ABSTRACT
Educational Technology plays an important role in learning facilitation for improving educational system. Competency Based Medical Education (CBME) has become central to the training and assessment of health-care education. Competency Based Medical Education (CBME) mainly focuses on outcomes and professional performance of the medical students. Assessment has a key role in shaping the outcomes and success of a curriculum and hence must be carefully planned before implementing. The CBME focuses on outcome and performance skills, so it is important to observe and assess at workplace. The Work Place Based Assessment (WPBA) methods assess at the 'does' level of Miller's pyramid and these assessments include various methods and Portfolio is one among them which is still on trial and error basis and not yet implemented in medical institutions. When a literature search was done only few review articles were available from India on Portfolio in medical education when compared to western countries. In the present review article we shall discuss elaborately the portfolio under various sections such as types and various models of portfolio, components of portfolio, learning portfolio and its types, how to construct a portfolio, various available software / tools for developing a portfolio, purpose, characteristics, responsibilities, assessment of CBME by portfolio in medical graduates at various professional levels and advantages and disadvantages of portfolio.

Keywords: Portfolio, Competency Based Medical Education, Work Place Based Assessments, Medical Education, Multimedia, Learning modalities.

INTRODUCTION:
In general terms, a portfolio can be defined as a collection of evidence that learning has taken place. A collection of evidence of student activity, whether paper–based or electronic that outlines the student's own learning experience (e.g. patients seen, study subject covered, articles read). Portfolios are different from curriculum vitae and career logs. Portfolio contains a component of self-reflection on the contents which is the key for professional development. Portfolios are used as a tool to increase students' self-awareness and their ability to learn independently and to encourage them to reflect on their own performance.

In medicine portfolios demonstrate an intern or resident's skill development, knowledge and attitude. They can include case scenario discussion, rare case presentations, chart notes, referral letters, procedure logs, videotaped consultations, peer assessments, patient surveys, literature searches,
quality improvement projects and any other type of learning resources that can be uploaded in portfolio. Portfolios also frequently include self-assessment, learning plans, and reflective essays. Portfolios are most commonly used in formative assessments, but their use for summative evaluations and high-stakes decisions about advancement is increasing.²

The use of portfolios for assessment in medical education has become a progressive shift from regular summative examinations towards broader methods of formative assessments. There’s been a notable shift of assessment from “of learning” to “for learning”. This form links the assessment methods and learning methods by improving learning outcomes using performance assessment and providing feedback. The performance and feedback information is used by the learner to show their progress, look back and reflect on feedback, and formulate plans/learning objectives for improving their performance or competence.³⁴ The use of portfolio is also thought to enhance the assessment of areas that are difficult to assess such as attitudes, personal attributes, reflection and professionalism by traditional methods in clinical contexts.⁵ Portfolios are an attractive assessment tool which have the potential for assessing the clinical performance over a period of time, constituting it as one form of authentic assessment.

Types of portfolio:

Tillema et al.,² made a differentiation in types of portfolios based on the purpose of the portfolio, being either selection or developmentally orientated, and the setting of use, being either mandated or self-directed. This further led to 4 types:

1. **Dossier portfolio** - containing mandated records of achievement, with specified levels of performance, used for selection or promotion.

2. **Training portfolio** - containing a mandated collection of acquired skills and competencies, in a fixed format, with some reflective comments on selected evidence.

3. **Reflective portfolio** - containing a purposeful collection of evidence for personal growth and development, used for promotion or selection.

4. **Personal development portfolio** - containing reflective and personal evaluations of progress in time, enabling discussion and valuing of these activities.

**Various models of portfolio:**

There are four models of portfolio which demonstrates how different the contents of a portfolio may be.⁶ The appropriateness of each model depends on its purpose and also whether it will be used in an assessment process is summarized in the table below (Table 1).

**Table . Models of Portfolio⁷**

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopping trolley</td>
<td>Contains anything which has been produced or used during the learning process.</td>
<td>Very inclusive.</td>
<td>Difficult to assess. No analysis of content.</td>
</tr>
<tr>
<td>Toast rack</td>
<td>“Toast” for each period of learning</td>
<td>Corresponds with the curriculum.</td>
<td>Each item is discrete and does not provide overall assessment of learning.</td>
</tr>
<tr>
<td>Cake mix</td>
<td>Integration of the parts. “Mixing” is reflection on the analytical components.</td>
<td>Global assessment.</td>
<td>No overall reflection.</td>
</tr>
<tr>
<td>Spinal column</td>
<td>Series of competency statements are the “vertebrae.” Evidence is linked to the competencies.</td>
<td>Each competency has its own evidence.</td>
<td>Individual components may not be clear.</td>
</tr>
</tbody>
</table>

The portfolio models should be easily aligned with the curriculum as the curriculum can form the “spinal column” or “toast rack”. The “shopping trolley” model is least likely to demonstrate alignment as this method relies heavily on the
student including relevant documentation. Whatever the method is chosen should provide an opportunity to demonstrate learning in many ways and should be a holistic record of learning.\(^7\)

**Components of a Portfolio:**

The components can be decided based on the purpose of portfolio, type of learning portfolio and the target audience. Once all these were finalized then one can proceed about what to include in portfolio.

**a) Learning modules / activities**

- Clinical postings
- Clinical rotations
- Clinical procedures and Entrustable Professional Activity (EPA)
- Research
- CMEs and conferences attended and presented paper / posters
- Achievements and activities
- Others include special training
- Critical incidents and lessons learnt from it
- Documents substantiating above has to be uploaded

**b) Assessments**

- Daily, periodic (academic, clinical and lab)
- Project, dissertation
- Other activities – teaching etc.
- MSF – Multi Source Feedback

**c) Reflections:**

- Learning plan and environment
- Competency
- Clinical and lab work
- Dissertation
- Successes and difficulties in handling cases
- Reflection on feedback from peers and faculty

**Learning Portfolios (ePortfolio)**\(^8\)

It is a digital collection of student work, reflections, and their educational experiences which demonstrate a student's work for a period of time, showcasing their skills, abilities, values, and experiences. All information will be put in an online format. A learning portfolio may include lot of outputs or relevant documents and media files that provide a holistic representation of who an individual is, academically, personally and professionally.\(^7\) A learning portfolio will be a source of collection of enormous academic work and sharing the academic work with all faculty members and also it will be serving as a tool for inviting collaborations and feedback from peers in the respective field. It also helps personally in the career growth and learning process.\(^9\)

**Purpose of a learning portfolio**\(^10\)

- To contribute holistic development in student in orientation of personal, academic and career development.
- To initiate integrative learning.
- To encourage active reflection and ethical considerations within academic disciplines.
- To facilitate integration of topics and themes across various disciplines.
- To provide a forum to cultivate self-centered learning and sharing their knowledge with others.
- To provide an opportunity for showcasing the students skills, abilities, and experiences in the future perspectives such as higher studies and job-search process.

Learning portfolio includes 3 main components such as:

1. **Learning Artifacts:**
Learning artifacts are documents or media files that are electronic evidence for learning and growth over a period of time. They can demonstrate the skills, abilities, experiences, or competency of an individual. They also give a reflection on individuals about their personal, professional, and academic activities. Learning portfolio artifacts can include:

- Photos or Slideshows
- Blogs or Vlogs
- Writing Samples (research papers, essays, fiction, reflections, journals)
- Videos
- Presentations
- Research Posters
- Web Links

2. Critical Reflection:

Critical reflection is reflecting on one's own experiences. It starts with sharing of experiences with an add-on as to why the experience was important, making connections between experiences, and articulating new learning that was grasped away from the experience. It allows taking a step back to make meaning of one's own experiences. Critical reflection occurs within the past, present, and future actions, and it allows connecting one's own experiences both within the classroom and beyond.\(^\text{10}\)

3. Platforms:

The platforms of portfolio includes, constructing an electronic learning portfolio through the various websites and assess the student learning competency outcomes based on skills, attitude and knowledge and keeping an online record of student learning artifacts through the web portal.\(^\text{10}\)

Types of Learning Portfolios\(^\text{10}\):

- Course Portfolios
- Integrative Portfolios
- Assessment Portfolios
- Professional / Showcase Portfolios

The various types of portfolios may also overlap in function. For instance, integrative portfolios can also be assessment portfolios.

Developing a portfolio in medical education:

The components of a portfolio are mainly based on the concepts of adult and reflective learning. Learners are asked to identify their own needs and agendas to be included in portfolio, through reflection on their own clinical practice and experiences they have in their learning period. A tutor, trainer or mentor is important to help any learner to think and reflect on experiences, particularly before drawing out any conclusion. This relationship is easier to achieve in a one-to-one relationship. Portfolios can contain virtually anything, but mainly it has to emphasize on collecting evidence to prove that learning has taken place. The following are examples of what a portfolio can contain:

- Critical incidents of events / experiences with patients
- A reflective journal
- Tutorials and learning plans
- Routine clinical experiences
- Exam preparation modules
- Video recordings of consultations
- Case study and project work
- Critical reviews of articles
- Feedback material
- Management module
Various tools to create online student profile

The digital revolution encompasses every aspect of our lives especially learning. One of the most promising learning opportunities brought by this transformation is the possibility of creating online student portfolios. Instructors can use portfolio options, in conjunction with data backpacks, to teach students how to build a narrative of their growth and achievement they can use in both their personal and professional development. The best portfolios are those which are compiled by students themselves. Fortunately, there are many tools available for crafting engaging digital student portfolios – here are 10 best picks (Figure 1) for fostering this creative exercise.

Figure 1. Various tools to create online portfolio

- **Kidblog** - This is an excellent tool which was actually built by teachers with online student portfolios in mind. Kidblog offers functionalities which perfectly match the goals of online student portfolios.

- **Edublogs** - Edublogs is a secure platform where blogs can be private or accessible to teachers, classmates and parents. Edublogs is very student-friendly and provides a smart guide on getting started with the platform which covers all the key basics required for digital portfolios.

- **VoiceThread** - This free app for iOS is another interesting tool for creating digital portfolios. Teachers and students can work together and add work samples which are then organized to form separate streams and narratives.

- **Weebly** - A platform which helps students to create websites with the use of specific visual templates. As you can imagine, this tool can easily serve as a digital portfolio creator, helping students to navigate through its simple interface and easily update their portfolios.

- **WordPress** - A great choice, it features an understandable dashboard where students can upload files of different formats and create their online space. Choosing from a number of free themes, they can create a website that perfectly captures their personality.

- **Google Sites** - Offers an interface enabling students to create comprehensive and varied collections of multimedia materials to craft a narrative of their work throughout. The tool provides site templates, so students won't need to work on the site structure at all. All they need to do is integrate their site with other Google apps to create their online portfolios.

- **Evernote** - students can write down notes, take photos, upload their own content, record audio and tag all items with specific keywords. They can then organize the content into notebooks and
groups, sharing it all to their social networks. The tool constantly synchronizes across different devices, be it desktop computers, laptops, tablets or smartphones.

- **Easy Portfolios** - This is an iOS app, which costs less than $2 and can bring many benefits to the classroom. Students can use its simple interface to create and manage classes and portfolios, recording audio and capturing pictures directly to their collections. Files stored on Dropbox can be transported here without any fuss. An interesting feature of Easy Portfolios is that it allows easily sharing portfolio items through email or dropping box upload – this is how teachers can keep and manage all their younger students’ portfolios in one place.

- **Crevado** – a webapp which makes it easy for one to create a free online portfolio to show case the work. It is easy to use and customize entire portfolio using just a web browser.12

### How to create a portfolio in Google site12

The steps in creating a portfolio was briefed with description and related images are displayed along with it as follows:

1. Create a new **Gmail account** (can use existing Gmail account too)
2. **Login** to Gmail account and click the apps from Google on right upper corner or directly enter to Google product sites (fig. 2).

   ![Google Product Sites](https://www.google.co.in/intl/en/about/products/)

   Select the sites from **Google product** and click it https://sites.google.com/site

   **Create label** show 2 options - in classic sites / **in new sites** and one can be selected.

   Latest one of **Google site (in new sites)** can be selected to create the site and click on it.

   In Google site click the red icon in the lower right side of the page, **new site page** opens as shown below (fig. 3).

   ![Google Site - New Page](https://www.google.co.in/intl/en/about/products/)

   Select the theme of the site from existing 6 templates such as Simple, Aristotle, Diplomat, Vision, Level and Impression.

   Enter a site name which will become your Google site address once the site was published.

   **Add title page (Portfolio / Profile)**

   Upload a cover photo by clicking change image at the bottom of the image, clicking Upload in the drop-down menu, selecting a photo, and clicking Open (fig. 4)

   ![Create Portfolio](https://www.google.co.in/intl/en/about/products/)

   Insert option will help you to insert a text box / Images / Embed URL / Files from Google Drive as shown below and so on with many other options of YouTube video, calendar, map, Documents, Slides, sheets, forms and charts whatever is needed and applicable for your portfolio can be chosen and inserted (fig. 5).
Figure 5. Inserting details.

◆ Pages option help you to add on new pages or sub-pages with title in each page as shown below (fig. 6):

Figure 6. Adding pages.

◆ Click on preview option to see the site as shown below and once all details are added up then can go for Publish option (fig. 7).

Figure 7. Publishing Portfolio.

◆ Click Publish. It’s a purple button in the top-right corner of the page.

◆ Doing so will create your Google Site at the domain https://sites.google.com/view/sitename (replacing sitename with your Google site’s address). This will open your Google site

◆ In Google site click the grey icon in the lower right side of the page, which help you in editing the portfolio and also to update and add-on documents/images/videos/power points and so on.

Purpose of portfolio:

Portfolio helps in evaluating the coursework quality, learning progress and academic achievements, helps in determining whether students have met learning standards or other academic requirements for courses, promotion or graduation, helps the students reflect on their academic goals and progress as learners and finally it enables the supervisors to give a feedback on strengths and weaknesses.

Characteristics of a portfolio:

A portfolio is a compilation of everything that the student wishes to include that is related to their course. It might include their bio data. It might include a record of achievements. The student would:

a) Note key clinical details
b) Consider ethical and psychosocial aspects
c) Reflect on how well they examined the patient
d) How well they communicated with the patient
e) Identify 'learning-points' for future thinking

The advantages and disadvantages of portfolio are summarized in table 2 and responsibilities in creating and maintaining portfolio given in Figure 8.
Portfolio assessment process:

Davis and Ponnamperuma (2006) propose five steps in the portfolio assessment process. They are as follows:

2. Reflection of the learning.
4. Defence of evidence by the individual being assessed.
5. An assessment decision. All the assessors involved, should make a decision based on pre-defined criteria.

<table>
<thead>
<tr>
<th>Table-2. Advantages and disadvantages of portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>Provides evidence of self-directed learning.</td>
</tr>
<tr>
<td>It is an UNIQUE record of what a student has done.</td>
</tr>
<tr>
<td>It is highly valid and authentic.</td>
</tr>
<tr>
<td>The quality is limited only by the students’ ability.</td>
</tr>
<tr>
<td>Focuses attention on the process of learning.</td>
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<tr>
<td>Students are no longer needed to retain and recall knowledge.</td>
</tr>
<tr>
<td>More documentation provides better quality assurance.</td>
</tr>
<tr>
<td>Enables supervisors to give a feedback on strengths and weaknesses.</td>
</tr>
<tr>
<td>Creates a lasting archive of academic work, achievements and accomplishments.</td>
</tr>
<tr>
<td>Residents take responsibility for their own learning tailored to their own needs and the needs of the profession.</td>
</tr>
<tr>
<td>Better ongoing assessment of individual training occurs.</td>
</tr>
<tr>
<td>Early identification of problems.</td>
</tr>
<tr>
<td>Encourages regular meetings and interactions with a mentor.</td>
</tr>
</tbody>
</table>

Figure 8. Portfolio – responsibilities

- **Portfolio Responsibilities**
  - **Role of faculty advisor**
    - Regular interaction
    - Interpreting data and making competency development decisions
    - Feedback and discussion on reflective aspects
    - Planning individualised intervention
  - **Faculty members**
    - Identify / define competencies and standards
    - Define what constitutes acceptable evidence of accomplishment of competence
    - Determine timelines and guidelines for evaluation
  - **Students**
    - Collect evidence
    - Document
    - Defend evidence of accomplishment
    - Reflect, respond to responses to reflections
Reliability of portfolio in assessment:

Roberts et al. (2002) conducted a systematic review of the evidence of the use of portfolios in the medical education literature. Jenkins et al., (2013) tested the reliability of a portfolio used as an assessment tool for postgraduate family medicine training in South Africa and found the tool as a whole to be reliable with a co-efficient of 0.92. Individual components of the portfolio were not reliable, so the researchers made recommendations on how to improve the portfolio. The literature suggests that in order to achieve high levels of inter-rater reliability, portfolios should be introduced to well-prepared students and should be of uniform content. Those portfolios should be marked by well trained, experienced assessors using clear criteria. Both assessors and assesses should have a shared understanding of the purpose of the assessment. Portfolios may include other assessments within them for example in postgraduate education, work-based assessments such as DOPS (directly observed procedural skills), CBD (case based discussion) and multi-source feedback. Generalizability studies have shown that content specificity is a major contributor to unreliability. This means that large samples of performance need to be tested before a reliable judgement about ability can be made. This allows individual competencies to be assessed in more than one way, and enables triangulation of evidence and therefore increases reliability.

Validity of portfolio in assessment:

The different aspects of validity include criterion and construct validity, predictive validity and content validity. Driessen (2006) looked in detail at which criteria affected an assessor's judgement of student's reflective skills and that the strongest predictor of variance was the “quality of reflection”. Driessen et al., (2006) suggested that portfolio standardization and the use of analytical criteria with the aim of improving reliability may threaten validity by limiting room for the description of personal learning experiences in different authentic situations. They also suggested that including checklists and analytical assessment criteria might trivialise the assessment process. In a study by Quinlan (2002), it was demonstrated that competence ratings were influenced by what assessors already knew about students, and therefore reducing validity of the assessment tool.

The use of portfolios in medical training to demonstrate clinical competence:

Portfolios were initially used in medical education for formative purposes in order to encourage reflection. More recently, the use of portfolios has been advocated for summative purposes. The “eportfolio” now forms the basis for both foundation year training and speciality training. This is a spinal column type of portfolio and individual pieces of evidence are linked to predefined competencies. In western countries for endoscopy training the trainees are expected to document all their procedure data in one database, and to collect work based assessments during their training. Trainees are deemed competent when they have achieved certain predetermined criteria laid out in the eportfolio. This documentation is available for trainers to explore.

Problems in use of portfolio in formative assessment:

- Ongoing reflective assessment of learning experiences moving forward in time
  - Problem faced: No reflections
REFERENCES:


12. Online Portfolio Websites from Crevado [Internet].

CONCLUSION:

Portfolios serve to teach a wide range of competencies. Incorporation of the element of assessment would make them effective tools for formative assessment as well. Documentation of portfolios as e-portfolios has become easy with the advent of advances in technology. Portfolios contribute not only to training of undergraduates and postgraduates, but help practitioners in appraisals and revalidation of their qualifications and help in continued professional development too. They are records of personal and professional outcomes which encourage lifelong learning. Portfolios are the need of the hour and are here to stay.


