INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

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ASSESSING SCIENCE FOR UNDERSTANDING

Danuše Nezvalová

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Unit 1

Formative and Summative Assessments in the Classroom

Objectives

- To understand the concept of formative assessment;
- To understand the concept of summative assessment;
- To compare summative and formative assessment;
- To describe shortly some strategies of formative assessment;
- To explain balances between summative and formative assessment.

Successful schools engage students in all aspects of their learning. There are many strategies for accomplishing this. How do we ensure that the information provides a balanced picture of the student's strengths and weaknesses? The answer to this is to balance both summative and formative classroom assessment practices and information gathering about student learning.

Assessment is a huge topic that encompasses everything from statewide accountability tests to everyday classroom tests. In order to grapple with what seems to be an over use of testing, educators should frame their view of testing as assessment and that assessment is information. The more information we have about students, the clearer the picture we have about achievement or where gaps may occur.

Defining Formative and Summative Assessments

The terms "formative" and "summative" do not have to be difficult, yet the definitions have become confusing in the past few years. This is especially true for formative assessment. In a balanced assessment system, both summative and formative assessments are an integral part of information gathering. Depend too much on one or the other and the reality of student achievement in your classroom becomes unclear.

Summative Assessments are given periodically to determine at a particular point in time what students know and do not know. Many associate summative assessments only with standardized tests such as state assessments, but they are also used at and are an important part of classroom programs. There are some examples of summative assessments:

- State assessments
- Interim assessments
- End-of-unit or chapter tests
- End-of-term or semester exams
- Scores that are used for accountability for schools (self-evaluation report, external report) and students (report card grades).

The key is to think of summative assessment as a means to gauge, at a particular point in time, student learning relative to content standards. Although the information that is gleaned from this type of assessment is important, it can only help in evaluating certain aspects of the learning process. Because they are spread out and occur *after* instruction every few weeks, months, or once a year, summative assessments are tools to help evaluate the effectiveness of programs, school improvement goals, alignment of curriculum, or student placement in specific programs. Summative assessments happen too far down the learning path to provide information at the classroom level and to make instructional adjustments and interventions *during* the learning process. It takes formative assessment to accomplish this.

Formative Assessment is part of the instructional process. When incorporated into classroom practice, it provides the information needed to adjust teaching and learning while they are happening. In this sense, formative assessment informs both teachers and students about student understanding at a point when timely adjustments can be made. These adjustments help to ensure students

achieve, targeted standards-based learning goals within a set time frame. Although formative assessment strategies appear in a variety of formats, there are some distinct ways to distinguish them from summative assessments.

One distinction is to think of formative assessment as "practice." We do not hold students accountable in "grade book fashion" for skills and concepts they have just been introduced to or are learning. We must allow for practice. Formative assessment helps teachers determine next steps during the learning process as the instruction approaches the summative assessment of student learning. A good analogy for this is the road test that is required to receive a driver's license. What if, before getting your driver's license, you received a grade every time you sat behind the wheel to practice driving? What if your final grade for the driving test was the average of all of the grades you received while practicing? Because of the initial low grades you received during the process of learning to drive, your final grade would not accurately reflect your ability to drive a car. In the beginning of learning to drive, how confident or motivated to learn would you feel? Would any of the grades you received provide you with guidance on what you needed to do next to improve your driving skills? Your final driving test, or summative assessment, would be the accountability measure that establishes whether or not you have the driving skills necessary for a driver's license not a reflection of all the driving practice that leads to it. The same holds true for classroom instruction, learning, and assessment.

Another distinction that underpins formative assessment is student involvement. If students are not involved in the assessment process, formative assessment is not practiced or implemented to its full effectiveness. Students need to be involved both as assessors of their own learning and as resources to other students. There are numerous strategies teachers can implement to engage students. In fact, research shows that the involvement in and ownership of their work increases students' motivation to learn. This does not mean the absence of teacher involvement. To the contrary, teachers are critical in identifying learning goals, setting clear criteria for success, and designing assessment tasks that provide evidence of student learning.

One of the key components of engaging students in the assessment of their own learning is providing them with descriptive feedback as they learn. In fact, research shows descriptive feedback to be the most significant instructional strategy to move students forward in their learning. Descriptive feedback provides students with an understanding of what they are doing well, links to

classroom learning, and gives specific input on how to reach the next step in the learning progression. In other words, descriptive feedback is not a grade, a sticker, or "good job!" A significant body of research indicates that such limited feedback does not lead to improved student learning.

There are many classroom instructional strategies that are part of the repertoire of good teaching. When teachers use sound instructional practice for the purpose of gathering information on student learning, they are applying this information in a formative way. In this sense, formative assessment is pedagogy and clearly cannot be separated from instruction. It is what good teachers do. The distinction lies in what teachers actually do with the information they gather. How is it being used to inform instruction? How is it being shared with and engaging students? It's not teachers just collecting information/data on student learning; it's what they do with the information they collect.

Some of the instructional strategies that can be used formatively include the following:

- **Criteria and goal setting** with students engages them in instruction and the learning process by creating clear expectations. In order to be successful, students need to understand and know the learning target/goal and the criteria for reaching it. Establishing and defining quality work together, asking students to participate in establishing norm behaviors for classroom culture, and determining what should be included in criteria for success are all examples of this strategy. Using student work, classroom tests, or exemplars of what is expected helps students understand where they are, where they need to be, and an effective process for getting there.
- **Observations** go beyond walking around the room to see if students are on task or need clarification. Observations assist teachers in gathering evidence of student learning to inform instructional planning. This evidence can be recorded and used as feedback for students about their learning or as anecdotal data shared with them during conferences.
- **Questioning strategies** should be embedded in lesson/unit planning. Asking better questions allows an opportunity for deeper thinking and provides teachers with significant insight into the degree and depth of understanding. Questions of this nature engage students in classroom dialogue that both uncovers and expands learning. An "exit slip" at the end of a class period to determine students' understanding of the day's lesson or

quick checks during instruction such as "thumbs up/down" or "red/green" (stop/go) cards are also examples of questioning strategies that elicit immediate information about student learning. Helping students ask better questions is another aspect of this formative assessment strategy.

- **Self and peer assessment** helps to create a learning community within a classroom. Students who can reflect while engaged in metacognitive thinking are involved in their learning. When students have been involved in criteria and goal setting, self-evaluation is a logical step in the learning process. With peer evaluation, students see each other as resources for understanding and checking for quality work against previously established criteria.
- **Student record keeping** helps students better understand their own learning as evidenced by their classroom work. This process of students keeping ongoing records of their work not only engages students, it also helps them, beyond a "grade," to see where they started and the progress they are making toward the learning goal.

All of these strategies are integral to the formative assessment process, and they have been suggested by models of effective school instruction.

Balancing Assessment

As teachers gather information/data about student learning, several categories may be included. In order to better understand student learning, teachers need to consider information about the products (paper or otherwise) students create and tests they take, observational notes, and reflections on the communication that occurs between teacher and student or among students. When a comprehensive assessment program at the classroom level balances formative and summative student learning/achievement information, a clear picture emerges of where a student is relative to learning targets and standards. Students should be able to articulate this shared information about their own learning. When this happens, a formative and summative assessment strategy, are valid. The more we know about individual students as they engage in the learning process, the better we can adjust instruction to ensure that all students continue to achieve by moving forward in their learning.

Teachers generally need to undertake or participate in some summative assessment as a basis for reporting grades or meeting accountability standards. However, the task of summative assessment for external purposes remains quite different from the task of formative assessment to monitor and improve

progress. While state tests provide a snapshot of a student's performance on a given day under test conditions, formative assessment allows teachers to monitor and guide students' performance over time in multiple problem-solving situations.

Tasks (assignments)

1. How you explain the concept of summative assessment?
2. Try to explain the concept of formative assessment in instructions.
3. Why is formative assessment important for effective science instructions?

Case study

Jane is a teacher of physics and chemistry. She taught sciences at lower secondary school for many years. She used some strategies of formative assessment in her science teaching very often. She had an experience how to use these strategies. She liked these strategies and her students could used these strategies without any problems. In this school these strategies were very common and other teachers used these strategies also. They found that formative assessment is a useful tool how to improve a quality of science teaching and students´ understanding of science concepts. In this school year she changed her position and she started to teach at general upper secondary school (grammar school). She wanted to use formative assessment in her science teaching also. But she found that her students are not able to apply strategies of formative assessment in their learning. In this school the tests and oral exams were used only. Teachers did not implement strategies of formative assessment yet. On the other side students did not understand scientific concepts fully. They did not like to learn physics and chemistry. They were only interested how to get the best marks in these subjects.

Questions to Case Study

1. Why do you think that Jane was not successful with the implementation of formative assessment?
2. Do you think that the formative assessment does not fit to science teaching on upper secondary school?
3. Do you recommend to Jane to use strategies of formative at her teaching and why?
4. Do you think that formative assessment is suitable only for weaker students?
5. Why teachers at that school should use formative assessment?

Summary

Summative and formative assessments are an integral part of information gathering. Depend too much on one or the other and the reality of student achievement in your classroom becomes unclear. Summative assessments are given periodically to determine at a particular point in time what students know and do not know. Formative assessment informs both teachers and students about student understanding at a point when timely adjustments can be made. These adjustments help to ensure students achieve, targeted standards-based learning goals within a set time frame. The more we know about individual students as they engage in the learning process, the better we can adjust instruction to ensure that all students continue to achieve by moving forward in their learning.

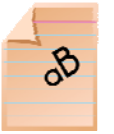
Frequently Asked Questions

I am a science teacher who is teaching in the first year. I teach chemistry and biology at upper secondary school. When I look back to my studies at lower and secondary schools I had no personal experience with formative assessment. My former teachers never used strategies of formative assessment. I want to implement formative assessment in my teaching. How I should start with this assessment?

Answer the question above

It is recommended to study theory of assessment from literature deeply. After that you can apply the strategy which you found in literature and which suits to you the best. You can get some personal experience firstly. Try to explain you approach to assessment also to your students. When you are not successful with formative assessment for the first time, try to do that again.

Next Reading



http://www.teachers.tv/video/565

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Unit 2

The Concept of Formative Assessment

Objectives

- To describe purposes of formative assessment;
- To explain benefits of formative assessment;
- To find a role of learners in formative assessment;
- To present examples of formative assessment;
- To explain the concept of assessment for learning;
- To understand the principles of assessment for learning.

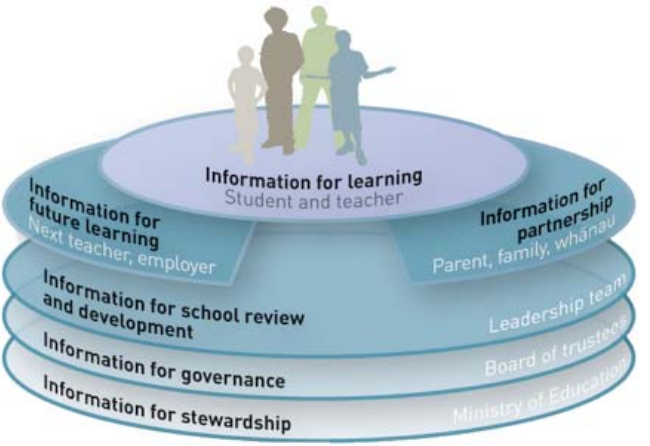
While many educators are highly focused on state tests, it is important to consider that over the course of a year, teachers can build in many opportunities to assess how students are learning and then use this information to make beneficial changes in instruction. This diagnostic use of assessment to provide feedback to teachers and students over the course of instruction is called formative assessment. It stands in contrast to summative assessment, which generally takes place after a period of instruction and requires making a judgment about the learning that has occurred (e.g., by grading or scoring a test or paper).

Purpose and Benefits of Formative Assessment

The primary purpose of assessment is to improve students' learning and teachers' teaching as both respond to the information it provides. Assessment for learning is an ongoing process that arises out of the interaction between teaching and learning. What makes assessment for learning effective is how well the information is used.

Assessment can do more than simply diagnose and identify students' learning needs; it can be used to assist improvements across the education system in a cycle of continuous improvement:

- Students and teachers can use the information gained from assessment to determine their next teaching and learning steps.
- Parents, families can be kept informed of next plans for teaching and learning and the progress being made, so they can play an active role in their children's learning.
- School leaders can use the information for school-wide planning, to support their teachers and determine professional development needs.
- School Boards can use assessment information to assist their governance role and their decisions about staffing and resourcing.
- The Inspection and Regional Office can use assessment information to inform their advice for school improvement.
- The Ministry of Education can use assessment information to undertake policy review and development at a national level, so that government funding and policy intervention is targeted appropriately to support improved student outcomes.



Black and Wiliam (1998b) define assessment broadly to include all activities that teachers and students undertake to get information that can be used diagnostically to alter teaching and learning. Under this definition, assessment encompasses teacher observation, classroom discussion, and analysis of student work, including homework and tests. Assessments become formative when the information is used to adapt teaching and learning to meet student needs.

When teachers know how students are progressing and where they are having trouble, they can use this information to make necessary instructional adjustments, such as re-teaching, trying alternative instructional approaches, or offering more opportunities for practice. These activities can lead to improved student success.

Feedback given as part of formative assessment helps learners become aware of any gaps that exist between their desired goal and their current knowledge, understanding, or skill and guides them through actions necessary to obtain the goal (Ramaprasad, 1983; Sadler, 1989). The most helpful type of feedback on tests and homework provides specific comments about errors and specific suggestions for improvement and encourages students to focus their attention thoughtfully on the task rather than on simply getting the right answer (Bangert-Drowns, Kulick, & Morgan, 1991; Elawar & Corno, 1985). This type of feedback may be particularly helpful to lower achieving students because it emphasizes that students can improve as a result of effort rather than be doomed to low achievement due to some presumed lack of innate ability. Formative assessment helps support the expectation that all students can learn to high levels and counteracts the cycle in which students attribute poor performance to lack of ability and therefore become discouraged and unwilling to invest in further learning (Ames, 1992; Vispoel & Austin, 1995).

While feedback generally originates from a teacher, learners can also play an important role in formative assessment through self-evaluation. Two experimental research studies have shown that students who understand the learning objectives and assessment criteria and have opportunities to reflect on their work show greater improvement than those who do not (Fontana & Fernandes, 1994; Frederikson & White, 1997). Students with learning disabilities who are taught to use self-monitoring strategies related to their understanding of reading and writing tasks also show performance gains (McCurdy & Shapiro, 1992; Sawyer, Graham, & Harris, 1992).

What is assessment for learning?

Assessment is an integral part of teaching and learning. Assessment for learning is best described as a process by which assessment information is used by teachers to adjust their teaching strategies, and by students to adjust their learning strategies. Assessment, teaching and learning are inextricably linked, as each informs the others. Assessment is a powerful process that can either optimise or inhibit learning, depending on how it's applied (Anbgelo, Cross, 1993).

Assessment for learning helps teachers gather information to:

- plan and modify teaching and learning programs for individual students, groups of students and the class as a whole;
- pinpoint students' strengths so that both teachers and students can build on them;
- identify students' learning needs in a clear and constructive way so they can be addressed;
- involve parents, families and others in their children's learning.

Assessment for learning provides students with information and guidance so they can plan and manage the next steps in their learning. Assessment for learning uses information to lead from what has been learned to what needs to be learned next.

Assessment for learning should use a range of approaches. These may include:

- day-to-day activities (such as learning conversations);
- a simple mental note taken by the teacher during observation;
- student self and peer assessments;
- a detailed analysis of a student's work;
- assessment tools (which may be written items, structured interview questions or items teachers make up themselves).

What matters most is not so much the form of the assessment, but how the information gathered is used to improve teaching and learning.

Principles of assessment for learning

Principles of assessment for learning are the following:

- Learning to learn;
- Building students' assessment capability;
- Engaging and motivating;
- Content knowledge;
- Planned and communicated;
- Progressive and cumulative;
- Supports teaching and learning goals;
- Recognizes social and cultural aspects of assessment;
- Teaching inquiry.

Learning to learn

Good assessment should focus less on "do they have the right or wrong answer?" and more on making students' thinking visible to both teacher and student. It should help develop understanding of the strategies and patterns students have constructed in order to make sense of the world. This empowers students to take control of their own learning, by developing their skills of self-regulation. Independent learners like this have the ability to seek out and gain new skills, new knowledge and new understanding, according to their own needs and learning goals.

Building students' assessment capability

When students actively participate in assessing their learning by interpreting their performance, they are better placed to recognize important moments of personal learning. This helps them to identify their own strengths and needs, and discover how to make 'Where to next?' decisions. Students should be educated in ways that build their assessment capabilities, so they can take increasing control of their own learning and, through this process, become more effective and independent learners.

Students make progress when they develop the ability to monitor their own work. To do this well, they need to understand:

- what high quality work looks like (examining examples and models of quality work helps develop this);
- what criteria define quality work (participation in the development of learning goals and assessment criteria helps develop this);
- how to compare and evaluate their own work against such criteria (peer and self-assessment help develop this).

Assessment-capable students can also provide better information to teachers. Better student feedback gives teachers a clearer picture of students' learning needs and enables more personalized development of next teaching and learning steps.

Engaging and motivating

One of the most important purposes of assessment for learning is the role it plays in student motivation. Knowledge and understanding of what is to be achieved is not enough. Students must want to make the effort and be willing to keep on engaging, even when they find the learning difficult. Developing students' assessment capabilities engages and motivates them, and helps them to become more independent learners. Assessment that encourages learning promotes motivation by emphasizing progress and achievement rather than failure. When students succeed or fail, they explain it to themselves in a ariety of ways (effort, ability, mood, knowledge, luck, help, clarity of instruction etc). It's the teacher's role to shift explanations away from uncontrollable ones, towards controllable ones. Assessment-capable students feel greater ownership of their learning and are more likely to attribute outcomes to factors within their control. This engages and motivates students.

Content knowledge

Knowledge of both curriculum and pedagogical content is essential for effective assessment for learning. Teachers require deep knowledge of the content to be taught and how students learn it. This means having a clear understanding of the concepts, a sense of the likely understandings and misunderstandings students will bring to the classroom and how to best facilitate new learning. Assessment for learning is dependent on knowledgeable teachers who can interpret their observations and act on those interpretations to enhance learning. The ways in which teaching, learning and assessment are structured by teachers are a direct product of their content knowledge and beliefs about how students think and learn.

Planned and communicated

Assessment for learning should be built into teachers' planning as a part of everyday classroom practice. Learning goals, teaching strategies and assessment criteria should be carefully matched. Students should know in advance what they will learn, as well as how and why they are to be assessed. Teachers' program planning should be flexible so that they can make changes in response to new information, opportunities or insights. Their planning needs to include strategies to check students understand the goals they are pursuing and the criteria that will be applied in assessing their work. How students will receive feedback, how they will take part in assessing their learning and how they will be helped to make further progress should also be planned.

Progressive and cumulative

Assessment should be valid, fair and suited to the purpose. It should measure progress, not just achievement. Any assessment can only provide a snapshot of achievement on a particular day. Performance will vary from day to day depending on:

- the nature of the assessment task;
- the conditions in which the assessment is undertaken;
- the purpose of the assessment;
- the student's preparation;
- the student's engagement and motivation.

To make a valid and fair measure of progress over time, teachers need to analyze information from a range of sources. It's important that teachers gather information both formally and informally, using a range of approaches to add to or modify their picture of each student's learning over time.

Supports teaching and learning goals

Teachers need to know how a given assessment should enhance learning, and how to check if it has. Assessment should emphasize quality student-teacher learning interactions and be fit for purpose. Assessment for learning supports teaching and learning goals in three key ways:

1. Identifying the learning need

Assessment information helps teachers and students identify where a student is in terms of their learning, where they want to be, and what next teaching and learning steps can help them to achieve their goals. This means striking a delicate balance. If the next instructional steps are too hard for the student, frustration will be the most likely result. If they are too easy, boredom and disengagement are potential outcomes. Good assessment practice should identify what next teaching and learning steps are achievable, and enable the teacher and student to move from the student's current state of learning towards their learning goals.

2. Feedback

Feedback based on assessment is one of the most powerful ingredients in teaching and learning, and maximizing the quality, appropriateness and use of feedback should be a core aim of all assessment practice. There should be as much or as little feedback as is needed, using a number of approaches if necessary. Knowledge of the learner is essential for knowing what is appropriate and ensuring feedback is delivered in a way that empowers the learner.

Feedback can drive a loop of continuous change and improvement for both the teacher and student, as both learn from each other. Feedback in the assessment for learning process:

- guides the student through the next teaching and learning steps;
- helps teachers assess and modify their teaching in response to student needs.

Effective feedback provides clear, descriptive, criterion-based information that enables the student to determine where they are in a learning progression, how their level of understanding differs from their learning goals, and what they need to do to move towards those goals.

3. Next teaching and learning steps

To be effective in describing next teaching and learning steps, assessment for learning should be linked to some form of learning progression. A learning progression should clearly articulate what steps make up progress towards an ultimate learning goal. Assessment for learning helps teacher and student locate the student's position along the learning progression.

Progression doesn't necessarily always happen in a linear fashion. Students will often move far ahead in one area while retaining significant learning needs in another. Part of the art of teaching is supporting students to build on strengths in order to meet needs, and providing students challenging yet achievable steps towards their learning goals.

Recognizes social and cultural aspects of assessment

All aspects of assessment carry a social and cultural dimension. Teachers need knowledge of their students' cultures, backgrounds and experiences to ensure assessment is appropriate and effective.

Social aspects

To be effective, assessment for learning needs to take place within a positive learning environment. Students should be encouraged to take risks and make errors, and understand that wrong answers can assist learning just as effectively as right answers. Encouraging a culture of listening critically to one another, responding positively and constructively, and appreciating the different strengths, experiences and skill sets among peers will help create such an environment. If this can be accomplished, students can learn to conduct effective peer assessments of each other.

Cultural aspects

In the classroom, non-judgmental exploration of teachers' and students' own cultural values, assumptions and understandings about learning and assessment may help them to use the differences that surface to develop their own strengths, and identify areas for improvement. Effective assessment practice needs to recognize different values, assumptions and understandings and the impact they have on how students may respond to different assessment approaches. Effective assessment practice reflects the educational values of different cultures, backgrounds and experiences.

Teaching inquiry

Assessment for learning practice needs to undergo continual review and professional discussion based on the impact the practice has had on student outcomes. Teachers need professional knowledge to plan for assessment, observe learning, analyze and interpret evidence of learning, give feedback to students and support students in their self-assessment. A culture of professional inquiry where teachers themselves seek out and learn the best ways to improve their skill in using assessment for learning is vital.

Assessment Tool Description
(www.2learn.ca/Projects/Together/evaluate.html#)

Assessment Tool	Description
Anecdotal Records	Observations of student actions and interactions set in a specific day, time, setting and learning context. Notes are to be objective and as specific as possible including dialogue or student reactions.
Anonymous Group Member Evaluation	Students evaluate other members in their group anonymously.
Checklists	This is a student self-monitoring tool given out to students before the teacher is going to begin an activity. It provides information on how students will be evaluated and what things they should be doing. Checklists can be either individual or class oriented. They can serve to provide feedback to students or information to the teacher of areas of growth. Observation checklists provide a wider range of information than found in traditional written work, and they help the teacher get to know the student as an individual.
Class Assessment	Check for preparation, readiness to participate and effort that the student is willing to put into the task at hand.
Collaborative Assignments	Students are graded as a group on a paper or project and all students receive the same grade. Students may be asked to sign a contract.
Collaborative Examinations	Students work collaboratively to complete the tasks assigned on the examination.
Conferencing	More formal than conversations because they have a set time established with a student which may disrupt the natural talking. Interviews and conferences: • are dynamic, interactive • help the teacher to understand a student's point of view • allow the student and the teacher to highlight questions and concerns • can be brief and informal or structured and formal • require that authentic questions be asked of the students so that they can provide genuine responses. Questions should focus on student work and ideas. The teacher can contribute but should not impose constraints on the student.

Conversations	Ongoing, short and informal exchanges between student and teacher.
Electronic Formative Feedback on Collaborative Group Products	Students electronically submit work in progress then the teacher inserts comments electronically throughout the text of the document.
Examinations	Students work individually to complete the tasks outlined on the examination.
Formative Feedback on Collaborative Group Products	Students may submit works in progress (such as an introduction, lead sentence or topic sentence), then receive focused feedback. A page limit may be set.
Journals	Students write about topics that are important to the course. Journals can be used for student reflection. As students become more independent in their thinking, feedback from the teacher becomes less important. The journal becomes a tool for self monitoring. Journals allow students a place to voice ideas, concerns and opinions. They stimulate a written conversation between student and teacher or student and student. Assessment of journals is based on effort and thoughtfulness. Students working collaboratively can record the steps they take in solving a problem that can then be evaluated based on their completeness and thoughtfulness.
Peer Assessment	Students of similar ages assess the achievement and performance of one or more of their peers. It is based on criteria developed by the teacher or jointly with the students and their teacher. Students need a vocabulary with which to speak about the evaluation of their peers. It is for this reason that the teacher needs to model for students the process of evaluation in order to display its possibilities. It is difficult for students to evaluate themselves objectively, critically, and effectively. It is easier for students to start by evaluating others, with sharing as part of the process.
Progress Report Without Personalized Feedback	Journals are taken in and key problems are identified and addressed to the whole class. This reduces the amount of time necessary to generate individual comments in each journal. More importantly for the student, it gives each student a better sense of how s/he fits within the context of the rest of the class--being able to tap into others' ideas, challenges, and solutions helps spur on the individual.
Rubrics	Rubrics provide a ranking of task ability based on criteria --"a scoring guide that differentiates on an articulated scale, among a group of sample behaviors or evidences of thought that are responding to the same prompt." --may be quantitative or qualitative. --may be formative or summative.

Self Assessment	Students evaluate themselves using an established form or set of criteria. • values multiple voices: student, peer and teacher • gives the student choices • is collaborative instead of competitive • conversation is real and not teacher-guided • allows for individual learning styles to be considered • allows for a shift away from quantitative to qualitative learning • encourages students to be responsible for their learning and to be more reflective about what they learn • helps students become more knowledgeable by helping them take more responsibility for evaluating themselves • Students who are included in their evaluation improve their work and improve their critical abilities. • As teachers we need to help students realize that they can learn from themselves as well as each other, not only teachers. • Before students can become responsible for evaluating themselves, they must clearly understand the criteria by which they are evaluating their activities and assignments. Be aware that this takes time to learn and teach or model.
Short Answer Questions	In traditional learning environments, short answer questions are often assigned to assess student performance. Within a more student-directed classroom, students can be given guidelines for creating questions, such as to create questions that fit the analysis level of Bloom's taxonomy, and then be assigned the task of pursuing answers to the questions, justifying their choices.
Student Papers	Students work collaboratively in generating information, but write an individual paper.

Examples

Peer Evaluation

Instructions: In the space provided, please evaluate yours peer´s contributions, using a scale of 1 (low) to 5 (high)	**1**	**2**	**3**	**4**	**5**
Demonstrates appositive attitude to the project team					

Produces the tasks that were agreed upon by the group					
Is organized in finding information					
Volunteers when tasks needed to be accomplished					
Completes fair share of the work load					
Demonstrates initiative with regard to the project					
Constructively develops ideas with group members					
Makes helpful suggestions					
Is a careful listener					
Encourages quiet members to participate					
Demonstrates effective independent work					
Meets deadlines					
Demonstrates interest in and knowledge of topic					
Shares resources					
Incorporate course materials and outside resources					

Writing checklist

Tasks	**Often**	**Sometimes**	**Seldom**
Able to write effectively			
-on self-selected topics			
-on teacher assigned topics			

-when following a structure or pattern			
Strategic Employed			
-resources in room			
-peer o teacher feedback			
-revision			
Writing			
-uses modeled writing strategies			
-able to self-edit			
-expresses ideas, thought and feeling effectively			

Research checklist

Research skills	**Complete**	**Incomplete**
Collecting		
Interviewing		
Recording		
Planning		
Researching		
Ordering information		
Using appropriate references		
Surveying		
Organizing results		
Reporting		
Writing up results		
Checking for errors		

Tasks (assignments)

1. Try to find the most important purposes of formative assessment.
2. Can you explain to your students the main benefits of formative assessment for their learning?
3. Try to apply the principles of assessment for learning to your science teaching.
4. In what ways can formative assessment impact student leaning?

Case study

When teacher Paul was asked how he assessed his students, he talked about tests and oral exams. When we asked how he knows whether his students have learned what they have taught, the answers were very different. He talked about classwork, the things student say in classroom discussions, and even the expressions on their faces.

Questions to Case Study

1. assessment for understanding and learning of science concepts?
2. Can you design two techniques (at least) for assessment that demonstrate that students have learned what they have taught?

Summary

When teachers know how students are progressing and where they are having trouble, they can use this information to make necessary instructional adjustments, such as re-teaching, trying alternative instructional approaches, or offering more opportunities for practice. These activities can lead to improved student success. Feedback given as part of formative assessment helps learners become aware of any gaps that exist between their desired goal and their current knowledge, understanding, or skill and guides them through actions necessary to obtain the goal. Assessment for learning provides students with information and guidance so they can plan and manage the next steps in their learning. Assessment for learning uses information for teachers to lead from what has been learned to what needs to be learned next.

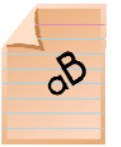
Frequently Asked Questions

I am a prospective science teacher. There is a lot of techniques for formative assessment leading to learning for understanding. How can I manage all of these techniques?

Answer the question above

It is recommended to select techniques that the best to you. These techniques you can apply on the content of your teaching during the teaching practice in school. You can discuss with your tutor and students about these techniques and analyze that.

Next Reading



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Unit 3

Purpose and Characteristic of Classroom Assessment

Objectives

- To understand purposes of classroom assessment;
- To define the concept of assessment;
- To characterize the classroom assessment.

The Nature of Assessment

With the release of the constructivist approach to science teaching, the issues of why, how, and what we, as teachers, assess in our classrooms will become a major challenge in the science teaching and learning. As educators are changing their ideas about what constitutes exemplary inquiry-based learning, and recognizing that science is an active process that encourages higher-order thinking and problem solving, there is an increased need to align assessment.

Assessment can be defined as a sample taken from a larger domain of content and process skills that allow one to infer student understanding of a part of the larger domain being explored. The sample may include behaviour, products, knowledge, and performances. Assessment is a continuous, ongoing process that involves examining and observing student's behaviour, listening to their ideas, and developing questions to promote conceptual understanding. The term authentic assessment is often referred to in any discussion of assessment and can be thought of as an examination of student performance and understanding on significant tasks that have relevancy to the student's life inside and outside of the classroom.

The increasing focus on the development of conceptual understanding and the ability to apply science process skills is closely aligned with the emerging research on the theory of constructivism. This theory has significant implications for both instruction and assessment, which are considered by some to be two sides of the same coin. Constructivism is a key underpinning of the science teaching and learning.

Constructivism is the idea that learning is an active process of building meaning for oneself. Thus, students fit new ideas into their already existing conceptual frameworks. Constructivists believe that the learners' preconceptions and ideas about science are critical in shaping new understanding of scientific concepts. Assessment based on constructivist theory must link the three related issues of student prior knowledge (and misconceptions), student learning styles (and multiple abilities), and teaching for depth of understanding rather than for breadth of coverage. Meaningful assessment involves examining the learner's entire conceptual network, not just focusing on discreet facts and principles.

The Purpose of Assessment

Critical to educators is the use of assessment to both inform and guide instruction. Using a wide variety of assessment tools allows a teacher to determine which instructional strategies are effective and which need to be modified. In this way, assessment can be used to improve classroom practice, plan curriculum, and research one's own teaching practice. Of course, assessment will always be used to provide information to students, parents, and administrators. In the past, this information was primarily expressed by a "grade". Increasingly, this information is being seen as a vehicle to empower students to be self-reflective learners who monitor and evaluate their own progress as they develop the capacity to be self-directed learners. In addition to informing instruction and developing learners with the ability to guide their own instruction, assessment data can be used by a school district to measure student achievement, examine the opportunity for children to learn, and provide the basis for the evaluation of the district's science program. Assessment is changing for many reasons. The valued outcomes of science learning and teaching are placing greater emphasis on the student's ability to inquire, to reason scientifically, to apply science concepts to real-world situations, and to communicate effectively what the child knows about science. Assessment of scientific facts, concepts, and theories must be focused not only on measuring

knowledge of subject matter, but on how relevant that knowledge is in building the capacity to apply scientific principles on a daily basis. The teacher's role in the changing landscape of assessment requires a change from merely a collector of data, to a facilitator of student understanding of scientific principles.

Characteristics of Assessment

The assessment is learner-centered, teacher-directed, mutually beneficial, formative, context-specific, ongoing, and rooted in good teaching practice. In the context of constructivist approach, assessments need to gauge the progress of students in achieving the three major learning outcomes of constructivist approach: conceptual understanding in science, abilities to perform scientific inquiry, and understandings about inquiry.

All learners come to learning tasks with some relevant knowledge, feelings and skills. By school age, students have already attained several thousand concepts and language labels for these concepts. Concepts are playing a primary role of constructivist learning theory. Learners do not store concepts as isolated bits; instead, they form relationships or connections between concepts to form propositions. Meaningful learning occurs when the learners seek to relate new concepts and propositions to relevant existing concept and propositions in her/his cognitive structure (Mintzes, Novak, Wandersee, 2000).

Teachers have a very challenging role to play in assessment process. They must seek to understand the major superordinate and subordinate concepts of the sciences and integrate these into a complex, integrated, hierarchical structure. Assessment can foster development of the kind of knowledge frameworks that are needed for effective science teaching. So prospective science teachers must seek on their own initiative to build this kind of understanding of their field. As it is focused on learning, assessment requires the active participation of students. By cooperating in assessment, students reinforce their grasp of the science content and strengthen their own skills and self-assessment.

Constructivist approach to assessment is formative rather than summative. Its purpose is to improve the quality of student learning, not to provide evidence for evaluating or grading students. Assessment has to respond to the particular needs and characteristics of the teachers, students and science content. Assessment is context-specific: what works well in one class will not necessarily work in another.

Assessment is ongoing process. Teachers get feedback from students of their learning. Teachers then complete the loop by providing students with feedback on the results of the assessment and suggestions for improving learning.

Most teachers already collect some feedback on their students´ learning and use that feedback to inform their teaching. Assessment is an attempt to build on existing good practice by making it more systematic, more flexible, and more effective. Teachers ask questions, react to students´ questions, monitor body language and facial expressions, read homework, and so on. Assessment provides a way how to integrate teaching and learning process. Assessment is an integral part of these processes.

Tasks (assignments)

1. How you explain the concept of assessment in constructivist classroom?
2. How should student learning be assessed?
3. Why students be assessed in constructivist classroom?

Case study

Ms. Novak facilitates science lessons in a number of ways. Students´ background knowledge is informally assessed through observation and conversation. She identifies students´ misconceptions, and design activities to promote basic understanding. When students work in groups, she facilitates learning by watching and listening to them as they make decisions. Some of her questions are: How do you know that this decision is correct? Which can had the greatest temperature change? How does the color of the material affect its ability to absorb? How did you determinate the solution? What problems did you incur while completing the activity?

Questions to Case Study

1. Do you think that these questions are relevant to constructivist approach?
2. Can you design the next questions (5 at least) for constructivist classroom?

Summary

Assessment can play an important role in the larger "assessment movement" that is discussed in many European countries recently. Constructivist theory requires a different approach to assessment. This assessment needs tools and methods to fit its purposes, and those will not be the same standardized tests. Constructivist classroom assessment requires the development of its own "appropriate technology" – simple tools designed for the task at hand: the understanding and improvement of learning.

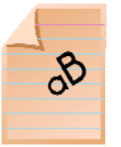
Frequently Asked Questions

I am a science teacher who is teaching in the first year. I have many difficulties in designing questions for assessment of students from the point of constructivism. How can I improve my ability to design questions?

Answer the question above

It is recommended to design these questions in advance on the cards or list. When the students do not understand the question, make a mark and try to change the question.

Next Reading



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Unit 4

A Constructivist Approach in Assessment

Objectives

- To understand the concept of constructivism;
- To apply constructivist theory on assessment;
- To find differences between traditional assessment and constructivist approach to assessment;
- To explain misconcepts in understanding of assessment.

Constructivism and Assessment

What kinds of assessments do teachers use in traditional and constructivist classrooms to assess student's learning? If assessments evolve out of instruction, as is expected in inquiry and constructivist-based classrooms, then assessments should reflect what students learn and can do. There is a problem with investigating classroom assessment strategies because teachers' beliefs, practices, and other factors cause teachers to use many different formal and informal assessments.

Three constructs emerge from the literature regarding constructivism and have implications for the learning environment. They are (1) learning is an active process, (2) the learner has prior knowledge, and (3) the learner takes responsibility for their own learning (Yager, 1991; Cobb et al 1992, Magoon, 1977; Hewson & Hewson, 1988). These three ideas are central to this study. These ideas can be operationalized by the following statements:

1. Assessments are in a meaningful context that is relevant or has emerging relevance to students (Brooks & Brooks, 1993).

2. The process of learning does not shut down during assessment (Brooks & Brooks, 1993).
3. Assessments are tailored to specific modules and teaching situations (Zahorik, 1995).
4. Assessments include higher order thinking skills, i.e., application, evaluation, analysis, synthesis (Burry-Stock, 1995; Yager, 1991).
5. Assessments include application of knowledge and comprehension (Zahorik, 1995).
6. A range of techniques is used in assessments (Burry-Stock, 1995; Zahorik, 1995).
7. Assessments focus on the big pictures on concepts and on issues and their accompanying facts and evidence (Zahorik, 1995).
8. Assessment includes inquiry (Brooks & Brooks, 1993; Yager, 1991).
9. Students go beyond initial information levels (knowledge and comprehension) through elaboration doing in-depth analysis of big ideas, issues and concepts (Brooks & Brooks, 1993).
10. Students solve problems in which they extend and re-conceptualize (accommodation) knowledge in new contexts (Brooks & Brooks, 1993; Osborne & Wittrock, 1983; Zahorik, 1995).
11. Students generalize (synthesis) experiences from earlier concrete experiences to understand abstract theories and applications (Brooks & Brooks, 1993; Osborne & Wittrock, 1983; Zahorik, 1995).
12. Students exhibit knowledge through application (Yager, 1991).
13. Students interact with each other in all circumstances including during assessments (Zahorik, 1995).

Constructivist learning is an active process, and alternative assessment celebrates this active process. Instead of testing for the presence or absence of discrete bits of information, alternative assessment instead provides a means to understand whether students organize, structure, and use information in context to solve complex problems. Assessment is not something that we tack onto learning: it is an essential *ongoing* component of instruction that guides the

process of learning. Ongoing assessment uses exhibitions, student explanations of concepts, the writing or any number of other thought-demanding performances to evaluate and reflect on students work.

Assessment can be used to build understanding through reflection and iteration. There is great promise for deeper understanding and appreciation of the creative, generative process we call learning when a student is aware of scholastic expectations and understands how to effectively review and critique his or her own work. This process has three steps:

1. The teacher must help students understand from the outset the criteria by which their work will be judged.
2. Students must document their work process for the duration of the project or unit.
3. Through performance and feedback, students come to understand the complex nature of judging and improving upon work.

In practice, both traditional and alternative assessment of students´ performance should require an understanding of how a particular student came into the learning process, including their cultural background, personal learning style and what they accomplished in relative terms while engaged in the learning process. It becomes a very delicate, finely tuned relationship between assessor and assessed. This balance is easier to maintain when working with alternative practices.

Assessment and Constructivist Classroom

Constructivism is basically a theory - based on observation and scientific study - about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To do this, we must ask questions, explore, and assess what we know.

In the classroom, the constructivist view of learning can point towards a number of different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk

about what they are doing and how their understanding is changing. The teacher makes sure she/he understands the students' pre-existing conceptions, and guides the activity to address them and then build on them. Constructivist teachers encourage students to constantly assess how the activity is helping them gain understanding. By questioning themselves and their strategies, students in the constructivist classroom ideally become "expert learners." This gives them ever-broadening tools to keep learning. With a well-planned classroom environment, the students learn HOW TO LEARN. You might look at it as a spiral. When they continuously reflect on their experiences, students find their ideas gaining in complexity and power, and they develop increasingly strong abilities to integrate new information. One of the teacher's main roles becomes to encourage this learning and reflection process.

Contrary to criticisms by some (conservative/traditional) educators, constructivism does not dismiss the active role of the teacher or the value of expert knowledge. Constructivism modifies that role, so that teachers help students construct knowledge rather than to reproduce a series of facts. The constructivist teacher provides tools such as problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Guided by the teacher, students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook.

Constructivism is also often misconstrued as a learning theory that compels students to "reinvent the wheel." In fact, constructivism taps into and triggers the student's innate curiosity about the world and how things work. Students do not reinvent the wheel but, rather, attempt to understand how it turns, how it functions. They become engaged by applying their existing knowledge and real-world experience, learning to hypothesize, testing their theories, and ultimately drawing conclusions from their findings.

In the constructivist classroom, the focus tends to shift from the teacher to the students. The classroom is no longer a place where the teacher ("expert") pours knowledge into passive students, who wait like empty vessels to be filled. In the constructivist model, the students are urged to be actively involved in their own process of learning. The teacher functions more as a facilitator who coaches, mediates, prompts, and helps students develop and assess their

understanding, and thereby their learning. One of the teacher's biggest jobs becomes ASKING GOOD QUESTIONS.

The chart below compares the traditional classroom to the constructivist one. You can see significant differences in basic assumptions about knowledge, students, and learning.

Traditional Classroom	Constructivist Classroom
Curriculum begins with the parts of the whole. Emphasizes basic skills.	Curriculum emphasizes big concepts, beginning with the whole and expanding to include the parts.
Strict adherence to fixed curriculum is highly valued.	Pursuit of student questions and interests is valued.
Materials are primarily textbooks and workbooks.	Materials include primary sources of material and manipulative materials.
Learning is based on repetition.	Learning is interactive, building on what the student already knows.
Teachers disseminate information to students; students are recipients of knowledge.	Teachers have a dialogue with students, helping students construct their own knowledge.
Teacher's role is directive, rooted in authority.	Teacher's role is interactive, rooted in negotiation.
Assessment is through testing, correct answers.	Assessment includes student works, observations, and points of view, as well as tests. Process is as important as product.
Knowledge is seen as inert.	Knowledge is seen as dynamic, ever changing with our experiences.
Students work primarily alone.	Students work primarily in groups.

As is the case with many of the current/popular paradigms, you're probably already using the constructivist approach to some degree. Constructivist teachers pose questions and problems, guide students to help them find their own answers. They use many techniques in the teaching process. For example, they may:

- prompt students to formulate their own questions (inquiry),
- allow multiple interpretations and expressions of learning (multiple intelligences),.
- encourage group work and the use of peers as resources (collaborative learning)

In a constructivist classroom, learning is . . .

CONSTRUCTED

Students are not blank slates upon which knowledge is etched. They come to learning situations with already formulated knowledge, ideas, and understandings. This previous knowledge is the raw material for the new knowledge they will create.

ACTIVE

The student is the person who creates new understanding for him/herself. The teacher coaches, moderates and suggests, but allows the students room to experiment, ask questions, try things that don't work. Learning activities require the students' full participation (like hands-on experiments). An important part of the learning process is that students reflect on and talk about their activities. Students also help set their own goals and means of assessment.

REFLECTIVE

Students control their own learning process, and they lead the way by reflecting on their experiences. This process makes them experts of their own learning. The teacher helps create situations where the students feel safe questioning and reflecting on their own processes, either privately or in group discussions. The teacher should also create activities that lead the student to reflect on his or her prior knowledge and experiences. Talking about what was learned and how it was learned is really important.

COLLABORATIVE

The constructivist classroom relies heavily on collaboration among students. There are many reasons why collaboration contributes to learning. The main reason it is used so much in constructivism is that students learn about learning not only from themselves, but also from their peers. When students review and reflect on their learning processes together, they can pick up strategies and methods from one another.

INQUIRY-BASED

The main activity in a constructivist classroom is solving problems. Students use inquiry methods to ask questions, investigate a topic, and use a variety of resources to find solutions and answers. As students explore the topic, they draw conclusions, and, as exploration continues, they revisit those conclusions. Exploration of questions leads to more questions.

EVOLVING

Students have ideas that they may later see were invalid, incorrect, or insufficient to explain new experiences. These ideas are temporary steps in the integration of knowledge. For instance, a child may believe that all trees lose their leaves in fall until she visits an evergreen forest. Constructivist teaching takes into account students' current conceptions and builds from there.

Tasks (assignments)

1. Can you find any differences between the assessment in traditional classroom and constructivist classroom?
2. Can you see significant differences in basic assumptions about knowledge, students, and learning in constructivist classroom?

Case study

Scores of assessment happen every day in every classroom. Usually there are dozens every hour. The teacher asks a question. A student interprets the questions, and responds. The teacher makes a judgment about how well the student understands. All the other students listening to the exchange also interpret what the teacher was asking, and they also evaluate the quality of the response. For many people, in fact, they pale in importance to many traditional assessment.

Questions to Case Study

1. Can you explain why many people (teachers, students and parents) still prefer traditional approach to the assessment?
2. Do you think that it is necessary to change traditional approaches to assessment?
3. How are you going to implement new strategies to assessment?

Summary

Benefits of Constructivist Classroom

- Students learn more, enjoyably and are more likely to retain learning;
- Students learn how to think and understand;
- It is a transferable skill to other settings;

- Students have ownership of their own learning;
- It applies natural curiosity to real world situations;
- Promotes social and communication skill within a group setting.

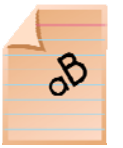
Frequently Asked Questions

How can I persuade my students in constructivism?

Answer the question above

Students must to understand the reason for his/her progress in learning. Try to use strategies which are highly motivated and interesting for students. Students would like to be active in the assessment.

Next Reading



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Unit 5

Planning and Implementing Classroom Assessment Projects

Objectives

- To develop skills to plan assessment;
- To improve ability to follow plan;
- To develop ability to work productively with others.

An Introduction to the Classroom Assessment Project Cycle

The classroom assessment project has three main phases, and each phase consists of three steps:

Phase	Steps	Description
I Planning a classroom assessment project	1. Choosing the class where to carry out the project	In your initial project focus on class you will teach again
	2. Focusing on assessable questions about student learning	Identify single teaching and learning goals and questions
	3. Designing an assessment project	Map out the path by which you will seek an answer to the assessable question and choose the tools that will help you get that answer

II Implementing a classroom assessment project	4. Teaching the lesson related to questions	Plan to integrate assessment activity into your regular class activities as smoothly as possible
	5. Assessing learning by collecting feedback	Choose a simple assessment technique
	6. Analyzing the feedback	Prepare yourself for surprising feedback. Look carefully at both positive and negative results.
III Responding to the results of assessment	7. Interpreting the results and formulating response to improve learning	Try to understand students´ feedback. Think through how you can respond to their feedback in way that will help the students improve their own learning.
	8. Communicating the results to students and learning	Maximize the possible positive impact of assessment
	9. Evaluating assessment project´s effect on teaching	Assess the outcomes and impact of your teaching on students learning

Tasks (assignments)

1. Formulate 3 goals (at least) for your project.
2. Suggest some questions related to formulated goals.
3. Design your small assessment project.
4. How many steps does your project have?
5. Discuss your project with your lecturer or with your schoolmates.

Case study

A science teacher believed in the importance of teaching problem solving, meta-cognition and learner´s pre-concepts. In planning his first assessment project, however, he came to the surprising realization that he could not identify where he was teaching those skills in the science course he was focusing on. At that point, he decided to devise new lessons to help students develop those skills.

Questions to Case Study

1. Do you think that science teacher used relevant questions to assess those skills?
2. Do you have any experience from your previous school life (as a secondary student) with the questioning to develop problem solving and recognition of pre-concepts?

Summary

The guidelines below sum up the best advice, based on experience with classroom assessment.

1. Start with assessable goals.
2. Focus on alterable variables.
3. Build in success.
4. Get students actively involved.
5. Start small.
6. Set limits on time and effort you will invest.
7. Be flexible and willing to change.
8. Work with other teachers who share your interest.
9. Remember that students must first learn to give useful feedback and then must practice doing so.
10. Enjoy experimentation and risk-taking, not just success.

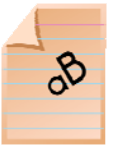
Frequently Asked Questions

How accurately can my students now determinate when, where, and why they have got "stuck" when they cannot solve a given problem?

Answer the question above

Prepare three or four problems of increasing difficulty. Give students the problem set, along with the instructions to indicate when and where, and explain why they have become stuck when they cannot solve one of the problems.

Next Reading



Bransford, J.D., Brown, A.L., Cocking, R.R. (Ed) *How People Learn. Brain, Mind, Experience, and School.* Washington, D.C.: National Academy Press, 2000. First Edition. ISBN 0-309-07036-8.

References

Angelo T.A., Cross, K.P. *Classroom Assessment Techniques.* San Francisco: Jossey-Bass Publisher, 1993. Second Edition. ISBN 1-55542-500-3.

Mintzes,J.J., Wanderee, J.H., Novak,J.D. (Ed) *Assessing Science Understanding. A Human Constructivist View.* San Diego: Academic Press, 2000. ISBN 0-12-498365-0.

Unit 6

Techniques for Assessing Knowledge and Skills

Objectives

- To understand techniques for assessing;
- To develop skills to use different techniques;
- To be able to apply different techniques in teaching practice.

Background Knowledge Probe

Background Knowledge Probes are short, simple questionnaires prepared by teachers for use at the beginning of the topic, at the start of a lesson, or prior to introducing an important new topic. Background Knowledge Probes are meant to help teachers determine the most effective starting point for a given lesson and the most appropriate level at which to begin instruction.

Before introducing an important new concept, or topic, teacher should consider what students may already know about it. It is recommended to prepare two or three open-ended questions, a handful of short-answer questions, or ten to twenty multiple-choice questions that will probe the students´ existing knowledge of that concept, subject or topic. These questions need to be carefully phrased, since a vocabulary that may not be familiar to students can obscure assessment of how well students know the facts or concepts. Students answer open-ended questions succinctly, in two or three sentences if possible. Teacher encourages students to give thoughtful answers that will help make effective in instructional decisions.

Example

Before the first lesson-demonstration-lab session, the teacher wanted to determine what students might already have learned – whether through unit work or the experience – about measuring current, voltage, and resistance. To find out, teacher prepared Background Knowledge Probe that contained five illustrations representing the displays of the following instruments: voltmeter, ohmmeter, deflection multimeter, and digital multimeter. Each illustration clearly indicated different reading or readings through the pointer positions and switch settings, or digital readouts shown. Teacher asked students to determine, and write about, the readings for the five instruments shown. The responses to this probe indicated that most students were familiar with digital instrument displays and had some idea what the readings on at least one of the instrument meant. But there were also students who did not use standard vocabulary in their responses and that there had quite a range of prior knowledge. A few students had no idea how to respond. To capitalize on the diversity in preparation, teacher decided to start with small group work on the basis of their prior understanding.

Focused Listing

This technique focuses students´ attention on a single important term, name or concept from a particular lesson or class instruction and directs them to list several ideas that are closely related to that focus point. Focused Listing is a tool for quickly determining what students recall as the most important points related to a particular topic. Focused Listing can be used before, during, or after the relevant lesson. As a result, teacher can use this technique to gauge the best starting point, make midpoint correction, and measure the students´ progress in learning one specific element of course content.

Example

Physics teacher hands out half-sheet of scrap paper and asks students to write a list of five or so words or phrases that define *work* in physics. After about two minutes, teacher collects their responses. Once teacher reads them quickly, physics teacher sorts the responses into three piles: those that do at least a fairly good of defining *work* in physics: those that confuse work in physics with work in everyday life; and the rest. Teacher explains and differentiates the two distinct but easily confusable meanings of work - the everyday and the

scientific. The teacher can help students learn other key concepts, such as mass, velocity, energy, impulse, and momentum.

Misconception/Preconception Check

Misconception/Preconception Check also assesses students´ prior knowledge, but with a twist. Its focus is on uncovering prior knowledge or beliefs that may hinder or block further learning. The greatest obstacle to new learning is often not students´ lack of prior knowledge but, rather, the existence of prior knowledge. Most teachers know from experience that it is much harder for students to unlearn incorrect or incomplete knowledge than to master new knowledge in unfamiliar fields. Consequently, teachers can benefit from discovering early in the term which common misconceptions or preconceptions students have that are likely to interfere with the learning in a given lesson.

Teacher starts by identifying some of the most troublesome common misconceptions or preconceptions students bring to instruction. Brainstorming this question with colleagues can be very effective way to generate such a list. Teacher selects a handful of these troublesome ideas and beliefs and focuses Misconception/Preconception Check on them. The next step is to create a simple questionnaire to elicit information about students´ ideas and beliefs in these areas. It is possible to use multiple-choice format or a short-answer format.

Example

The teacher handed out half-sheets of paper and asked students to write their best answers to the following question: What makes the seasons change on Earth? Teacher told students that any sincere answer was acceptable except "I do not know". Students do not write their names on the papers. Later teacher looked through the student responses very quickly, dividing them into the following four piles, based on the type of explanations given: the correct pile, the distance pile, the weather pile, and the others pile. After that teacher picked out the clears, most articulate example from each of the four piles and transcribed those four answers onto an one-page handout, which is distributed to students then. After students had read all four explanations, teacher asked them simply to circle the one correct answer and to turn in the handouts. Teacher quickly tallied the responses. The second time around, the proportion of correct responses was much higher. This is a common effect, occurring because students can more often recognize the correct answer when it is presented to them than they can independently produce that same answer. At

that point, the teacher invited several students to explain their choices. Proponents of each of four major positions explained their models of seasonal change. Each assignment was to find out which of the answers really was correct and why. Students present their explanations and teacher offers minor corrections.

Minute Paper

One-Minute Paper provides a quick and extremely simple way to collect written feedback on student learning. Students respond briefly to some variations on the following two questions: "What was the most important thing you learned during this class?" and "What important questions remain unanswered?" Teacher can quickly check how well students are learning what they are teaching. One-Minute Paper also ensures that students´ questions will be raised, and in many cases answered, in time to facilitate further learning.

Example

A few minutes before the end of lesson, teacher asked students to list five most important points from this lesson, along with one or two important questions they had. Then teacher collected the responses and quickly read them making a list of the most important points and questions. Teacher explained the relative importance of these points and their relationships to one another. Teacher also let students know which points were definitely not related.

One-Sentence Summary

One-Sentence Summary enables teachers to find how concisely, completely, and creatively students can summarize a large amount of information on a given topic. This assessment technique can provide feedback on students´ summaries of just about any information that can be represented in declarative form. This sentence is created on the basis of following questions: Who?, Does what?, To what or whom?, When?, Where?, How?, Why?.

Example

After the class with the topic of Assessment Techniques the teacher students are asked to write One-Sentence Summary of this unit. One of the student created the following One-Sentence Summary: Teachers assess their students´ learning regularly during their lessons in their own classrooms, by using Classroom Assessment Techniques and any other appropriate tools and

methods of inquiry, so that they can understand and improve teaching effectiveness and the quality of student learning.

Word Journal

The Word Journal can help teacher assess and improve several related skills. First, it focuses on students´ ability to read carefully and deeply. Second, it assesses skill and creativity at summarizing what has been read. And third, it assesses the students´ skill at explaining and defending, in just a few more words, their choice of single summary word. This practice helps students develop the ability to write highly condensed abstracts and to understand large amount of information for more effective storage in long-term memory.

Teacher makes choices of the short texts that students will be assigned to read. Teacher decides what aspect of that text – main theme, central conflict or problem, core metaphor, which students should focus on. Students should know that the choice of a specific word is less important than the quality of the explanation for that choice.

Example

To help students prepare for discussions in lesson, the teacher used the Word Journal. The students´ summary words became the starting points for the discussions. Teacher listed a number of those words on the board and then asked students to explain their particular characterizations of the central problem.

Concept Maps

Concept Maps are drawings or diagrams showing the mental connections that students make between a major concept the teacher focuses on and other concepts they have learned. This technique provides an observable and assessable record of the students´ conceptual schemata – the patterns of associations they make in relation to a given focal concept. Concept Maps allow the teacher to discover the web of relationships that learners bring to the task at hand – the students´ starting points.

A concept map is a two-dimensional, hierarchical node-link diagram that depicts the structure of knowledge within a scientific discipline as viewed by a student, an instructor or an expert in a field or sub-field. The map is

composed of concept labels, each enclosed in a box or oval; a series of labeled linking lines, and an inclusive, general-to-specific organization. By reading the map from top to bottom, an instructor can:

1. gain insight into the way students view a scientific topic;
2. examine the valid understandings and misconceptions students hold; and
3. assess the structural complexity of the relationships students depict.

Figure 1: Concept Map Of Concept Maps

Limitations

Concept maps provide a useful and visually appealing way of depicting the structure of conceptual knowledge that people have stored in long-term memory. As a result, they offer a readily accessible way of assessing how well students see "the big picture." They are not designed to tap into the kind of

process knowledge that students also need to solve novel problems or for the routine application of algorithmic solutions. Because they probe an individual's or a group's cognitive organization, they are very idiosyncratic and difficult to compare, either among individuals or groups, or across time for the same individuals or groups.

Figure 2: Jason's Concept Map on the Human Circulatory System [From Mintzes, Wandersee & Novak, 1998]

Teaching Goals

- Learn terms, facts, and concepts of this subject
- Organize information into meaningful categories
- Synthesize and integrate information, ideas, and concepts
- Think about the "big picture" and see connections among concepts

- Think creatively about this subject
- Improve long-term memory skills for accessible knowledge
- Develop higher-level thinking skills, strategies, and habit
- Use graphics effectively

Suggestions for Use

Instructional Tool

The instructor can present "expert" concept maps to the whole class to highlight key concepts and connections. These should be more detailed and flow from the global maps executed for the course design. Concept maps can then serve as "advanced organizers" (to preview material) and also for review. An instructor can continuously refer to a concept map in class to show how to "grow" the connections, and to keep the instruction focused. Caveat: At first, students will find concept maps very strange and may even try to memorize them, rather than use them as a thinking tool.

This technique also helps the teacher assess the degree of "fit" between the students´ understanding of relevant conceptual relations and the teacher´s Concept Map – which is often a "map" commonly used by members of that discipline. With such information in hand, the teacher can go on to assess changes and growth in the students´ conceptual understandings from instruction. The Concept Map allows them to scrutinize their conceptual networks, compare their maps with those of peers and experts, and make explicit changes.

Concept Maps provide insights into the connections students are making among theories and concepts. At the same time, Concept Maps can be used to assess the connections students make between theories or concepts and information. Before beginning instruction on a given concept or theory, teachers can use Concept Maps to discover what preconceptions and prior knowledge structures students bring to task. This information can help teacher make decisions about when and how to introduce a new topic – as well as discover misconceptions that may cause later difficulties. During and after a lesson, they can use Concept Maps to assess changes in the students´ conceptual representations.

Teacher selects the concept which is used as the stimulus or starting point for the Concept Map. It should be a concept that is both important to understanding the course and relatively rich in conceptual connections. Students brainstorm

for a few minutes, writing down terms and short phrases closely related to the stimulus. Students draw a Concept Map based on brainstorming, placing the stimulus in the centre and drawing lines to other concepts. Students determine the ways in which the various concepts are related to each other and write those types of relations on the lines connecting the concepts. Teacher can serve own Concept Map as the master copy for comparison.

Learning Tool

Ask students to construct their own concept maps covering a section of the course material from class or the textbook. Most (if not all!) of them will probably never have seen a concept map before, and many have not developed the learning skills needed to construct them. As a result, the instructor will need time (either in class, or perhaps in the lab) to work with groups and individuals. The impact of student-created concept maps is so powerful that it is worth the investment of time!

Step-by-Step Instructions

- Introduce a concept that is familiar to all students, such as "car", "chair" or "food."
- Have students write down 10 other concepts that they associate with this main concept (*i.e.* for food, "vegetables", "meat", "cereal", "milk", "steak", "carrots"...).
- Ask them to rank the 10 concepts from "most general and inclusive" to "least general and inclusive" or from "most important" to "least important"; this step will require several minutes.
- Tell students to write the "most general" or "most important" concept near the top of a large piece of paper (*e.g.*, posterboard or butcher paper are excellent, but regular notebook paper will suffice). Have them enclose this "superordinate concept" in a box or oval. Use pencils instead of pens! (Post-its® are excellent for this step.)
- Explain that you want them to connect concepts from their list, one pair at a time, with directional links; and most importantly, to label the linking lines (*e.g.*, Carrots →vitamin A (linking word is, "contain") OR meat →iron (linking words are, "is a good source of"). Continue this process until all concepts appear on the map.

- Give students plenty of time (20-30 minutes). Encourage them to include a lot of branching and many levels of hierarchy. Put special emphasis on cross-linking concepts in one area of the map with those in other areas. Suggest that they may add as many additional concepts as they wish to make their maps unique and personally meaningful. Remind them that the boxes or ovals should contain only one or two words. Emphasize that "neatness doesn't count" and that they may re-draw their maps as often as they wish.
- Circulate around the room as students construct their maps. Be supportive but not directive. Remind students that a concept map is a distinctive representation of their understanding, and that individual components on their maps may or may not be scientifically accurate, but there is a large set of ways to organize and represent what they know. Encourage creativity and stress that there is not one "correct" answer.
- Select several students to share their maps with the class. You may need to make a transparency to display the maps in large classes. Focus attention on appropriate connections between concepts. Remind students that concept maps may be a very helpful way to study; they can be used to condense many pages of textbook verbiage into a succinct summary of what the author presents.
- In the next class, introduce a central concept from your course (*e.g.*, "star", "cell", "energy", "matter") and ask your students to construct a concept map on this topic. Collect the maps and review them, but don't grade them. You may want to suggest ways the maps could be improved.
- Return the maps to the students and suggest that they rethink some of their ideas. We have used different colored pencils for each iteration so students may depict and emphasize how their ideas change over time. The same map may be used for several class periods, and students may be encouraged to add to, delete, reorganize or even begin anew whenever they need to do so.

Variations

Collaborative Concept Mapping Sometimes the frustration levels can be very high when concept mapping is first introduced, especially in large classes of relative novices. To counter some of this anxiety and to encourage students to reflect on their own thinking, ask groups of 3 or 4 students to work together on a concept map. This exercise is often a very rewarding and rich learning

experience as peers argue, debate, and cajole each other. The result is a genuine effort to negotiate the meaning of scientific concepts, attempting (as scientists do) to reach consensus, or to stake out different points of view. The power of the process resides in the interpersonal sharing of ideas, which are made explicit to the instructor.

Fill-in Concept Mapping

You construct a concept map and then remove **all** of the concept labels (keep the links!). You then ask the class to replace the labels in a way that makes structural sense. Best done with small classes; a good way to introduce a new topic.

Select and Fill-in Concept Mapping

You create a concept map and then remove concepts from the nodes (about one-third of them). These deleted concepts are placed in a numbered list on the map and students choose among them. Scoring can be as simple as "percent correct." Instructors of large classes may use multiple-choice type scanning sheets. The assumption of this technique is that as students' thinking approximates that of the instructor, the closer their connected knowledge is "expert-like." The key is to select nodes that are at different levels of the hierarchy and have nearby or antecedent links.

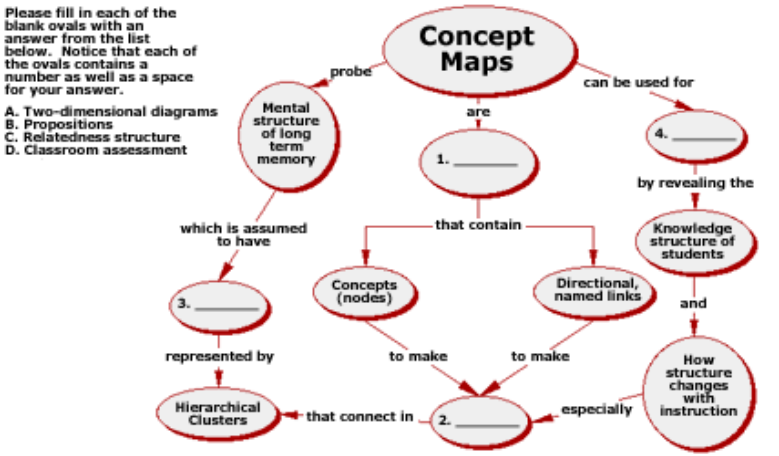


Figure 3: Select and Fill-in Concept Map on Concept Maps
[See Figure 1 for the "answers"]

Selected Terms Concept Mapping

You provide a list of concept labels (10 to 20) and ask students to construct their maps using only these labels. The focus here is on the linking relationships, and the evolution of structural complexity of students' knowledge frameworks.

Seeded Terms Concept Mapping

In this approach, also known as "micromapping" (Trowbridge and Wandersee, 1996), you furnish a small set of concept labels (5 to 10) and invite students to construct a concept map using these, and an equal number of labels drawn from their own knowledge of the topic.

Guided Choice Concept Mapping

Here you present a list of some 20 concept labels from which students select 10 to construct their maps. When done over a period of time, the instructor focuses on which concepts appear and which disappear. The assumption is that these changes represent significant restructuring of the students' knowledge frameworks.

Pros and Cons

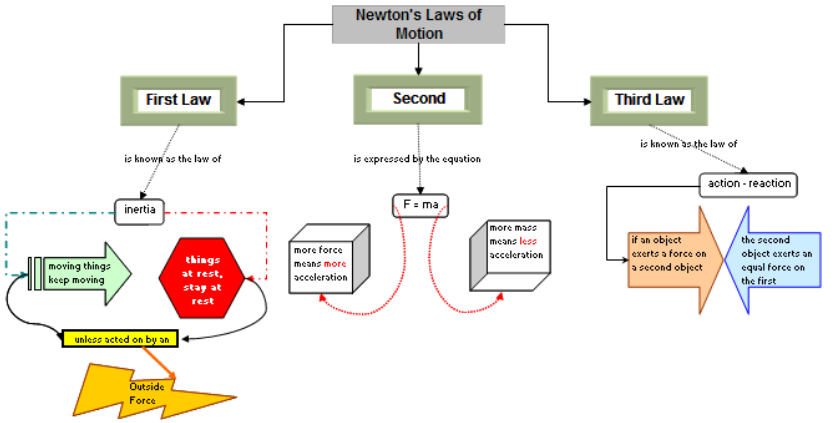
- Concept maps help students focus on the "big picture", enabling them to devote more of their time to conceptual understanding rather than rote learning
- Concept maps force students (and instructors!) to make valid connections among concepts
- They provide a low tech (cheap!) vehicle that enables students to represent graphically their knowledge, and to share it with the instructor and other students
- They shift the emphasis from inert, static knowledge to contextually-embedded knowledge; from isolated facts to theoretical frameworks of related concepts
- In addition to their role as assessment tools, concept maps offer a useful way to help students "learn how to learn"; they also serve as useful vehicles for course development and as graphic organizers before, during and after instruction

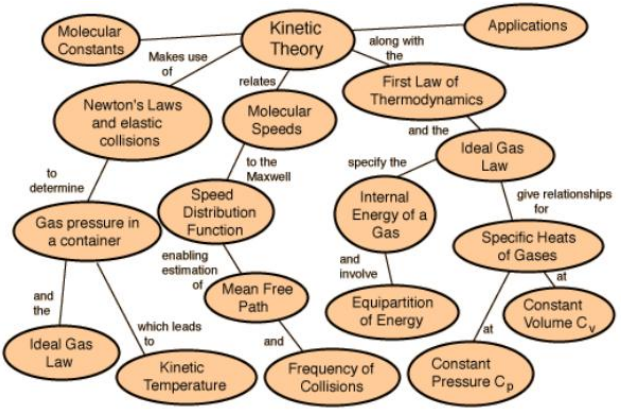
Howeve:

- Comparisons among students are more difficult because concept maps tend to reveal the idiosyncratic way that students view a scientific explanation, as a result...
- Evaluation can become more time-consuming for the instructor, especially in large classes, unless some variation (such as Select & Fill-in) is adopted
- If you score maps, you must use a consistent (and tested) scheme
- Students who have developed a strong facility for rote learning of verbal knowledge sometimes find concept maps intimidating
- Constructing concept maps is a demanding cognitive task that requires training

Example

The teacher asked students to draw a Concept Map centered on theory of natural selection. The map was to connect theory with its predecessors, contemporaries, competitors, and descendants. Teacher urged the students to use their imaginations in representing the relationships but to stick to the facts in characterizing them.

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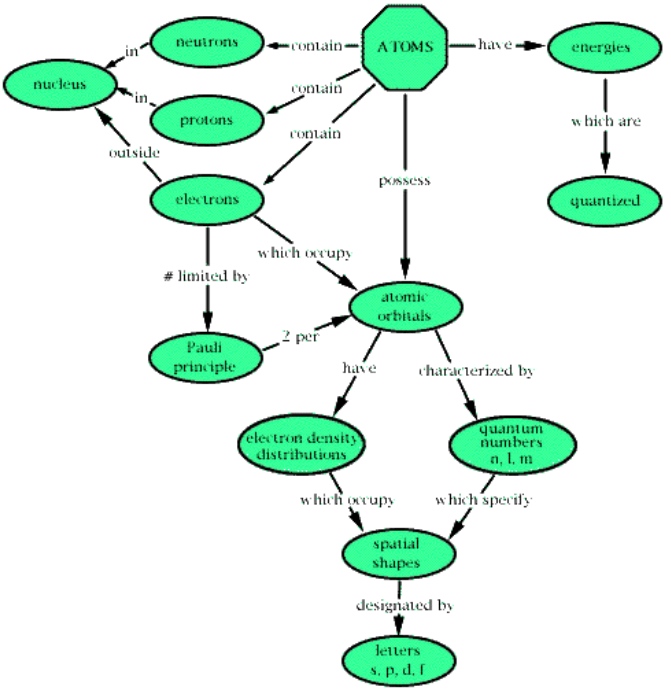
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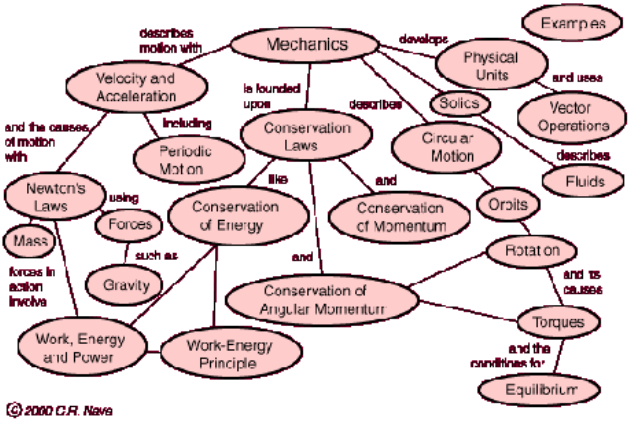


Links

- Mintzes, J.J web page: http://www.uncwil.edu/people/mintzes
- National Association for Research in Science Teaching (NARST). web page: www.narst.org
- The software package Inspiration aids in creating concept maps. It is easy to learn and use. http://www.inspiration.com
- University of Minesota Digital media Center. http://dmc.umn.edu
- Institute for Human and Machine Cognition (IHMC) CmapTools: http://cmap.ihmc.us

Annotated Portfolios

Assessment of portfolios is a common and well-accepted practice. Annotated Portfolios used for assessment contain a very limited number of examples of creative work, supplemented by the students´ own commentary on the significance of those examples.

Annotated Portfolios provide the teacher with a limited sample of students´ creative work, along with the students´ explanation of that work in relation to the content or goals. In this way, the technique allows teachers to assess students´ skill at making explicit connections between their creative work and the content. In other words, it helps teachers see how well students can apply what they have learned and how well they can explain those applications. Annotated Portfolios prompt students to show and tell their teachers - and themselves – how their creative and self-evaluative skills are developing.

Annotated Portfolios allow students to express their conceptions of problems or topics. It requires students not only to select work samples that are personally meaningful but also to interpret the meaning of those sample for others. This technique allows students to choose the work on which they will be assessed; the teacher gains insights into what they value and appreciate. In some fields, this technique also helps students prepare to present their work to prospective employers.

Example

The physics teacher required students to make Annotated Portfolios of materials they had created during school year. Specifically, each student put together a folder containing materials from the lessons (projects, labs, tests, reports, presentations, solved problems,…) along with an explanation of the principles applied in these materials.

Tasks (assignments)

1. Which techniques for assessing knowledge and skills of students will suit you the best and why?
2. Try to apply one of the techniques for assessing knowledge and skills on real situation in the classroom.
3. Apply one chosen techniques for assessing knowledge and skills on a specific topic with the regards to scientific content.

Case study

The science teacher made a decision to assess students on the basis the portfolio. Students put to portfolio different materials: labs, problem solving tasks, presentations, reading, tests, and so on. It was not easy to assess these portfolios. He could not mark students.

Questions to Case Study

1. Which mistakes did the teacher make in the use of portfolio for students´ assessment?
2. Is it possible to use only portfolio for students´ marking in sciences?

Summary

Assessment techniques presented in this chapter provide information on skills and competencies identified in the latest development in cognitive assessment, but the techniques are familiar and useful to the average science teacher.

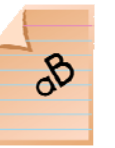
Frequently Asked Questions

How can I make right choice of the techniques for assessing knowledge and skills? How many techniques for assessing knowledge and skills should I be able to use?

Answer the question above

The right choice of the techniques for assessing knowledge and skills depends on the science content, goals, and abilities of students. Teachers should manage the highest number of strategies.

Next Reading



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Angelo T.A., Cross, K.P. *Classroom Assessment Techniques.* San Francisco: Jossey-Bass Publisher, 1993. Second Edition. ISBN 1-55542-500-3.

Mintzes, J.J., Wandersee,J.H. & Novak, J.D. (1998). *Teaching science for understanding: A human constructivist view.* San Diego, CA: Academic Press.

Unit 7

Techniques for Assessing Learner Attitudes, Values and Self-awareness

Objectives

- To understand constructivist approach of assessing learner attitudes, values and self-awareness;
- To develop an openness to new ideas;
- To help prospective teachers better understand and promote the development of students´ attitudes and values;
- To develop constructivist manner of teaching;
- To develop respect for others.

Assessing Students´ Awareness of Their Attitudes and Values

In constructivist classroom students need to be actively involved in their own learning. This constructivist approach includes four types of knowledge and some techniques and strategies for monitoring understanding. The types of knowledge are: (1) self-knowledge, including an understanding of own learning preferences, abilities, and constructivist style; (2) knowledge of the learning tasks; (3) knowledge and prior understanding and (4) knowledge and understanding of useful constructivist strategies.

Classroom Opinion Polls

Students often have pre-existing opinions about the material that they will encounter in the lessons, and those opinions – when they are unsupported by

evidence – can distort or block the instructional message. By uncovering student opinions on specific issues, teacher can better gauge where and how to begin teaching about those issues – and what the roadblocks are likely to be. Teachers can use this technique to prepare students to discuss a controversial issue or to assess their opinions after they have studied the material. Polling can also be used as a pre- and post-assessment device, to determine whether and how students´ opinions have changed in response to class discussions and assignments.

Example

Teacher previews the material that should be tought, looking for questions or issues about which students may have opinions that could affect their learning. Teacher chooses one or two issues. Teacher explains the exercise to students and gives them a couple of minutes to respond. The teacher used the following statements to assess students´ views on nuclear energy:

If you found a great house at a great price, close to work and schools, which was within five kilometres of a nuclear power plant, you would (circle only one):

a. Be absolutely willing to consider buying it, and not worried about the plant;

b. Be somewhat willing to consider buying it, but concerned about the plant;

c. Be very scaeptical about buying it, and worried about the plant;

d. Be absolutely unwilling to consider it because of the plant.

Self-Confidence Surveys

In many instances, individuals who are generally self-confident may lack confidence in their abilities or skills in specific context – for example, in their skills or ability to speak in public. When teachers know the students´ level of confidence, and what affects that confidence, they can more effectively structure assignments that will build confidence.

Example

Teacher focuses on skills or abilities that are important to success in science. Teacher makes up questions to assess students´ self-confidence in relation to

these skills or abilities. Teacher creates a simple survey form for gathering the data. Survey response are to be anonymous. Class is divided into small groups. Students discuss and compare their responses.

This survey is to help both of us understand your level of confidence in your science skills. Circle the most accurate response for each.

Kinds of Problem	Rate	Rate	Rate	Rate
Understanding electric charge	None	Low	Medium	High
Understanding electric current	None	Low	Medium	High
Using Ohm´s Law in problem solving	None	Low	Medium	High
To create electrical circuits	None	Low	Medium	High
Comparing electric circuits	None	Low	Medium	High
Using electrical power and energy in society	None	Low	Medium	High

Interest/Knowledge/Skills Checklists

Interest/Knowledge/Skills Checklists are brief, teacher-made versions of the commercial interest and skills inventories. Teachers create checklists of topics covered in science course. Students rate their interest in the various topics, and assess their levels of skill or knowledge in these topics. Teacher lets students know why he/she is asking them to assess their interests, skills, knowledge. Students need to know that their answers may have an influence on the teaching.

Example

Please, circle the letter after each item below that best represents your level of skill or knowledge in relation to that topic. The letters stand for the following responses:

N No skills, no knowledge

B Basic skills and knowledge

F Functionally adequate skills and knowledge

A Advanced level of skills and knowledge

Energy and work	N	B	F	A
Swinging energy	N	B	F	A
Designing own experiment	N	B	F	A
Temperature and heat	N	B	F	A
Thermal Pollution	N	B	F	A
Measuring thermal energy	N	B	F	A
Using thermal energy on the move	N	B	F	A
Creating convection currents	N	B	F	A
Using heat to do work	N	B	F	A

Self-Assessment

Self-assessment prompts students to describe their general approaches to learning and understanding. Teacher develops two or three questions that will assess students´ abilities. Students can discuss their answers in groups.

Example

1. In the topic Waves, Light, and Sound list the terms which were the easiest for your to understand.
2. In the topic Waves, Light, and Sound list the terms which were the most difficult for you to understand.
3. In the topic Waves, Light, and Sound list the experiments you can use.

Tasks (assignments)

1. Which technique for assessing learner attitudes and values seems to be the most useful in your teaching?
2. Try to choose one of the presented techniques and suggest some questions related to the topic you are going to teach in the class.
3. Design small project for assessing students´ attitudes and values.
4. Discuss your project in your working group.

Case study

Student teacher applied technique Knowledge/Skills Checklists mentioned above in the class during teaching practice at school. He/she found that students do not mostly understand the terms energy and work, and temperature and heat. He/she tried to explain these concepts again but the results were not better. He/she used the same questions in the checklist.

Questions to Case Study

1. Do you think that student teacher used the relevant technique?
2. Do you think that he/she used the right questions?
3. Can you suggest other questions?

Summary

In constructivist classroom students need to be actively involved in their own learning. This constructivist approach includes some techniques and strategies for monitoring understanding.

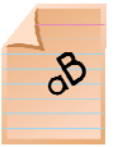
Frequently Asked Questions

Can my students accurately assess their understanding of science concepts? Is it important for my teaching to know how deeply they understand these concepts?

Answer the questions above

Students are able to assess their understanding of the science concepts. Constructivist teacher should know how students understand these concepts. On the basis of this knowledge he/she can choose teaching methods, problems to be solved or experiments to be done.

Next Reading



Mintzes,J.J., Wanderee, J.H., Novak,J.D. (Ed) *Assessing Science Understanding. A Human Constructivist View.* San Diego: Academic Press, 2000. ISBN 0-12-498365-0.

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Unit 8

Assessing Learner Reactions to Instructions

Objectives

- To cultivate a sense of responsibility for science teacher students to constructivist assessment;
- To develop management skills of prospective teachers;
- To develop skills using materials, tools and technology;
- To learn to evaluate methods and materials in science assessment;
- To develop the skill in using different techniques.

Techniques for Assessing Learner Reactions to Instructions

Much of the controversy over student evaluations of teaching concerns their use in making promotion and tenure decision – an issue that will not be addressed here, since our interest is in helping teachers design, collect, and use student reactions to improve their own teaching. Students are in a good position to evaluate the impact of the teaching on their own learning. But are the reactions of students reliable, valid, and useful for the purpose of improving teaching, course materials, assignments and activities, and – consequently – useful for improving learning?

The question of the validity of student judgments is more difficult and controversial. Here is the question: "Are students really good judges of effective teaching?" The answer is probably that students are the best evaluators a teacher can get on some matters and not very credible judges of others. Teachers usually find some characteristics that are ranked high: concern for students, knowledge of subject matter, stimulation of interest, availability, encouragement of discussion, ability to explain clearly, enthusiasm, and

preparation. We believe that it is possible to effect significant improvement in teaching through obtaining feedback from students.

Electronic Mail Feedback

The teacher poses a question to the class, via electronic mail about his or her teaching, and invites student responses. Students respond to the E-mail question wit a personal, though anonymous, message sent to electronic mailbox. Teacher writes one or two questions in which he/she asks for students´ reactions to some aspect of teaching. E-mail message is sent to all students with clear instructions on the length and type of response he/she is seeking and the deadline for responding.

Example

The science teacher sent the following question: "What is one specific, small change I could make that would help you learn more effectively in the topic Exploring Motion and Forces? The next day after deadline teacher read e-mails, analyzed the feedback, and wrote an e-mail response to the class, letting them know which suggestions he/she would act on, which he/she would not, and why.

Group Instructional Feedback Technique

This technique has many names and many variations, but they all centre on getting student responses to three questions related to their learning in the class. However they are worded, these three questions basically ask, "What works? What does not? What can be done to improve it?"

Example

The veteran physics teacher agreed to try this technique after he had convinced his colleague from chemistry to act as the "visiting assessor". These were the prompts they agreed on:

1. Give one or two examples of specific things your teacher does that really help you learn molecular physics.
2. Give one or two examples of specific things your teacher does that make it more difficult for you to learn molecular physics.
3. Suggest one or two specific, practical changes your teacher could make that would help you improve your learning in the class.

The physics teacher told the students what was going to happen and asked them to cooperate. He assured them that their responses would remain anonymous, and he urged them to give honest, thoughtful feedback. Twenty minutes before the end of the next lesson, the chemistry teacher arrived, and the physics teacher introduced him and left. The "visiting assessor" quickly explained what he was doing and why, and how the process would work. He asked students to take about five minutes to write answers to all three questions on cards and then to take five minutes to discuss their answers in a small group. He then asked the groups to share only those responses that they heard from several members. He quickly listed common responses to the first two questions and then asked the students to indicate whether they agreed with each response by raising their hands. The chemistry teacher simply estimated the percentages of students raising their hands each time and wrote that rough estimate on the board. In this way, the whole class saw how much agreement there was on a few common "helpful" and "not helpful" points. The chemistry teacher summarized this information and shared it with the physics teacher.

Group-Work Evaluations

Group-Work Evaluations forms are simple questionnaires used to collect feedback on students´ reactions to cooperative learning in constructivist classroom. Group-Work Evaluations can help students and teachers see what is going well in learning groups, so that potentially destructive conflicts in groups can be discovered and defused. Group-Work Evaluations are most helpful in lessons where students regularly work in small groups.

Example

Science teacher decides what he/she wants to know about the group work and composes a few questions to get this information. The teacher used the groups to solve problem. In the end of lesson students got the simple evaluation form:

1. Overall, how effectively did your group work together on this problem?
   Poorly Adequately Well Extremely well
2. Out of the five group members, how many participate actively most of the time?
   None One Two Three Four All five
3. Give one specific example of something you learned from the group that you probably would not have learned working alone.

4. Give one specific example of something the other group members learned from you that they probably would not have learned otherwise.
5. Suggest one change the group could make to improve its performance.

Tasks (assignments)

1. Can your students be good evaluators of your teaching? Why?
2. Try to design evaluation sheet for students to evaluate science teacher.
3. Which techniques suits you the best and why?

Case study

Students of a grammar school (17 y old) got an e-mail from science teacher where she asked students to write a few brief sentences to answer to the following question: "If you were the teacher of this class, what would you do to make physics lab assignments more useful?" She was surprised that only a few students (5 from 30) send her a replay in the next two days. Quality of their answers was very low. She was very unhappy with the result of this approach of students.

Questions to Case Study

1. Did the science teacher make any mistake in the application of the technique?
2. Try to suggest a little bit better application and modify her question.

Summary

Much of the controversy over student evaluations of teaching exists. Students are in a good position to evaluate the impact of the teaching on their own learning. But are the reactions of students reliable, valid, and useful for the purpose of improving teaching, course materials, assignments and activities, and – consequently – useful for improving learning? The question of validity of student judgements is more difficult and controversial. Here is the questions: "Are students really good judges of effective teaching?" The answer is probably that students are the best evaluators a teacher can get on some matters and not very credible judges of others. We believe that it is possible to effect significant improvement in teaching through obtaining feedback from students.

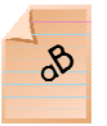
Frequently Asked Questions

Shall I apply any technique assessing student reactions on my science instruction?

Answer the question above

Yes, it is very useful tool for evaluation of your teaching. You can get important feedback from your students.

Next Reading



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