik Driessen and Cees van der Vleuten at Maastricht University, where they implemented portfolios in the undergraduate programme of the Faculty of Medicine of the University of Maastricht. Since then, they have published a series of articles and books about using portfolios in higher education and have advised numerous faculties and originations in medical education and elsewhere about the use of portfolio for learning and assessment. Their corporation is not limited to the topic of portfolios; they also work together on research on how to stimulate and assess self-critical thinking and reflection.

Notes

1. Parts of this section were published in the journal *Quality in Higher Education* (van Tartwijk et al. 2007).
2. Parts of this chapter were published earlier in *Quality in Higher Education* (van Tartwijk et al. 2007).

References

Anderson RS, DeMeulle L. 1998. Portfolio use in twenty-four teacher education programs. *Teach Educ Quart* 25:23–32.

Bird T. 1990. The schoolteacher's portfolio: An essay on possibilities. In: Millman J, Darling-Hammond L, editors. *The new handbook of teacher evaluation: Assessing elementary and secondary school teachers*. Newbury Park, CA: Corwin Press. pp 241–256.

Bland CJ, Starnaman S, Wersal L, Moorhead-Rosenberg L, Zonia S, Henry R. 2000. Curricular change in medical schools: How to succeed. *Acad Med* 75:575–594.

Bransford J, Brown AL, Cocking RR, Editors., 2000. *How people learn: Brain, mind, experience, and school*. Washington DC: National Academy Press.

Buckley S, Coleman J, Davison I, Kahn KS, Zamora J, Malick S, et al. 2009. The educational effects of portfolios on undergraduate student learning: A Best Evidence Medical Education systematic review. BEME Guide No. 11. *Med Teach* 31:282–298.

Collins A. 1991. Portfolios for biology teacher assessment. *J Pers Eval Educ* 5:147–167.

Conlon M. 2003. Appraisal: The catalyst of personal development. *Brit Med J* 327:389–391.

Darling-Hammond L, Pacheco A, Michelli N, LePage P, Hammerness K, Young P. 2005. Implementing curriculum renewal in teacher education: Managing organizational and policy change. In: Darling-Hammond L, Bransford J, LePage P, Hammerness K, Duffy H, editors. *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco: Jossey-Bass. pp 442–479.

Davis DA, Mazmanian PE, Fordis M, van Harrison R, Thorpe KE, Perrier L. 2006. Accuracy of physician self-assessment compared with observed measures of competence: A systematic review. *JAMA* 296:1094–1102.

Davis MH, Friedman Ben David M, Harden RM, Howie P, Ker J, McGhee C, et al. 2001. Portfolio assessment in medical students' final examinations. *Med Teach* 23:357–366.

Davis MH, Ponnampuruma GG, Ker JS. 2009. Student perceptions of a portfolio assessment process. *Med Educ* 43:89–98.

Denzin NK. 1978. *Sociological methods: A sourcebook*. 2nd ed. New York: McGraw Hill.

Denzin NK, Lincoln YS. 2000. *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Dornan T, Carroll C, Parbooshing J. 2002. An electronic learning portfolio for reflective continuing professional development. *Med Educ* 36:767–769.

Dreyfus SE. 2004. The five-stage model of adult skill acquisition. *Bull Sci Technol Soc* 24:117–181.

Driessen EW, Muijtjens AMM, van Tartwijk J, van der Vleuten CPM. 2007a. Web- or paper-based portfolios: Is there a difference? *Med Educ* 41:1067–1073.

Driessen EW, van der Vleuten CPM. 2000. Matching student assessment to problem based learning: Lessons from experience in a law faculty. *Stud in Continuing Educ* 22:235–248.

Driessen EW, van der Vleuten CPM, Schuwirth L, van Tartwijk J, Vermunt JD. 2005a. Credibility of portfolio assessment as an alternative for reliability evaluation: A case study. *Med Educ* 39:214–220.

Driessen EW, van Tartwijk J, Dornan T. 2008. The self-critical doctor: Helping students become more reflective. *BMJ* 336:827–830.

Driessen EW, van Tartwijk J, Overeem K, Vermunt JD, van der Vleuten CPM. 2005b. Conditions for successful reflective use of portfolios in undergraduate medical education. *Med Educ* 39:1230–1235.

Driessen EW, van Tartwijk J, van der Vleuten CPM, Wass V. 2007b. Portfolios in medical education: Why do they meet with mixed success? A systematic review. *Med Educ* 41:1224–1233.

Driessen EW, van Tartwijk J, Vermunt JD, van der Vleuten CPM. 2003. Use of portfolio in early undergraduate medical training. *Med Teach* 25:18–23.

Duque G, Finkelstein A, Robert A, Tabatabaia D, Gold SL, Winer LR. 2006. Learning while evaluating: The use of an electronic evaluation portfolio in a geriatric medicine clerkship. *BMC Med Educ* 6:1–7.

Ericsson KA. 2006. The influence of experience and deliberate practice on the development of expert performance. In: Ericsson KA, Charness N, Feltovich PJ, Hoffman RR, editors. *The Cambridge handbook of expertise and expert performance*. New York: Cambridge University Press. pp 683–704.

Eva KW, Regehr G. 2008. 'I'll never play professional football' and other fallacies of self-assessment. *J Contin Educ Health Prof* 28:14–19.

Finlay IG, Maughan TS, Webster DJ. 1998. A randomized controlled study of portfolio learning in undergraduate cancer education. *Med Educ* 32:172–176.

Frederiksen N. 1984. The real test bias: Influences of testing on teaching and learning. *Am Psychol* 39:193–202.

Friedman Ben David M, Davis MH, Harden RM, Howie PW, Ker J, Pippard MJ. 2001. AMEE medical education guide no. 24: Portfolios as a method of student assessment. Dundee, UK: AMEE.

Fung Kee Fung M, Walker M, Fung Kee Fung K, Temple L, Lajoie F, Bellemare G, et al. 2000. An internet-based learning portfolio in resident education: The KOALA-super (TM) multicentre programme. *Med Educ* 34:474–479.

General Medical Council.. 2000. *Revalidating doctors: Ensuring standards. securing the future*. London: GMC.

Gibson D, Barrett H. 2003. Directions in electronic portfolio development. *Contemp Issues Technol and Teach Educ* 2:559–576.

Grant AJ, Vermunt JD, Kinnersley P, Houston H. 2007. Exploring students' perceptions of the use of a significant event analysis as part of a portfolio assessment process in general practice, as a tool for learning how to use reflection in learning. *BMC Med Educ* 7:5.

Guba EG, Lincoln YS. 1989. Judging the quality of fourth generation evaluation. In: Guba EG, Lincoln YS, editors. *Fourth generation evaluation*. London: Sage.

Hammerness K, Darling-Hammond L, Bransford J, Berliner DC, Cochran-Smith M, McDonald M, et al. 2005. How teachers learn and develop. In: Darling-Hammond L, Bransford J, LePage P, Hammerness K, Duffy H, editors. *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco: Jossey-Bass. pp 358–389.

Harden RM. 1979. How to assess students: An overview. *Med Teach* 1:65–70.

Hargreaves A, Fink D. 2004. The seven principles of sustainable leadership. *Educ Leadership* 24(2):8–13.

Hargreaves A, Lieberman A, Fullan M, Hopkins D, Editors. 1998. *International handbook of educational change*. Dordrecht: Kluwer Academic Publishers.

Hatton N, Smith D. 1995. Reflection in teacher education: Towards definition and implementation. *Teach Teach Educ* 11:33–49.

Kjaer NK, Maagard R, Wies S. 2006. Using an online portfolio in postgraduate training. *Med Teach* 28:708–712.

Korthagen FAJ, Kessels J, Koster B, Lagerwerf B, Wubbels T. 2001. *Linking theory and practice: The pedagogy of realistic teacher education*. Mahwah, NY: Lawrence Erlbaum Associates.

Korthagen FAJ, Koster B, Melief K, Tigchelaar A. 2002. *Teach teachers to reflect: Systematic reflection in the training and coaching of teachers*

- [in Dutch: Docenten leren reflecteren: Systematische reflectie in de opleiding en begeleiding van leraren]. Soest: Uitgeverij Nelissen.
- Lawson M, Nestel D, Jolly B. 2004. An e-portfolio in health professional education. *Med Educ* 38:569–570.
- Lockyer JM, Clyman SG. 2008. Multisource feedback (360-degree feedback). In: Holmboe ES, Hawkins RE, editors. *Practical guide to the evaluation of clinical competence*. Philadelphia, PA: Mosby Elsevier. pp 75–85.
- Lyons N. 1998. Reflection in teaching: Can it be developmental? A portfolio perspective. *Teach Educ Quart* 25(1):115–127.
- Malden B. 1994. The micropolitics of education: Mapping the multiple dimensions of power relations in school policies. *J Educ Policy* 9:147–167.
- Mann K, Gordon J, MacLeod. 2007. Reflections and reflective practice in health profession education: A systematic review. *Adv Health Sci Educ* (First published online November 2007), 1–27.
- Martin E, Trigwell K, Prosser M, Ramsden P. 2003. Variations in the experience of leadership of teaching in higher education. *Stud High Educ* 28:247–259.
- Mathers NJ, Challis MC, Howe AC, Field NJ. 1999. Portfolios in continuing medical education – Effective and efficient? *Med Educ* 33:521–530.
- Miller GE. 1990. The assessment of clinical skills/competence/performance. *Acad Med* 65:S63–S67.
- Norcini JJ, Burch VC, Editors., 2007. *Workplace-based assessment as an educational tool*, guide no. 31. Dundee, UK: AMEE.
- Norcini JJ, Holmboe ES, Hawkins RE. 2008. Evaluation challenges in the era of outcome based education. In: Holmboe ES, Hawkins RE, editors. *Practical guide to the evaluation of clinical competence*. Philadelphia, PA: Mosby Elsevier. pp 1–9.
- O'Sullivan PS, Reckase MD, McClain T, Savidge MA, Clardy JA. 2004. Demonstration of portfolios to assess competency of residents. *Adv Health Sci Educ* 9:1–15.
- Oermann MH. 2002. Developing a professional portfolio in Nursing. *Orthop Nurs* 21:73–78.
- Paulson FL, Paulson PR, Meyer CA. 1991. What makes a portfolio a portfolio? Eight thoughtful guidelines will help educators encourage self directed learning. *Educ Leadership* 48:60–63.
- Pearson DJ, Heywood P. 2004. Portfolio use in general practice vocational training: A survey of GP registrars. *Med Educ* 38:87–95.
- Royal College of General Practitioners. 1993. *Portfolio-based learning in general practice: Report of a working group on higher professional education*, Occasional paper 63. London: Royal College of General Practitioners.
- Royal College of Physicians and Surgeons of Canada. 1996. *Canmeds 2000 Project: Skills for the New Millennium*. Report on the societal needs working group. Ottawa: The Royal College of Physicians and Surgeons of Canada.
- Shulman LS. 1998. Teacher portfolios: A theoretical activity. In: Lyons N, editor. *With portfolio in hand: Validating the new teacher professionalism*. New York: Teachers College Press. pp 23–38.
- Shute VJ. 2008. Focus on formative feedback. *Rev Educ Res* 78: 153–189.
- Smither JW, London M, Flautt R, Vargas Y, Kucine I. 2003. Can working with an executive coach improve multisource feedback ratings over time? A quasi-experimental field study. *Pers Psychol* 56:23–44.
- Snadden D. 1999. Portfolios – Attempting to measure the unmeasurable? [Commentary]. *Med Educ* 33(7):478–479.
- Snadden D, Challis M, Thomas ML. 1999. AMEE medical education guide no. 11: Portfolio-based learning and assessment. Dundee, UK: AMEE.
- Snadden D, Thomas ML. 1998a. Portfolio learning in general practice vocational training – Does it work? *Med Educ* 32:401–406.
- Snadden D, Thomas ML. 1998b. The use of portfolio learning in medical education. *Med Teach* 20:192–199.
- Snyder J, Lippincott A, Bower D. 1998. The inherent tensions in the multiple uses of portfolios in teacher education. *Teach Educ Quart* 25:45–60.
- Spandel V. 1997. Reflections on portfolios. In: Phye GD, editor. *Handbook of academic learning: Construction of knowledge*. San Diego: Academic Press. pp 573–591.
- Stoof A, Martens RL, van Merriënboer J, Bastiaens TJ. 2002. The boundary approach of competence: A constructivist aid for understanding and using the concept of competence. *Hum Res Dev* 1:345–365.
- Tigelaar DEH, Dolmans DHJM, De Grave WS, Wolfhagen HAP, van der Vleuten CPM. 2006. Participants opinions about the usefulness of a teaching portfolio. *Med Educ* 40(4):371–378.
- Tigelaar DEH, Dolmans DHJM, Wolfhagen HAP, van der Vleuten CPM. 2004. Using a conceptual framework and the opinion of portfolio experts to develop a teaching portfolio prototype. *Stud Educ Evaluation* 30:305–321.
- Tigelaar DEH, Dolmans DHJM, Wolfhagen HAP, van der Vleuten CPM. 2005. Quality issues in judging portfolio: Implications for organizing teaching portfolio assessment procedures. *Stud High Educ* 30:595–610.
- Tochel C, Haig A, Hesketh A, Cadzow A, Beggs K, Colthart I, et al. The effectiveness of portfolios for post-graduate assessment and education: BEME Guide No. 12. *Med Teach* 31:299–318.
- van der Vleuten CPM, Dolmans DHJM, Scherpbier AJJA. 2000. The need for evidence in education. *Med Teach* 22:246–250.
- van Manen M. 1977. Linking ways of knowing with ways of being practical. *Curriculum Inq* 6:205–228.
- van Tartwijk J, Driessen EW, Stokking K, van der Vleuten CPM. 2007. Factors influencing the successful introduction of portfolios. *Qual in Higher Educ* 13:69–79.
- van Tartwijk J, van Rijswijk M, Tuithof H, Driessen EW. 2008. Using an analogy in the introduction of a portfolio. *Teach Teach Educ* 24:927–938.
- van Veen K, Slegers P, van de Ven P. 2005. One teacher's identity, emotions, and commitment to change: A case study into the cognitive-affective processes of a secondary school teacher in the context of reforms. *Teach Teach Educ* 21:917–934.
- Webb C, Endacott R, Gray MA, Jasper MA, McCullan M, Scholes J. 2003. Evaluating portfolio assessment systems: What are the appropriate criteria? *Nurs Educ Today* 23:600–609.
- Woodward H, Nanlohy P. 2004. Digital portfolios: Fact or fashion. *Assess Eval Higher Educ* 29:227–238.