DOWNLOAD PDF FORMATIVE ASSESSMENT STRATEGIES FOR ENHANCED LEARNING IN SCIENCE, K-8

Chapter 1 : Elizabeth Hammerman (Author of Differentiated Instructional Strategies for Science, Grades K-

Outlining the formative assessment process and providing strategies for embedding assessment into the K-8 standards-based science curriculum, this essential resource demonstrates how teachers can use formative assessments to modify instruction, monitor student progress, and evaluate learning.

A particular focus was given to formative assessment, project-based learning, and problem-based learning for math and science. The review situates assessment in Virginia within the national context of assessment resources being developed in conjunction with national initiatives such as the Common Core State Standards for Mathematics and the Next Generation Science Standards. Click here for the bibliography. Assessment Overviews National Research Council. Board on Testing and Assessment and, J. The National Academies Press. National Council of Teachers of Mathematics. Ensuring mathematical success for all. Putting it into practice. Assessment and classroom learning. Assessment in Education, 5 1 , 7â€" Inside the black box: Raising standards through classroom assessment. Phi Delta Kappan, 80 Are We Losing an Opportunity? Council of Chief State School Officers. What Are They Thinking? Task Design Grootenboer, P. Premises for changing to PBL. International Journal for the Scholarship of Teaching and Learning, 4 1. Mathematics Capstone Course Units, Virginia. The why, what, how and when of rich tasks. Retrieved online at http: Partnership for 21st Century Skills. What is it and who is it for? The new basic research report. Retrieved online from http: An analysis of the rich task reports data including comparisons Teaching with problem-oriented curricula: A case study of middle-school mathematics instruction. Journal of Experimental Education, 64 1. Learning mathematics via a problem-centered approach: Mathematical Thinking and Learning, 11, The top 10 elements that must be in place to implement standards-based mathematics curricula. Phi Delta Kappan, 80 7. Reflective states associated with creating inquiry-based mathematical discourse. Theory and Practice, 11 2 , The consequences of a problem-based mathematics curriculum. The Mathematics Educator, 14 2 , Managing a standards-based classroom: A specially designed professional development program supports quality instruction by novice teachers. Mathematics Teaching in the Middle School, 17 5 , Designing professional development for teachers of science and mathematics. Educational Studies in Mathematics, 42, Interactions among instructional practices, curriculum, and student achievement: The case of standards-based high school mathematics. Journal for Research in Mathematics Education, 32 5 , Implementing standards-based mathematics instruction: A casebook for professional development 2nd ed. Journal of Mathematics Teacher Education, 4, How principals in predominantly Hispanic-serving schools conceive of their leadership roles in the implantation of a district-wide mathematics reform initiative. Designing design studies for professional development in mathematics education: Innovations in science, technology, engineering and mathematics learning and teaching pp. Project based learning toolkit series: Buck Institute for Education. Developing essential 21st century skills using student team projects. The International Journal of Learning, 15 9 , First year implementation of a project-based learning approach: International Journal of Science and Mathematics Education, 9,

Chapter 2 : Formative Assessment Strategies for Enhanced Learning in Science, K-8 - | SlugBooks

Use formative assessment to guide successful teaching and learning in science! Proven to be one of the most powerful tools for promoting effective learning, formative assessment enables teachers to capture evidence of student thinking and learning and use that information to adjust instruction.

The Fundamentals of Formative Assessment This chapter looks at the essential principles of formative assessment and provides a preview of best practice. Our focus here is both the content and context of formative assessment: Essential Principles The information in this section has been gathered from numerous sources and aligned around three significant concepts: In an effort not to duplicate information available in other resources, I have condensed the elements and their definitions quite a bit. Formative Assessment Is Student Focused Formative assessment is purposefully directed toward the student. It does not emphasize how teachers deliver information but, rather, how students receive that information, how well they understand it, and how they can apply it. They also show students how to accurately and honestly use self-assessments to improve their own learning. Instructional flexibility and student-focused feedback work together to build confident and motivated learners. Early in the unit, Mrs. Chavez asks her students to define a character trait and give an example of someone in literature or in real life who demonstrates that trait. She gathers their examples in a list, which she posts in the classroom. This is valuable information about the starting point for the unit: Based on the data her students provide, Mrs. Chavez decides to move forward. She arranges the class into random groups and asks each group to write all the character traits of Scout that they can think of on individual yellow sticky notesâ€”one trait per noteâ€”and then do the same for Holden Caulfield, this time using blue sticky notes. Then each group posts their responses on the original list of traits, alongside each character trait. Areas of agreement and disagreement are discussed. Chavez uses a questioning strategy to elicit information and to clarify any lingering gaps in understanding or accuracy. Following this, students work on their own to create a T chart for each character, using the left side of the T to list life experiences and challenges and the right side to list how these factors have influenced traits and behaviors. Chavez has done very little lecturing or whole-class teaching to this point, making for a very student-focused lesson. Formative Assessment Is Instructionally Informative During instruction, teachers assess student understanding and progress toward standards mastery in order to evaluate the effectiveness of their instructional design. Both teachers and students, individually and together, review and reflect on assessment outcomes. As teachers gather information from formative assessment, they adjust their instruction to further student learning. Formative assessment Provides a way to align standards, content, and assessment Allows for the purposeful selection of strategies Embeds assessment in instruction Guides instructional decisions In practice: During a high school social studies unit on the development of American nationalism after the War of , Mr. Sandusky begins with a pre-assessment focused on content similar to what students will encounter in the final selected-response test. One group reads about the reasons the United States and Britain went to war, another reads about specific events that occurred during the war, and a third reads about Francis Scott Key. Each group reports out, sharing information with the rest of the class. As the unit progresses, students keep track of their learning and assignments on a work-along, turning it in to Mr. Sandusky every day for a quick check. This is followed by a Corners activity where students pick different lines of the song to analyze and respond to in terms of relevance to current events. Later, after a discussion of the diverse opinions on the War of , the teacher asks students to report one pro and one con viewpoint. In these activities, Mr. Formative Assessment Is Outcomes Based Formative assessment focuses on achieving goals rather than determining if a goal was or was not met, and one of the ways it does so is by helping to clarify learning goals and standards for both teachers and students. Teaching and learning are based on these standards. Students know the criteria for meeting the standards and are frequently shown exemplars. Teachers give frequent and substantive feedback to students about their progress, pointing out both strengths and areas that need improvement. Teachers plan

steps to move students closer to learning goals. Work is assessed primarily on quality in relation to standards rather than student attitude or effort. Formative assessment Makes goals and standards transparent to students Provides clear assessment criteria Closes the gap between what students know and desired outcomes Provides feedback that is comprehensible, actionable, and relevant Provides valuable diagnostic information by generating informative data In practice: A curricular standard for 10th grade Biology requires that students understand the chemical basis of all living things. In her classroom, Ms. Jefferson asks students to track their progress toward the specific objective of describing, comparing, and contrasting the molecular structure of proteins, carbohydrates, and fats. The applied learning comes from explaining how these differences are exhibited by foods that students eat every day. Jefferson uses a signaling activity to get a baseline assessment of where her students stand; afterward, she delivers a traditional lecture, beginning the lesson as she will all lessons by stating the specific learning outcome students are expected to master and then focusing on transitioning students from what they know to what they need to know. Students keep a record of their learning by recording specific content knowledge in lab report notebooks. In one section, they draw the molecular structure of proteins, carbohydrates, and fats. Later in the unit, they watch a video and fill in a provided empty outline and then complete a lab in which they test a variety of foods for the presence of proteins, carbohydrates, and fats and report their findings in their lab notebooks. Jefferson reviews these notebooks regularly to monitor student progress and understanding, provide specific feedback, and inform her instructional decisions. Other formative assessment strategies she uses include Bump in the Road and Feathers and Salt. A Brief History of Formative Assessment As with most effective teaching methods and practices, individual teachers have probably used formative assessment throughout history. Indeed, we could claim Socrates as an early practitioner. Peppering his students with questions that probed and provoked, he used their responses to measure their learning and guide his instruction; this is the primary attribute of formative assessment. Scriven explained that while a program is in the planning and developmental stages, it is still malleable, and the information gathered from evaluation can therefore contribute to change in the program. This concept, in turn, became the basis for modular instruction, widespread in the s, in which students learned from self-directed packets, or modules of instruction. When a student successfully completed one packet, he or she could move on to the next packet, proceeding through modules until all objectives were met. In the decades following, formative assessment began to be more widely explored. States considered ways to embed it in standardized tests. Bloom continued his theoretical work, examining several issues relating to formative assessment. He identified two essential elements of formative learning: He also argued that formative information could be used to divide the class into cooperative groups based on the corrections required. From this point, teachers could differentiate instruction to meet the needs of individual students through selected teaching strategies and corrective responses Bloom, In New Zealand, Terry Crooks studied the effect of classroom assessment practices on students and reported on their potential to emphasize what is important to learn and positively affect student motivation. Around the same time, Sadler reasoned that assessment is most effective when students can monitor the quality of their own work through specific provisions that are incorporated directly into instruction. Perhaps the biggest step forward in the embrace of formative assessment came in , when Paul Black and Dylan Wiliam completed a meta-analysis of more than research studies on the topic. New Zealand, Australia, and Great Britain have been especially strong leaders in this movement. The recent groundswell in interest and information is creating an imperative to change how we think about and use assessment. Evidence for Formative Assessment The Black and Wiliam study provided evidence that formative assessment can make a difference in learning outcomes at all grade levels. An effect size is a comparison of a range of scores of students exposed to a specific practice to those of students who were not exposed to the practice. Black and Wiliam drew additional conclusions, each of which is worthy of further research: The success of formative assessment is highly related to how teachers use it to adjust teaching and learning practices. Effective learning is based on active student involvement. Enhanced feedback is crucial to improved outcomes. There is a link between formative assessment and self-assessment. An assessment plan

must come first, not last, in the educational process. Assessment, by necessity, integrates knowledge, skills, procedures, and dispositions. Assessment as a diagnosis of student progress shifts the emphasis from summative to formative. Teachers involved in the study were trained and supported in their use of classroom-based formative assessment. The research team measured the effects of formative assessment on learning outcomes and found a mean effect size of 0. Also in , Ruiz-Primo and Furtak measured the effect of three formative assessment strategiesâ€"eliciting, recognizing, and using informationâ€"in the science classroom. Moving Forward with Formative Assessment In recent years, recommendations for including high-quality formative assessment as an integral part of a larger and more balanced assessment system has come from many groups and organizations, among them the Joint Committee on Standards for Educational Evaluation and the National Council on Measurement in Education Content- and level-specific organizations, such as the National Council of Teachers of Mathematics, the National Science Teachers Association, and the National Middle School Association, have also endorsed formative assessment as a way to advance learning. Although influential organizations and education thought-leaders have reached a general consensus about the benefits of formative assessment, teacher education and training efforts lag behind. This deficit in teacher knowledge and practice was the basis of my own doctoral dissertation, in which I concluded that secondary teachers continue to use traditional summative assessment that infrequently aligns with recommended strategies. Shepard summed it up well when she quoted this observation by Graue The key to high-quality formative assessment is to intertwine the two. What teachers and students need is assessment and instruction that are conceived as a unit, employed as a unit, and applied as a unit. The most important thing you can take away from this discussion of formative assessment is the understanding that no single principle makes assessment formative. It is through the weaving together of all the principles that high-quality formative assessment arises and the blending of assessment and teaching occurs. For a quick overview of what these components look like woven together, see Figure 1. A teacher preparing for a discussion of current events in an English, social studies, or other class might produce the following plan. Differentiate fact from opinion in written text. Signaling in response to simple sentences read aloud by the teacher. A Corners activity in which the teacher reads more complex sentences and students express their response by going to Fact or Opinion corners. The teacher gives examples of how writers extend fact into opinion along with guidelines for distinguishing fact from opinion. Students read selected text, color-code examples of fact and opinion, and record their responses in their work-alongs. A Thinkâ€"Pairâ€"Share activity in which students create a color-coded T chart with facts on the left and opinions on the right. This is followed by a whole-class review of the charts to reach consensus. The teacher uses data gathered to chart individual and group learning outcomes and target areas of misunderstanding and areas where students need additional challenge.

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Chapter 3 : Formative assessment - Wikipedia

Formative Assessment Strategies for Enhanced Learning in Science, K demonstrates how teachers can use various models of formative assessments to instruct, monitor student progress, and evaluate learning, helping to broaden teachers' understanding of assessment and how assessment tools can be used to guide successful standards-based teaching.

How to Develop 3D Formative Assessments for the Science Classroom Posted on April 05, This short course will help you learn how to develop and use 3D formative assessments in the classroom. Background Formative assessment in the classroom is crucial because everyone engaged in complex learning benefits from timely and focused feedback from more expert others. The process also promotes important processes of self-explanation, reflection, and learning. One powerful approach to formative assessment is to develop short tests of student understanding that get embedded into an unfolding curriculum unitâ€”allowing for instruction to shift to support student understanding of specific learning goals. The new vision for K science education calls for a new three-dimensional model of science learning. From this 3D integrated perspective, research shows that students learn science best by engaging in science and engineering practices SEPs as part of sustained and meaningful investigations as they learn and apply disciplinary core ideas DCIs and cross-cutting concepts CCCs. This integrated approach to learning has major implications for how formative assessments should be developed and used. Here are some activities with linked resources that can help you learn how to develop or refine 3D formative assessments. The sequence assumes that you are familiar with the basics associated with the new vision and the associated equity goals for science education. Formative Assessment Activities Activity 1: Getting Oriented 30 min To learn more about the overall approach to assessment for K science education, read about Designing an Assessment System that Measures Three-Dimensional Science Learning and think about what parts of the recommended "system of assessments" that you will be working on. Learning about Formative Assessment 15 min If you need some background on formative assessment, skim this report on Attributes of Effective Formative Assessment and think through how the definition for formative assessment and five attributes relate to the work that you do or could do. Learning About the Very Idea of 3D Assessment 20 min To get oriented to 3D assessment development, read about How teachers can develop formative assessments that fit a three-dimensional view of science learning and explore the embedded examples. How similar or different are they to the formative assessments you are familiar with? Learning How to Build 3D Assessment Clusters 20 min To get started developing 3D assessment items, read How can assessments be designed to engage students in the range of science and engineering practices? Engaging in a Procedure to Develop 3D Assessments 30 min to orient plus ongoing work To get detailed guidance on a process you can use to develop assessment clusters, sink into Steps to Designing a Three-Dimensional Assessment and use the five steps to guide the development of your assessment cluster. This tool get used in Step 3. Formative Assessment Extension Activities The following materials come from teacher workshops focused on the development of 3D formative assessments. The slides and resources are worth exploring and leveraging in your own work. Research has shown that building on student interests and experience can make science more relevant, help them identify with science, and learn how science is a human endeavor that has an important role in society. In this workshop, participants will learn how to use different formative assessment approaches to support interest-driven learning in their classroom. These general strategies help students make meaningful connections between the science concepts they are learning and the application of those ideas to their own lives and to other everyday situations -- including the many careers and pursuits that leverage STEM knowledge and practices. How can we design assessment tasks that elicit the core ideas, practices, and crosscutting concepts in the NGSS performance expectations PEs? There are very few examples of elementary and middle school assessments completely aligned to NGSS, so people will need to adapt the ones that exist. Performance expectations also under specify the nature of evidence needed to draw inferences about student

learning. We guide participants through an analysis of common assessment tasks to identify components and qualities of these tasks that support assessment of practices, crosscutting concepts, and core ideas. Tasks examples will will be drawn from all four domains of disciplinary ideas linked across elementary and middle school. Through this activity , participants will review tasks that aim for assessing PEs, discuss strengths of these tasks and gain practice with adapting them to better elicit three dimensional science learning. Opinions expressed are not those of any funding agency.

Chapter 4 : The Fundamentals of Formative Assessment

"Proven to be one of the most powerful tools for promoting effective learning, formative assessment enables teachers to capture evidence of student thinking and learning and use that information to adjust instruction.

The study showed that higher achieving students were able to look past this while other students were not. Another study done by White and Frederiksen [25] showed that when twelve 7th grade science classrooms were given time to reflect on what they deemed to be quality work, and how they thought they would be evaluated on their work, the gap between the high achieving students and the low achieving students was decreased. By examining the different levels of work, students can start to differentiate between superior and inferior work. Feedback[edit] There has been extensive research done on studying how students are affected by feedback. Kluger and DeNisi [26] reviewed over three thousand reports on feedback in schools, universities, and the workplace. Of these, only of them were found to be scientifically rigorous and of those, 50 of the studies shows that feedback actually has negative effects on its recipients. Feedback is often given in the form of some numerical or letter grade and that perpetuates students being compared to their peers. The studies previously mentioned showed that the most effective feedback for students is when they are not only told in which areas they need to improve, but also how to go about improving it. The next thing students tend to do is to ask other students in the class for their grade, and they compare the grade to their own grade. Questioning[edit] Questioning is an important part of the learning process and an even more important part is asking the right types of questions. Questions that promote discussion and student reflection make it easier for students to go on the right path to end up completing their learning goals. Here are some types of questions that are good to ask students: Wait time[edit] Wait time is the amount of time that is given to a student to answer a question that was posed and the time allowed for the student to answer. Mary Budd Rowe [28] went on to look at the outcomes of having longer wait times for students. Students are able to speak to one another in a language that they are more comfortable with than they would be with an instructor. The insight of a fellow student might be more relatable than that of a teacher. Students tend to accept constructive criticism more from a fellow student than from an instructor. While students are in the process of peer-assessment, a teacher can more easily take command of the learning going on. Formative assessment is also known as educative assessment, classroom assessment, or assessment for learning. Methods[edit] There are many ways to integrate formative assessment into Kâ€”12 classrooms. For example, researchers developed generative activities Stroup et al. Others developed strategies computer-supported collaborative learning environments Wang et al. Purpose[edit] Formative assessment, or diagnostic testing as the National Board of Professional Teaching Standards argues, serves to create effective teaching curricula and classroom-specific evaluations. Students are encouraged to think critically and to develop analytical skills. P Scot et al. The following are examples of application of formative assessment to content areas: In math education[edit] In math education, it is important for teachers to see how their students approach the problems and how much mathematical knowledge and at what level students use when solving the problems. That is, knowing how students think in the process of learning or problem solving makes it possible for teachers to help their students overcome conceptual difficulties and, in turn, improve learning. In that sense, formative assessment is diagnostic. In math classes, thought revealing activities such as model-eliciting activities MEAs and generative activities provide good opportunities for covering these aspects of formative assessment. Feedback examples[edit] Here are some examples of possible feedback for students in math education: Then we add one more variable. Try to find them and fix them. Can you find a way to work it out? Can you use elimination now to solve them? Can you explain the advantages and disadvantages of each method? Can you make up your own more difficult problem? Talk to Katie about the differences with the two. In classroom, short quizzes, reflectionals journals, or portfolios could be used as a formative assessment Cohen, Teachers and students both use formative assessments as a tool to make decisions based on data. Formative assessment occurs when teachers feed

information back to students in ways that enable the student to learn better, or when students can engage in a similar, self-reflective process. The evidence shows that high quality formative assessment does have a powerful impact on student learning. Black and Wiliam report that studies of formative assessment show an effect size on standardized tests of between 0. The effect size is the ratio of the average improvement in test scores in the innovation to the range of scores of typical groups of pupils on the same tests; Black and Wiliam recognize that standardized tests are very limited measures of learning. Formative assessment is particularly effective for students who have not done well in school, thus narrowing the gap between low and high achievers while raising overall achievement. Research examined by Black and Wiliam supports the conclusion that summative assessments tend to have a negative effect on student learning. Model-eliciting activities MEAs are ideally structured to help students build their real-world sense of problem solving towards increasingly powerful mathematical constructs. Teachers do not prompt the use of particular mathematical concepts or their representational counterparts when presenting the problems. Instead, they choose activities that maximize the potential for students to develop the concepts that are the focal point in the curriculum by building on their early and intuitive ideas. Generative activities[edit] In a generative activity, students are asked to come up with outcomes that are mathematically same. Students can arrive at the responses or build responses from this sameness in a wide range of ways. The sameness gives coherence to the task and allows it to be an "organizational unit for performing a specific function. In addition, as a complementary to all of these is to modify and adapt instruction through the information gathered by those activities. In computer-supported learning[edit] Many academics are seeking to diversify assessment tasks, broaden the range of skills assessed and provide students with more timely and informative feedback on their progress. Others are wishing to meet student expectations for more flexible delivery and to generate efficiencies in assessment that can ease academic staff workloads. The move to on-line and computer based assessment is a natural outcome of the increasing use of information and communication technologies to enhance learning. As more students seek flexibility in their courses, it seems inevitable there will be growing expectations for flexible assessment as well. When implementing online and computer-based instruction, it is recommended that a structured framework or model be used to guide the assessment. In UK education[edit] In the UK education system , formative assessment or assessment for learning has been a key aspect of the agenda for personalised learning. The Working Group on 14â€”19 Reform led by Sir Mike Tomlinson , recommended that assessment of learners be refocused to be more teacher-led and less reliant on external assessment, putting learners at the heart of the assessment process. Teachers can decide what minor modifications or major changes in instruction they need to make so that all students can succeed in upcoming instruction and on subsequent assessments. Teachers can create appropriate lessons and activities for groups of learners or individual students. Teachers can inform students about their current progress in order to help them set goals for improvement. Students take responsibility for their own learning. Students can become users of assessment alongside the teacher. Students learn valuable lifelong skills such as self-evaluation, self-assessment, and goal setting. Students become more adept at self-assessment [44] [45] [46] Common formative assessments[edit] The practice of common formative assessments is a way for teachers to use assessments to beneficially adjust their teaching pedagogy. The concept is that teachers who teach a common class can provide their classes with a common assessment. The results of that assessment could provide the teachers with valuable information, the most important being who on that teacher team is seeing the most success with his or her students on a given topic or standard. It is essential to note that the purpose of this practice is to provide feedback for teachers, not necessarily students, so an assignment could be considered formative for teachers, but summative for students. What do we want students to know and do? How do we know they are learning? Common formative assessments are a way to address the second question. Teachers can collect data on how students are doing to gain understanding and insight on whether students are learning, and how they are making sense of the lessons being taught. After gathering this data, teachers can proceed to develop systems and plans to address the third and fourth questions and, over several years, modify the first question to fit the learning needs of their specific students.

In tandem, they can also share the strategies they used in the classroom to teach that particular concept. With these things in mind, the teacher team can make some evaluations on what tasks and explanations seemed to produce the best student outcomes. Teachers who used alternate strategies now have new ideas for interventions and for when they teach the topic in upcoming years. Teacher teams can also use common formative assessments to review and calibrate their scoring practices. Teachers of a common class should aim to be as consistent as possible in evaluating their students. Comparing formative assessments, or having all teachers evaluate them together, is a way for teachers to adjust their grading criteria before the summative assessment. Through this practice, teachers are presented with an opportunity to grow professionally with the people who know them and understand their school environment. To make the practice of teacher teams, common formative assessments, and power standards the most advantageous, the practice of backwards design should be utilized. Backwards design is the idea in education that the summative assessment should be developed first and that all formative work and lessons leading up to that specific assessment should be created second. It is unrealistic to think that every student will get every topic perfect and ready to take the summative assessment on a prescribed schedule.

Chapter 5 : Bibliography of Assessment Resources â€“ Virginia Mathematics and Science Coalition

Formative Assessment Strategies for Enhanced Learning in Science, K-8 demonstrates how teachers can use various models of formative assessments to instruct, monitor student progress, and evaluate learning, helping to broaden teachers' understanding of assessment and how assessment tools can be used to guide successful standards-based teaching and learning in science.

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Outlining the formative assessment process and providing strategies for Read more embedding assessment into the K-8 standards-based science curriculum, this essential resource demonstrates how teachers can use formative assessments to modify instruction, monitor student progress, and evaluate learning.