Criterion-referenced modelling of assessment: an innovative tool for learning

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Abstract
In a globally interdependent world, the concept "complexity" frames the socio-political and environmental issues of the day. The educational challenge is to foster the development of critical, creative and conceptually receptive minds in learners and to use assessment as innovating preparation for this complex, interactive world. An in-depth literature review and empirical study revealed that learners who encounter a knowledge or skill deficiency related to solving a problem could re-enter the "instructional space" to find guidance and support through the scaffolding of assessment criteria. In this way, learners could gain a deeper understanding of expectancies. Criterion referencing is an attempt to provide information about standards by describing the knowledge and skills that are characteristic at a given level of attainment. The paper provides examples of the use of assessment criteria to innovate learning, supported by the effective use of questioning. Reference is made to the alignment of assessment criteria and feedback. The study is framed in a constructivist paradigm. (Words: 159)

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1. Background and introduction

In a globally interdependent world, the concept "complexity" frames the socio-political and environmental issues of the day and teachers are charged with preparing learners for this complex, interactive world. The reality of this educational challenge is especially to foster the development of critical, creative and conceptually receptive minds in learners, but still to teach the required content. Pink, in his book "A Whole new mind: Moving from the Information Age to the Conceptual Age" (2005:1-69) highlights the increasing importance of creative thinking and the ability to construct one's own meaning for new concepts also by being able to solve increasingly complex problems in daily life. This creative thinking ability will almost certainly include metacognitive teaching, learning and assessment of such thinking. This notion of metacognitive assessment reinforces the idea that assessment needs to reflect how significant understanding at the conceptual level can be established, how understanding can be transferred across time and situations and how the assessment presupposes the relation with prior knowledge in order to confirm the understanding of patterns and connections.

Central to the World Bank Working Paper, No 128 (2008:43-45) is the notion of active learning which focuses on the provision of a platform for developing knowledge, skills and competencies for innovation, social development and economic growth. The investigation reported on in the World Bank Working Paper (2008), the pedagogical idea behind active learning is to provide learners with the opportunity for active engagement with learning matter for them to construct knowledge themselves instead of reciting facts. Regarding planning and the choice of teaching strategies, it seems clear that the underlying methodological principles which may lead to improved and adapted classroom activities are centred around learner participation with the emphasis on holistic development, critical thinking and the integration of knowledge (World Bank, 2008:44).

An understanding of the cognitive pathways along which learners are expected to progress can guide the kind of learning that needs to happen, teaching designs and assessment practices. The question is still how the teacher's mediation of the demands at a particular cognitive level can assist the learner to apply the intellectual skill required in, for instance, a problem-solving task or a creative thinking activity. Another question is, that if both teacher and learner understand the various levels of demand, would it then become easier to switch among a large number of intellectual skills associated with the levels of demand? The answers to these questions are closely related to the application of a criterion-referenced model to enhance learning.

2. Theoretical framing and research methodology

The research into how a criterion-referenced model and the alignment of intended outcomes with assessment criteria could enhance learning is based on reinterpretations of various taxonomies, experiential learning, productive thinking models and Gagné's taxonomy of learning outcomes.

This paper reports on the findings from both the reinterpretations and the practical developmental sessions held in 2015-2017. The developmental sessions were attended by teachers, subject advisors and moderators of examination papers in the schooling and post-schooling sector in South Africa. The workshops included the following:
- Using a taxonomy to determine question demands;

- Setting quality questions (and tasks) requiring different cognitive demands; and
- Writing assessment criteria based on and aligned to set outcomes.

The researcher used a guided discovery model; problem-based learning and discussion sessions to assist the participants in ways to interpret, organise information actively, look for internal patterns and application possibilities in their particular subject fields.   The participants identified examples from their particular subject fields to write outcomes, set questions and align assessment criteria to the set outcomes. The participants used the same content in a particular field in setting questions on different cognitive demands.

3.   Key findings emanated from reinterpretations and participant engagement

A first line of discussion with the participants in the practical sessions included a conceptual interrogation of what a criterion-referenced model entails. It was agreed that criteria should become the "shared language" between learners and their teacher in a particular context. It is this "shared language" that would assist in creating understanding and own meaning of expectancies.

All further discussions where based on the understanding that a criterion-referenced model guides the evaluation against a set of pre-specified qualities or criteria, without reference to the achievement of others (Brown, 1998). The pre-specified qualities or criteria are what learners have to do during assessment in order to demonstrate that they have achieved the learning outcomes. How well the learners are performing, is described at different levels often presented in a rubric. Setting criteria in a rubric encourages deeper, critical thinking and even facilitate communication with colleagues on the interpretation of the criteria and scoring against certain set criteria (Stevens & Levi, 2005; Brookhart, 2013).   Set criteria could direct interpretation of expectancies and become the key element of a teaching strategy to enhance learning.

Criterion-referenced assessment is an important foundation for engaging learners with the learning process. When done well, it -
- identifies what is valued in a curriculum and ensures that what is measured by assessment, is the same as the skills, knowledge and understandings defined by the intended learning outcomes;
- enables reliable and valid judgements about the learners' work which in turn provide comparability between assessors and streamlined moderation processes;
- serves as a tool to provide relevant feedback to learners about the quality of their work, and what is required for improvement on future assessments;
- enables transparent and defensible marks and grades;
- enables evaluation of how well learners have achieved the intended learning outcomes;
- assists in planning and adaptation of teaching designs; and
- supports learners to develop strong self-evaluation capacity, providing tools for them to review, refine, and improve their own work (Brown, 1998).

Findings from the participant engagement in the practical sessions confirmed the application value of a criterion-referenced model in teaching, learning and assessment practices. Some of the key findings are detailed below.

3.1 The outcomes - assessment criteria relation

The participants agreed with Killen (2007: 329, 335) who states that alignment of assessment tasks with the outcomes ensures that the teacher will only assess content and skills defined in the outcomes. The teacher's attempt to assess learners' understanding may be to -
- access the learner's capacity to use explanatory concepts creatively; or
- the capacity to think logically; or
- tackle new problems ; or
- the ability to re-interpret the type of learning that needs to take place.

With that determined, the teacher can write and structure the required achievements in the form of statements (outcomes).

Setting assessment criteria associated with expected outcomes gives all learners equal opportunities to demonstrate how well they have achieved the outcomes. Criteria serve as a well-defined standard according to which a learner's performance can be compared and according to which a learner can compare her/his own performance. Clear criteria describe and define what level of achievement is, for instance, worth an "A", and what is worth a "B". The focus in this case is on what a learner can do and the skills the learner has mastered.

It was evident from the practical sessions that guiding teachers to set outcomes and to write explicit assessment criteria, will assist them in guiding learners to understand expectancies as well as how their work will be assessed. The teacher will also be more able to explain learners' results with reference to the stated criteria. Giving learners an opportunity to ask questions in order to clarify the criteria and to know exactly what is expected of them, would help to ensure that learners *know how* to attempt different types of assessment successfully.

3.2 Assessment criteria as task scaffolding mechanism

Scaffolding is in educational terms a teaching strategy which provides a temporary, supportive and adjustable framework for a learner to be enabled to participate in or complete a task/activity that is beyond the learner's reach. According to Gagnon and Collay (2006:23-108), scaffolding takes place where a learner encounters difficulties/ problems in a particular task or activity. Such a situation will require the intervention by a more knowledgeable person in the learning of the learner to interpret the situation and be able to guide and support the learner to construct a higher level of understanding.

Scaffolding refers to the way the teacher guides the learner's learning via focused questions and positive interactions (Hartmann, 2002). Using assessment criteria to "scaffold" understanding assist learners in constructing meaning and knowledge on the basis of existing knowledge.

Using assessment criteria as scaffolding enable the teacher to -
- direct or focus the learner's attention to the particular starting point of the task/where to proceed.
- enhance the quality of "talk" between the teacher and learner and direct expectancies.
- simplify the task/activity by referring to different steps to follow (making the task/activity easier to complete).

- highlight crucial features (i.e. important aspects of the task/activity).
- find appropriate information to proceed to the next step.

With assessment criteria as reference, the teacher would be able to determine whether learners would need additional pieces of information that would clarify some steps in the task. The teacher must be aware that the learners are coming to class with different ideas about a particular topic. Environmental and social structures do have a great influence on interpretation of content and construction of meaning – especially where learners have limited experience and existing knowledge.

Where it is clear that learners feel unsure, the assessment criteria would even serve as way to provide emotional support/verbal or non-verbal reinforcement, also to allow peer support towards constructing understanding of expectancies.

Using assessment criteria to "scaffold" the understanding of expectancies direct the learners' attention and even assist with classroom management, motivation and filling gaps in existing knowledge structures. The evidence that the learner successfully accomplished the skill/ability/knowledge to complete the task or activity successfully would indicate what level of independent competence is reached.

3.3 Directing classroom discussions through assessment criteria

The participants in the practical sessions referred to a general trend to rely predominantly on questions of fact, which will probably produce quicker answers. The downside is that teachers will not attempt to pose more demanding questions to the learners anticipating that they have to wait for answers. The participants realised that changing the formulation of the question to include other levels of demand, would probe much deeper thinking and discussion in the classroom of which the following were given as example:

- To encourage more substantiated answers, the following change is useful: "*Some people describe friction as the opposite of slipperiness. Do you agree or disagree?*" was changed to *"Some people describe friction as the opposite of slipperiness. What is your opinion on this description?"*
- Another attempt brought the participants to: *"Do you agree that friction could be viewed as the opposite of slipperiness? Explain your opinion.*

Small changes in the way questions are formulated, based on the set criteria, the use of various levels of demand in questions and even allowing for "wait time" for answers to verbally asked questions might impact on how effective learning is taking place. Black et al. (2003:33-42) report on research findings that if "wait time" is increased in the classroom, the learners answer with more confidence, the answers are longer and include alternative explanations, while some learners even improve on the attempts of others. This form of discussion provides the opportunity for sustained thinking in the classroom which facilitates learning.

Using the assessment criteria in question format proved to not only enhance classroom discussion, but also serve as good introduction to discussion of tasks and expectancies.

If the assessment criteria is linked to the interpretation of a scenario, the use of *"What if"* questions would guide deeper insight. The following example from an economic and business management field lends itself well to the use of *"what if"* questions to guide a better understanding of the assessment criteria: Learners interpret the situation in an electronics firm and provide solutions to the application of inventory policy.

The scenario reads as follows:

The current inventory policy is to replenish the stock whenever the month-end inventory is below 150 units. In this case, the order is made for the difference between 500 units and the ending inventory. It takes approximately a month for the order to be placed, filled and delivered. Each order costs R1 200 in fixed costs and R90 per unit ordered. The firm estimates that its inventory- carrying costs are R2 per month, computed on the average inventory for that month. Because stock is taken only at the end of the month, the average is approximated by the average of the starting inventory and ending inventory. Stockouts are viewed with dissatisfaction since, in addition to disrupting the orderly production process, it costs R120 per unit to purchase the shortages on an emergency basis with immediate delivery.

The learners now have to ask *"what if"* questions based on the simulation, for example: "*What if* they decide to re-order earlier? *What if* they order smaller quantities? *What if* the demand for the equipment rises by 20 per cent within the next year?" Answers to these questions require learners to understand and apply the complex interaction between the different inventory costs, the way in which the stock is checked and the demand for the product. Where the assessment criteria are formulated in questions to assist in the interpretation and critical analysis of case studies, these questions could prompt the deeper discussion of the case study and assist in guiding learners to construct meaning and understanding.

The scenarios and case studies should be available in writing and each learner to receive a copy.

A case can be portrayed in a single paragraph or it can consist of an entire file (including reports, letters, accounts, receipts, memorandums and numerical data). A case study can be the first stage of a discussion, but it can also form an information base which leads role play or brainstorming. A good case study which depicts a specific event or series of events can result in hours of constructive discussion and the effective analysis of assessment criteria.

A case study can also represent certain events, and learners can then be asked to find solutions to the problems by means of brainstorming.

Except for using a criterion-referenced model to enhance learning through discussion and engagements, the teacher encourages the following:
   i.   *Participation:* After the case study has been read out, or the learners have read it themselves, they could divide into smaller groups and discuss the case study and possible solutions. This ensures that all learners participate.
   ii. *Application possibilities:* Since the case study is usually a real or possible event and has to connect with the teaching-learning situation, its relevance to the real world is usually obvious and it is highly probable that the learners will encounter a similar situation in real life.
   iii. *Relevance of the case:* Given that the case has to relate directly to the teaching or training situation, the instructor or teacher can select or write case studies that will be of real value or that are relevant to the specific situation or group of learners.
   iv. *Practicing problem solving, decision making and gathering information.* To assist learners to identify certain underlying principles. Instead of merely telling learners what these principles are, the learners are confronted through questions based in the set criteria to identify the principles themselves.

To assist in the discussion and to guide learners towards a more nuanced understanding of what "interpretation and critical analysis" entails, the following could serve as part of a teaching design:

- Learners are given a detailed version of the events that led to the problem, e.g. a buyer /seller dispute. They are then asked which additional information is required before the dispute can be resolved and how the information can be obtained.
- The facts that gave rise to a problem are presented to the learners (for instance an example from the business world, a misunderstanding on the payment of interest). The learners then have to say what they think will probably happen next.
- Learners are reminded of an event that received a great deal of media coverage (e.g. a stock market crash). The learners then have to say what will happen next. Their predictions are then checked and discussed the next day.
- Learners are given comprehensive information and statistical data. Some of the data are facts, some opinion. Some are important, others trivial. Learners have to work through the data and identify the problem, propose solutions, explain why they are proposing those specific solutions, suggest alternative solutions and draw up a plan of action.

These activities all require interpretation, the analysis of the case study and critical decision making. When learners are faced with a similar task in future, they would be able to interpret the expectancies and would be able to provide peer support and evaluate their own work effectively. In this case, the assessment criteria was used in choosing activities to prompt discussion and assist in the interpretation of expectancies.

3.4 Using assessment criteria as tool to enhance reflection on learning

Where teacher and learner are working collaboratively, a meta-cognitive element of "I know what I've learned and why", is vital for both. Teachers can promote learners' metacognition (awareness of thought process), through guiding the learners to become more conscious of their own learning and levels of understanding. To develop the ability to engage in self-reflection and for learners to be able to identify the next step in their learning, deepen the ability to seek out and gain new skills, deeper insight is needed. Teachers can equip learners with the desire and the capacity to take charge of their learning through developing the skill of self-assessment. Commencing with the assessment process, including an explanation and giving reasons why certain tasks are important will encourage learners to get involved in self-assessment. Reflection could be encouraged through the use of the set criteria, which in turn will result in willingness to engage with the assessment task. A good comprehension of the set criteria, the knowledge of *how* to apply a particular set of outcomes in answering questions and being able to value one's own work, develop learners' capacity to interpret expectancies and value responses.

Teachers who are teaching younger learners may make use of the "traffic-lighting"-method where learners assigned red, amber or green to indicate whether they did or did not understand the expectancies in a task. Also to allow peer assessment, enable learners to challenge each other's judgements of their work. This may spark further discussion and debate, which in turn may enhance the possibility of formative feedback and the improvement of planning.

3.5 Criterion-referenced feedback

Teachers should be aware of the impact that comments, marks and grades can have on learners' confidence and enthusiasm. Comments based on expectancies aligned to assessment criteria are more constructive and effective in motivating learners and direct discussion. When learners have a good understanding of what they are attempting to achieve, achievement comes quicker and easier.

Following a criterion-referenced model to provide feedback to learners not only structure the feedback and provide constructive direction, but could have a positive effect on motivation. The learner's emotional state (mood) to take up challenging tasks appears to be connected to motivation, which consciously or unconsciously may inhibit or promote conceptual processing. Especially difficult, peripheral subjects or actions which require judgement, opinion, redesign and new application of knowledge and skills appear to be most affected by the presence or lack of motivation (Lazarus, 1991; Forgas 1995). Motivation carries the characteristic of intentionality which also includes the idea that motivation will encourage the learner to "move" in a particular direction. Criterion-referenced feedback would "move" the learner toward deeper understanding of expectancies. It would also ensure that feedback is concrete, specific, useful and meaningful. Clearly, the learner can only adjust successfully if the information fed back to him or her is stable, unvarying in its accuracy, and trustworthy according to set criteria. Aligning feedback to the set criteria could ensure that judgements are formalised, descriptive and according to intended outcomes. In this way set criteria would direct learning and frame feedback in terms of the degree of understanding. By extension, if we want learner-to-learner feedback to be more helpful, learners have to be guided the same way as teachers to be consistent, using the same exemplars and set criteria.

4. Concluding remarks

There is a need to shift from the merely informative, if learners are to achieve more advanced conceptual levels of understanding. Learners who have reached a more advanced conceptual level will not only grasp the critical factual knowledge, but also understand the generalisations and principles and can therefore apply these in new contexts. The research provided clear evidence that teaching, learning and assessment should be seen as being in a triangular relationship where planning for teaching and assessment practices should refer to the same intended criteria. How teaching, learning and assessment are planned for and the way knowledge is mentally organized, makes the difference between real understanding and just reciting facts. It is therefore necessary to focus on how the organization of knowledge can be planned to be more accessible to the learner, enabling him or her to construct his or her own understanding and then provide proof of understanding in the assessment process.

Assessment criteria could be used as a mediating tool that shapes the understanding of new concepts. The mediation of concepts happens most effectively through the engagement of expectancies and the interaction between learner and teacher. Assessment criteria direct the process of negotiating common meaning and what is expected in a task.

The ability to engage in reflection and self-assessment through assessment criteria, will deepen the ability to seek out and gain new insights and skills. Learners will be encouraged to do self-assessment if they also understand what is expected in a question or task and what the task demands of them. Learners will become reflective in their learning when they understand how to apply a particular set of outcomes in answering questions and being able to value their own work.

The use of set criteria enable both the teacher and learner to work through expectancies and stated problems to arrive at a novel solution. The alignment of outcomes and assessment criteria enhances the teacher's ability to ask questions about a question, but also to guide effective questioning. The teacher's observation and interpretation of learners' responses on set criteria and the tasks at hand, might result in more effective assessment and improved learning.

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