EDUCATION

Assessment of the Psychomotor Domain: Proposal of Innovative Methods

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To develop an innovative new method for assessment of student psychomotor domain in Tikrit University College of Medicine (TUCOM), I follow the following model:

Step I. Outcomes formulation.

Formulation of student learning outcomes for 3 rd year program. The list of these outcomes was presented in Table 1.

Step II. Determination the method of assessment for each program outcome.

There are two kinds of assessment: Direct assessment methods and Indirect assessment methods. Direct assessment methods require student to demonstrate knowledge and skills and provide data that directly measures achievement of expected outcomes. Indirect assessment methods require that faculty infer actual student skills, abilities, knowledge and values from sources other than observable direct evidence [1].

All assessment methods have strengths and intrinsic flaws, however, the use of multiple observations and several different assessment methods over time can partially compensate for flaws in any one method [2]. Van der Vleuten [3] describe five criteria for determining the usefulness of a particular method of assessment

reliability (the degree to which the measurement is accurate and reproducible), Validity (whether the assessment measures what its claims to measure), impact on future learning and practice, acceptability to learners and faculty, and costs (to the individual trainee, the institution and society at large).

The use of multiple methods of assessment can overcome many of the limitations of the individual assessment formats [4]. Longitudinal assessment avoids excessive testing at any one point in time and serves as the foundation for monitoring ongoing professional development. Considering the challenges that we face in TUCOM, current assessment practices would be enhanced if the principles summarized in Table 2 were kept clearly in mind [5]...

The content, format, and frequency of assessment, as well as the timing and format feedback, should follow from the specific goals of the medical education program [5]. The various domains competence should be assessed in an integrated, coherent, and longitudinal fashion with the use of multiple methods and provision of frequent and constructive feedback [5].

The assessment can be formative (guiding future learning, providing reassurance, promoting reflection and shaping values) or summative (making an overall judgement about competence, fitness to practice, or qualification for advancement to higher leve3ls of responsibility). Formative assessment provides benchmarks to orient the learner who is approaching a relatively unstructured body of knowledge. They can reinforce student intrinsic motivation to learn and inspire them to set higher standards of themselves [6]. Although summative assessments are intended to provide professional self-regulation and accountability, they may also act as a barrier to future practice or training [7]. A distinction should be made between assessments that are suitable only for formative use and those that have sufficient psychometric rigor for summative use.

For the 3 rd year assessment in TUCOM, I suggest a multi-methods assessment that might include:

A. Simulation methods → Objective Structured Clinical Examination [OSCE] as tool.

B. Performance method → Objective Structured Practical Examination [OSPE] as tool.

C. Observation method → Mini-Clinical Evaluation Exercise (Mini-CEX) or Direct Observation of Procedural Skills (DOPS).

D. Product method→ D1. Product creation and special reports as a tool.

→ D2. Research – Community Research Project.

Tool design

Each competency assessment tool comprises three major components [1, 8]:

- Criteria.
- Indicators.
- A graduated scale.

Criteria: Tool development usually begins with the identification of the essential skill items which combine to characterise the overall skill of performing a task or role. The items chosen are generally observable behaviours or minimal elements of clinical practice [9]. Authors (experts), focus group or panels of experts can be employed to devise the items lists. Alternatively, can be sourced from existing documents or standards [1].

Indicators: The literature supports the use of rubrics or indicators to assist with consistent assessment and evaluation of performance, precisely pinpointing what constituted the decision for grade / scale. Rubric provides specific descriptions of the response for each criteria and match proficiency levels and quality ratings [1]. Developmental learning theories can be used to inform the descriptions [9].

Graduated scale: The use of a scale facilitates the identification of the degree of the skill. Adaptation or combination of commonly used scales such as Bloom's and the Bondy rating scale is frequent [10] (Table 3). A scale seeks to summarise the differences in the use of time, space, equipment and expenditure of energy across the development continuum. As I biochemist, I present the description of OSPE tool.

Objective Structured Practical Examination (OSPE).

Task Description

Walk around stations-based and paper-based assessment, including identification and interpretation of specimens, charts, graphs, data,

models, and any other materials encountered during practical tutorial and lecture sessions during the 3rd year course.

Task length: 2 hours

Task Content:

The content of the task are shown in Table 4.

Checklists:

1. Assessment tool checklist.

This checklist used for choosing the right assessment tool selection. A version for such checklist is presented in Table 5.

2. Rating scale checklist.

Table 6. Presented a form that can be used as checklist or rating scale according to Bondy's score for station 3 in the exam. (Blood sample collection for serum calcium determination).

3. Rating scale rubric.

Many experts believe that rubrics improve student's end products and therefore increase learning [1,11]. A rating scale rubric for station 9 of the exam [Abdominal paracentesis] is presented in Table 7.

4. General Indicator Hierarchy.

In developing the competency assessment tools, both Bloom's and Bondy's learning theories and associated descriptions of behavioural levels have been used to inform the descriptions of performance specified in the competency assessment tools. Indicators in the competency assessment tool are thus mapped against two vertical dimensions, representing relative difficulty and quality of performance according to both of the developmental learning theories. Table 8 shows the general hierarchy of indicators used in competency assessment tools.

Step III: Conduct and document assessment activities:

Conducting assessment activities is probably the most difficult and time consuming portion of the process. I should sure to select assessment techniques that are reasonable based on the resources (time, technology, and budget) available for our program and our College. After performing the assessment I list the results of each assessment methods in Row 3 of the Student Learning Outcomes [SLO] Assessment Form. (Appendix 1.).

Step IV. Use the results of assessment for program or course improvement.

Once the results of assessment have been collected, faculty in the program should meet to discuss what the results reveal about areas in which the program or course succeeds and about areas in which improvements can be made. Determinations will then be made on what action should be taken. In Row 4 of the SLO Assessment Form, I state exactly how and with whom the results are shared, the improvements that have been planned or implemented, and who is responsible for implementation and follow-up. The actions should generally be substantive and detailed (I list, for example, the specific course number in which changes to the curriculum were made), although there are times when no action is necessary and this is stated as well.

Step V. Conduct follow-up assessment to determine effectiveness of program or course improvement.

The curricular changes inspired by the initial assessment may be followed up by a second identical assessment to verify their effectiveness. If our goal is to improve the student learning, then we must determine if our instructional changes had the positive impact that we desired. To do so, it is necessary that we should administer those same instruments in the same way to the same or an equivalent group of student. The findings of the follow-up assessment should be closely analyzed and widely discussed by the assessment project team members, other department members (instructors or instructional aided alike) and other concerned members of the college community.
Outcomes assessment is an ongoing process. When I compile the findings of our follow-up assessment, I will of course want to compare them to the initial assessment. I must think about what worked and what can still be improved, in terms of the curriculum and of the creation and design of the assessment itself.

Table 1. Learning outcomes of 3rd year program as presented by Amina Alobaidi

1. Recognize and describe the important anatomical / histological structures relevant to the systems in the 3rd year program.
2. Explain the biochemical, nutritional, microbiological and physiological principles of the normal functioning of the systems included in 3rd year program.
3. Describe the role of kidney in normal physiology and relate this to the pathophysiology of the respiratory and cardiovascular systems.
4. Describe the underlying pathophysiology, pathogenesis, and pathology of the common diseases of systems included in 3ed year program.
5. Describe the common clinical manifestation of these diseases.
6. Describe the appropriate collection of specimens, ordering of pathology testing and the interpretation of pathology investigation relevant to these diseases.
7. Describe how the common imaging modalities can be used in investigations of these system diseases.
8. Demonstrate an ability to take an appropriate history and perform a competent examination of the systems included in the program.
9. Describe the pharmacological principles of hormones manipulation in contraception.
10. Improve knowledge, understanding and appreciation of reflective writing.
11. Gain an appreciation of reflective practice as it relates to undergraduate medical education.
12. Introduce students to concept and practices of critical analysis.
13. Review the ethical framework as it prepares students for educational experience in community and hospital settings.
14. Introduce students to ethical dilemmas in community and hospital programs.
15. Review medical student's roles and responsibilities within the context of community and hospital settings.
16. Review professional code of conduct.
17. Introduce students to the professional requirements of understanding educational experiences in tertiary hospitals.
18. Prepare students for the sensitivities associated with engaging with hospital patients.
19. Improve understandings of professional requirements for

3rd year.

20. **Respect the needs, values and culture of patients involved in medical education.**
21. **Understand role and responsibilities of a 3rd year medical students.**
22. **Introduce students to the literature and evidence base for safety and quality in Iraqi healthcare system.**
23. **Introduce students to the practice of safer health outcomes for the Iraqi population.**
24. **Improve awareness and understanding of the quality and safety issues.**
25. **Review the Iraqi healthcare system.**
26. **Identify integrated healthcare models.**
27. **Discuss the value, strength and weakness of integrated healthcare.**
28. **Develop and demonstrate an understanding of the issues surrounding the healthy and wellbeing of families and children living in Iraq.**
29. **Perform routine technical procedures related to systems included in the 3rd year program.**
30. **Interpret the results on commonly used diagnostic procedures.**
31. **Communicate effectively, both orally and in writing, with patients and their families, colleagues, and others with whom physicians must exchange information in carrying out their responsibilities and knowledge.**

Table 2. Principles of Assessment [5]

Target	*Description*
Goals of assessment	• *Provide direction and motivation for future learning, including knowledge, skills and professionalism* • *Protect the public by upholding high professional standards and screening out trainees and physicians who are incompetent* • *Meet public expectations of self regulation.* • *Choose among applicants for advanced training*
What to assess	• *Habits of mind and behaviour* • *Acquisition and application of knowledge and skills* • *Communication* • *Professionalism* • *Clinical reasoning and judgement in uncertain situations* • *Teamwork* • *Practice based learning and improvement* • *Systems based practice*
How to assess	• *Use multiple methods and a variety of environments and contexts to capture different aspects of performance* • *Organize assessments into repeated, ongoing, contextual, and developmental programs* • *Balance the use of complex, ambiguous real life situations requiring reasoning and judgement with structured, simplified, and focused assessments of knowledge, skills and behaviour* • *Include directly observed behaviour* • *Use experts to test expert judgement* • *Use pass – fail standards that reflect appropriate developmental levels* • *Provide timely feedback and mentoring*
Cautions	• *Be aware of the unintended effects of testing* • *Avoid punishing expert physicians who use shortcuts* • *Do not assume that quantitative data are more reliable, valid, or useful than qualitative data*

Table 3. Bondy's competency assessment tool [10]

Scale label	Score	Standard procedure	Quality of performance	Assistance
Independent	5	Safe Accurate Achieved intended outcome Behavior is appropriate to context	Proficient Confident Expedient	No supporting cues required
Supervised	4	Safe Accurate Achieved intended outcome Behavior is appropriate to context	Proficient Confident Reasonably expedient	Requires occasional supportive cues
Assisted	3	Safe Accurate Achieved most objectives for intended outcome Behavior generally appropriate to context	Proficient throughout most of performance when assisted	Required frequent verbal and occasional physical directives in addition to supportive cues
Marginal	2	Safe only with guidance Not completely accurate Incomplete achievement of intended outcome	Unskilled Inefficient	Required continuous verbal and Frequent physical directive cues
Dependant	1	Unsafe Unable to demonstrate behavior Lack of insight into behavior appropriate to context	Unskilled Unable to demonstrate behavior/ procedure	Required continuous verbal and continuous physical directive cues
X	0	Not observed		

Table 4. Task content of proposed 3rd year OSPE in biochemistry

Station	Topic	Weight %	Type
1	Asthma – case history	5	Written
2	Respiratory alkalosis- case history	5	Written
3	Blood sample collection for serum calcium determination	5	Exposure
4	Drugs side effect	5	Written
5	Determination of serum uric acid	5	Exposed
6	Determination of random blood sugar	5	Exposed
7	Renal failure- case history	5	Written
8	Malabsorption – case history	5	Written
9	Ascites – Sampling and biochemical examination of sample	5	Exposed
10	Determination of creatinine	5	Exposed
11	Determination of protein in urine	5	Exposed
12	Meningitis – case history	5	Written
13	Indicate the test you would undertake on sample A to answer the question posed on the form	5	Written
14	Measurement of LDL	5	Exposed
15	Determination of TSB in serum	5	Exposed
16	Vitamin metabolism disorder- case history	5	Written
17	Hepatic damage- case history	5	Written
18	Acute pancreatitis- case history	5	Written
19	Indicate how the concentrations of X and Y can be determined by spectroscopy in a plasma extracts containing both X and Y and suggest other techniques which could possibly be used to assay X and Y.	5	Written
20	You are provided with the data for a batch of samples for which the growth hormone concentrations have been determined. The analyst for this patch wants to know which samples if any can be authorized. a. Indicate, giving your reason, which samples if any can be authorized and how you would deal with the remaining samples. b. What would you want to know to optimize quality control in this assay?	5	Written

Table 5. Assessment Tool Checklist

Validity	**Does the assessment adequately evaluate academic performance relevant to the desired outcome?**	
Validity	**Does this assessment tool enable students with different learning styles or abilities to show you what they have learned and what they can do?**	
Content validity	**Does the content examined by the assessment align with the content from the course?**	
Domain validity	**Does this assessment method adequately address the knowledge, skills, abilities, behavior, and values associated with the intended outcome?**	
Bloom's	**Will the assessment provide information at a level appropriate to the outcome?**	
Authentic Assessment	**Will the data accurately represent what the student can do in an authentic or real life situation?**	
Reliability	**Is the grading scheme consistent; would a student receive the same grade for the same work on multiple evaluations?**	
Reliability	**Can multiple people use the scoring mechanism and come up with the same general score?**	
alignment with outcome	**Does the assessment provide data that is specific enough for the desired outcomes?**	
Type	**Is the assessment summative or formative - if formative does it generate diagnostic feedback to improve learning?**	
AAHE Good practice	**Is the assessment summative or formative - if summative, is the final evaluation built upon multiple sources of data?**	
Feedback	**If this is a summative assessment, have the students had ample opportunity for formative feedback and practice displaying what they know and can do?**	
Standards	**Is the assessment unbiased or value-neutral, minimizing an attempt to give desirable responses and reducing any cultural misinterpretations?**	
Grading, program review, both	**Are the intended uses for the assessment clear?**	
Feedback	**Have other faculty provided feedback?**	
Applicability	**Has the assessment been pilot-tested?**	
Standards	**Has the evaluation instrument been normed?**	
AAHE Good Practice	**Will the information derive from the assessment help to improve teaching and learning?**	
Acceptability	**Will you provide the students with a copy of the rubric or assignment grading criteria?**	
Acceptability	**Will you provide the students examples of model work**	

Table 6. Check list and /or rating scale for station 3 of the examination

No	Task	Yes or No	Bondy's Score
1	Educates the patient prior to and during the sampling procedure including clinical indications for sampling and possible side effects		
2	Ensures that the indication(s) for the sampling fall within the Iraqi National Clinical Practice Guidelines regarding blood product sampling		
3	Assembles equipment required for the sampling, including any specialized equipment required.		
4	Prepares and handles equipment using non-touch aseptic technique e.g. wearing a glove		
5	Proper exposure of sampling site		
6	Candidate cleans and sterilize the site for sampling		
7	Candidate apply tourniquet		
8	Selects a proper syringe and needle size		
9	Selects the proper anatomical site for sampling		
10	Palpates the site of sampling searching for suitable vein		
11	Inserts the needle with proper angle		
12	Get adequate sample volume		
13	Places a cotton pad on the point of needle insertion before its removal to prevent bleeding		
14	Pulls out needle properly and gently press on the point of needle insertion		
15	Flex the arm if the sampling is from the cubital area		
16	Removes the needle from syringe before pouring the blood sample into the container		
17	Removes the needle from syringe properly		
18	Pours the blood on the wall of the test tube		
19	Puts test tube in rack		
20	Discards syringe in the proper disposal site		
21	Keeps for 10 minutes at room temperature		
22	Puts the test tube in the centrifuge and spin for 10 minutes		
23	Transfers the serum into another test tube		

Table 7. Rating Rubric Scale for station 9 of the exam [1, 11]

Criteria/Dimension	Characteristics of highest level of performance	1	2	3	4	5	Score
Following instructions	Educates the patient prior to and during the sampling procedure including clinical indications for sampling and possible side effects such as : bleeding disorder, malnutrition, hernia, excess scar, pregnancy, severe intestinal inflammation or distension, bladder distension, enlarged spleen or liver, distended abdomen due to an obstruction.						
Safety	• Ensures that the indication(s) for the sampling fall within the Iraqi National Clinical Practice Guidelines regarding blood						

	product sampling. • **Physical examination performance.** • **Checking the case by inspecting one or more of the following [blood tests to make sure patient's blood clots normally, X ray, CT scan, Ultrasound, MRI scan].**						
Quality	**Assembles equipment required for the sampling, including any specialized equipment required.**						
Intervention during procedure	**Prepares IV fluids, anesthesia, anaphylactic shock treatment set, Blood for transfusion.**						
Patient posture	**Patient lay on back, with head 45 -90^0 elevation, or if there is only a small amount of fluid the patient position himself on**						

	his hands and knees,						
Achievement of sampling outcome	**If the procedure is scheduled rather than done in emergency, Does the candidates check whether the patients eat or drink in last 12 hours, Is the patient empty his bladder just before the procedure, if the entry area shaved.**						
Technique performance	**Prepares and handles equipment using non-touch aseptic technique e.g. wearing a glove, Proper site, cleans the area for needle insertion with iodine and draped with sterile cloths, proper needle insertion angle, Does the candidate puts a small bandage over the area of needle insertion**						
Handling sample	**Discard needle properly; pour the sample in test tube labelled with**						

	patient name, proper dividing of the sample for different tests, proper syringe discard.						
Sample volume	• **For diagnosis, small amounts of fluid are removed.** • **For patients having trouble in breathing, 1 - 4 litres of fluid may be removed** • **In case of malignant Ascites and when the goal of therapy is patient's comfort, a large amount of fluid, even 4-6 litres, can be removed at one time.**						
Length of procedure	• **Abdominal paracentesis can take as little as 10-15 minutes for diagnostic purposes.** • **Longer duration needed for therapeutic goal.**						
Candidates knowledge of possible	• **Bleeding.** • **Persistent leakage of**						

complications	**ascetic fluid.** • **Hypotension.** • **Peritonitis.** • **Accidental piercing of other structure s in the abdomen such as intestine, liver, spleen, stomach, bladder, or blood vessels.**						
Complications management	• **Safe** • **Accurate** • **Achievement with the intended outcomes** • **Behaviour is appropriate to context**						
Candidate information regarding hospital stay	• **No hospital stay is needed, if the procedure is done for diagnosis.** • **But if the procedure is done for therapeutic goal, the patient needs hospital stay.**						
Postoperative care	• **Patient stay in recovery room.** • **Checks blood pressure.** • **Checks for complications**						

Laboratory test	• **Biochemistry** • **Cytology** • **Microbiology**						
Total							

5 = Excellent

- Uses procedures rapidly and skilfully
- Explains function of each step in procedure
- Modifies procedure to fit changing conditions, e. G. Development of complications.

4= Good

- Uses procedure correctly but with some hesitation.
- Give general explanation of steps in procedure.
- Modifies procedure but needs some instructor guidance.

3= Satisfactory

- Uses procedure correctly but is slow and clumsy
- Explanation of procedure is limited
- Modifies procedures but only after demonstration by instructor

2= Marginally satisfactory

- Uses procedure correctly but is slow and unsafe for candidate
- Explanation of procedure is limited and unconfident.
- Modifies procedures but only after demonstration by instructor and perform it's slowly.

1= Inadequate

- Fails to use procedure correctly
- Explanation of procedure shows lack of understanding.
- Uses trial and error in adjusting procedure

Table 8. General indicator hierarchy.

Score	Indicators
0	Indicators describe in complete / unsafe practice using the following stems: • Does not able to • Incomplete • Not obtained • Performed • Inappropriate • Inaccurate
1	Indicators describe a minimum level of safe practice Demonstration of the psychomotor elements of the skill are limited to lower levels on a taxonomic scale and are described using the following stems. • Obtained • Collected • Checks • Performs • Slow
2	Indicators describe a level of proficient practice. Demonstration of the psychomotor elements of the skill reflect higher levels on a taxonomic scale and are described using the following stems: • Efficient • Accurate • Appropriate • Intended outcome

Appendix 1. Student Learning Outcome Assessment Form
Department of Biochemistry
Team Members:
Date:
Program / Course

Step	Target for assessment	Score
I	Student Learning Outcome Statements	
II	Assessment Methods & Criteria for Success	
III	Assessment Results	
IV	Changes/ Improvements Implemented	
V	Results of Follow-up Assessment	

References:

1. Gronlund NE. Assessment of Students Achievement. 8th Edition, Pearson, USA, Chapter 9& 10, 2006..
2. Wass V, Van der Vleuten C, Shatzer J, Jones R. Assessment of clinical competence, Lancet 2004;357:945-949.
3. Van der Vleuten CPM. The assessment of professional competence: developments, research and practical implications. Adv Health Sci Edu 1996;1:41-67.
4. Norman GR, Van der Vleuten CP, De Graaff E. Pitfalls in the pursuit of objectivity: issues of validity, efficiency and acceptability. Med Edu 1991;25:119-126.
5. Epstein RM. Assessment in medical education. N Eng J Med 2007;356:387-396.
6. Friedman BD. Standard setting in student assessment, AMEE Education Guide 18. Association for Medical Education in Europe, Dundee, UK, 2000.
7. Sullivan W. Work and integrity: the crises and promise of professionalism in America. 2nd ed. San Francisco: Jossey-Bass, 2005.
8. Amin Z, Seng C, Eng K. Practical Guide to Medical Student Assessment. World Scientific Publishing Co. Pte. Ltd, Singapore. Chapter 12-21, 2006.
9. Dent J, Harden RA. A Practical Guide for Medical Teachers. 2nd eds. Churchill Livingstone. 2005.
10. Bondy KN. Criterion-referenced definitions for rating scales in clinical evaluation. Journal of Nursing Education. 1983;22: 376-382.
11. Tierny R, Simon M. What's still wrong with rubrics: focusing on the consistency of performance criteria across scale levels. Practical Assessment, Research & Evaluation, Vol:9; Article (2). 2004. https://scholarworks.umass.edu/pare/vol9/iss1/2.