Attributes of Classroom Formative Assessment Techniques in Medical Education : A Review

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ABSTRACT

The knowledge acquired at instructional level in medical field plays a vital role in conceptual understanding and developing professional competencies by ensuring a sound foundation. If the foundation is not firm, the entire connexion of knowledge and skills remains weak and loosely imparted. It is therefore essential to continuously share learning goals, monitor learning, assess learning, provide appropriate, timely feedback and adjust instruction that should typically occur at classroom level when instructional activities are on going. Formative assessments (FA) are the most instructionally sensitive types of assessment and are considered as an on-going process. By being embedded within instructional activities, they can be linked directly to teaching and learning activities within a medical classroom and provide a sound basis for timely diagnosis of learning gaps and appropriate remedial actions. This manuscript reviews six Classroom based FAs that can be considered for a typical medical classroom, viz. Classroom Quiz, Exit ticket, One minute paper, One sentence summary, Directed Paraphrasing and Muddiest point. The uniqueness of these six methods is mainly its ease of administration, catering to varied learning styles and simple analysis of responses. They can be practised during instructions monitoring mechanisms to uncover learners' pre-existing ideas, diagnose learning gaps and ensure appropriate remedial actions for a sound conceptual learning.

Introduction :

Teaching learning in medical education is largely classroom based. The relationship between instruction and learning is complex. The knowledge acquired at instructional level in medical field plays a vital role in conceptual understanding and developing professional competencies. Even when instruction is well designed, conceptual understandings are impossible to predict with certainty. Gaps often exist between what is taught and what students actually learn and these gaps do not show up until summative assessments. At that point it is often too late to go back and modify instruction. If the foundation is not firm, the entire connexion of knowledge and skills remains weak and loosely imparted. The knowledge gaps that are left undiagnosed and unattended are never bridged and the subsequent learning takes place on this weak conceptual framework. Hence, it is essential to continuously share learning goals, monitor learning, assess learning, provide appropriate, timely feedback and adjust instruction. This has to typically occur in the classroom when instructional activities are ongoing as if embedded within the curriculum. Formative assessments (FA) are the most instructionally sensitive types of assessment and are considered as an ongoing process. By being embedded within instructional activities, they are linked directly to teaching and learning activities within the classroom. Evidences strongly support FA to be highly integrated with instruction (and most commonly takes the form of classroom exchanges between teachers and students or, less commonly, between students).[1]

Other definitions extend the concept of formative assessment as a 'process' by incorporating assessment tools that can seamlessly be integrated into classroom activities[2] for the explicit purpose of gathering feedback to inform instruction. This answers the key questions regarding FA : *Where it takes place (in the classroom); when it takes place (during the process of instruction); what it is (it is a strategic instructional approach, strategic in that it*

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is adapted to meet the needs of individual students) and finally, when assessment becomes formative (when it is so adapted to close the gap between a student's current level of understanding and the target). Classroom based FAs can be used to spark students' interest, surface ideas, initiateinquiry, and encourage classroom discourse all assessment strategies that promote learning rather than measure and report learning. A rich repertoire of Formative Assessment Classroom Techniques (FACT) enable learners to interact with assessment in multiple ways - through writing, drawing, speaking, listening, physically moving, designing and carrying out investigations. They help teachers continuously examine how students' ideas form and change over time as well as how students respond to particular teaching approaches. This information is constantly used to adjust instruction and refocus learning to support each student's intellectual growth in science.

The possible formats of classroom formative assessments are correspondingly broad. The evidence can be gleaned from information-gathering activities such as traditional classroom tests, but also from observations, oral questioning, class discussions, projects, portfolios, homework, performance assessments, and group work with peer feedback, student self-assessment, and other sources. Teachers' questioning during instruction may be informal and spontaneous or may be formal and planned prior to the lesson.[3,4] A teacher's informal questions to students during class may be for the purpose of assessing students' learning or for probing more deeply to gather evidence that might yield better understanding of their thought process. Regardless of format, the distinguishing characteristic of FA is that their design and primary goal is gathering of information for the purpose of adapting teaching and learning to the current functioning and future needs of students. Any instructional activity that allows teachers to uncover the way students think about what is being taught and that can be used to promote improvements in students' learning can serve a formative purpose. As such, the process concerns itself exclusively with the activities undertaken by teachers and their students during the process of classroom instruction. Another important piece of formative assessment is variation. Not every student learns in the same way; therefore, not every student should be assessed in the same way. In order to get the big picture of what a student knows, a variety of formative assessment strategies need to be used at many different times. The more information a teacher can gather, the more accurate a picture of a student and his or her learning will appear.[5]

This manuscript reviews six Classroom based FAs that can be considered for a typical medical classroom, viz. Classroom Quiz, Exit ticket, One minute paper, One sentence summary, Directed Paraphrasing and Muddiest point. The uniqueness of these six methods is mainly the ease of administration, catering to varied learning styles and simple analysis. They can be practised in medical classroom to monitor student's conceptual learning and timely remediation within instruction to rectify learning gaps ***(Table - 1)***.

1. **Classroom quiz :** Classroom quizzes are effective for assessing cognitive learning in content-based courses. Its potent effect lies in what the scholars call "effortful retrieval". Frequent quizzing triggers a process that enhances long-term retention of just-learned knowledge. The very process of responding to a quiz triggers learning.[6] Quiz can serve as a practice - test which guides students to focus on the vital course content, provides them with some assessment of their learning progress, and offers them a motivation to learn more.[7-9] Implementation details are as depicted below :

Classroom instruction on a particular topic

↓

At the end of Instruction, students can be divided into 4-5 equal batches

↓

Classroom Quiz can be conducted with multiple-choice questions as power-point presentation. One question posed to each group.

↓

Classroom instruction on a particular topic

↓

At the end of Instruction, students are asked to describe the steps of generation of Action Potential along with its ionic basis with a flowchart

↓

Responses are collected anonymously

↓

Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity

EXIT TICKET

2. **Exit ticket** is simply a question that is posed to all students prior to conclusion of a class. Students write their answer on a card or piece of paper and submit it as they exit (hence exit ticket)[7,10]. Implementation details are as depicted below :
3. **One-minute paper (OMP) :** The OMP - also known as the one-minute wonder or the half page paper - is a FACT, which has become aligned with the philosophy of continuous quality improvement. The OMP is a valuable tool, not only to engage students and provide the teacher with early feedback on classroom learning, but also to provide the lecturer with an insight into the perceived effectiveness of their teaching practices.[6,8,12] Implementation details are as depicted below :

Classroom instruction on a particular topic

↓

At the end of Instruction, learners are asked to determine :

1. "What was the most important concept you learned in the lesson today?"

2. "What concepts were less clear in the lecture today?".

↓

Responses are collected anonymously

↓

Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity

One-Minute Paper

4. **One sentence summary :** This technique make students distill, simplify, reorganize, synthesize, and chunk complex material into smaller, essential units that are easier to manipulate and remember.[8] Implementation details are asdepicted below :

Classroom instruction on any particular topic

↓

At the end of Instruction, students are asked to summarize the entire lecture by answering key questions on a piece of paper in terms of Who? Does what? To what or whom? When? Where? How? Why?

↓

Responses are collected anonymously

↓

Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity

One Sentence Summary

5. **Directed Paraphrasing :** Students summarize the content of a reading assignment, a lecture, a discussion, or a lab to a defined audience for a specific purpose, in their own words. Because students have to paraphrase material, they must work to understand it in depth and internalize it.[5,7] Implementation details are as depicted below :

Classroom instruction on any particular topic

↓

10 minutes before the end of instructional activity students are asked to write in brief about the concept taught in class. Peers are considered as defined audience

↓

Responses are collected anonymously

↓

Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity

Directed Paraphrasing

6. Muddiest point : The learners are asked to reflect upon the contents taught and note the poorly understood part of the lecture.[12] It enables the teacher to weigh the contents through the students' perspective. Implementation details are as depicted below :

Classroom instruction on any particular topic

↓

Students are asked to decide upon the most confusing / poorly

understood part of the lecture by a paper based / Online platform.

↓

Responses collected

↓

Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity

Muddiest point

Implications : These purposeful and planned teacher-to-student and student-to-teacher verbal and written interactions are easy, on-the-go monitoring mechanisms to uncover learners' pre-existing ideas, diagnose learning gaps and ensure appropriate remedial actions. Post instruction FA provides an opportunity for students to reflect on their learning, develop a future work plan, and address concepts that are still unclear. It also helps medical teachers to customize interventions for better student learning in weaker areas. The analysis of responses to FA gives a rich repertoire of information that can be explored for subsequent instructional activities to close learning gaps. It is suggested that medical teachers should consider such classroom based FAs to truly manifest the principle of FA as 'Assessment for Learning' and thereby improve the conceptual understanding of medical science over a guided trajectory.

Table 1 : **Characteristic features of six Formative Assessment Classroom Techniques**

Sr. No.	FACT	Value (Purpose for using specific FACT)	Process (in brief)	FACT Hallmark
1	**Classroom Quiz**[7-9] **Learning Style : Aural, Verbal, Visual**	Classroom quizzes are effective FACTs for assessing cognitive learning in content-based courses. Its potent effect lies in what the scholars call "effortful retrieval". Frequent quizzing triggers a process that enhances long-term retention of just-learned knowledge. The very process of responding to a quiz triggers learning. The quiz can serve as a practice- test which guides students to focus on the vital course content, provides them with some assessment of their learning progress, and offers them a motivation to learn more.	Classroom instruction on a particular topic ↓ At the end of Instruction, students can be divided into 4-5 equal batches ↓ Classroom Quiz can be conducted with multiple-choice questions as power-point presentation. One question posed to each group. ↓ Answer to every MCQ discussed before proceeding to next one ↓ Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity	• **Engage and motivate students** • **Self Assessment** • **Diagnose knowledge gap**
2.	**Exit Slip/ticket**[7,10] **Learning Style : Solitary**	The exit ticket is simply a question that is posed to all students prior to conclusion of a lecture. The question focusses on the most important concept taught within the lecture class.	Classroom instruction on a particular topic ↓ At the end of Instruction, students are asked to describe the steps of generation of Action Potential along with its ionic basis with a flowchart	• **Formal concept development and transfer,** • **Self assessment** • **Diagnose knowledge gap**

			↓ Responses are collected anonymously ↓ Knowledge gaps analysed and dealt appropriately in subsequent instructional activity	
3	**One minute Paper**[6,8,12] **Learning Style : Solitary**	Minute Papers are particularly useful when assessing : • "Student recall and understanding. • Student evaluation of what they recall. • Student ability to self-assess their learning and understanding" It helps students absorb, digest, and internalize new material, moving it into long-term memory.	Classroom instruction on a particular topic ↓ At the end of Instruction, learners are asked to determine; 1. "What was the most important concept you learned in the lesson today?" 2. "What concepts were less clear in the lecture today?" ↓ Responses are collected Anonymously ↓ Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity	• **Activate thinking and promote metacognition,** • **Self Assessment** • **Reflection** • **Diagnose knowledge gap**
4	**One sentence summary**[8] **Learning Style: Social**	This technique makes students distill, simplify, reorganize, synthesize, and chunk complex material into smaller, essential units that are easier to manipulate and remember.	Classroom instruction on any particular topic ↓ At the end of Instruction, students are asked to summarize the entire lecture by answering key questions on a piece of paper in terms of Who? Does what? To what or whom? When? Where? How? Why? ↓ Responses are collected anonymously ↓ Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity	• **Formal concept development,** • **Metacognition** • **Self Assessment** • **Reflection**
5	**Directed Paraphrasing** [5,7] **Learning Style : Social**	Students summarize the content of a reading assignment, a lecture, a discussion, or a lab to a defined audience for a specific purpose, in their own words. Because students must paraphrase material, they must work to understand it in depth and internalize.	Classroom instruction on any particular topic ↓ 10 minutes before the end of instructional activity students are asked to write in brief about the concept taught in class. Peers are considered as defined audience ↓ Responses are collected anonymously ↓	• **Provide stimuli for scientific discussion,** • **Formal concept development and transfer,** • **Metacognition** • **Self Assessment** • **Reflection**

			Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity	
6	**Muddiest point**[12] **Learning Style : Solitary**	The learners are asked to reflect upon the contents taught and note the poorly understood part of the lecture. It enables the teacher to weigh the contents through the students' perspective.	Classroom instruction on any particular topic ↓ Students are asked to decide upon the most confusing / poorly ↓ Understood part of the lecture by a paper based / Online platform. ↓ Responses collected ↓ Knowledge gaps analyzed and dealt appropriately in subsequent instructional activity	• **Activate thinking and metacognition** • **Self assessment** • **Diagnose knowledge gap**

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