Palacký University, Olomouc
Faculty of Science

Socrates - Comenius 2-1-2006-1
Improving Quality of Science Teacher Training
in European Cooperation - constructivist approach (IQST)

DESCRIPTION OF THE UNITS FOR DIRECT TEACHING

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FOREWORD

Project IQST Improving Quality of Science Teacher Training in European Cooperation – constructivist approach is a project under the Socrates – Comenius 2.1 programme of the European Commission.

The aim of this project is to implement newer pedagogical theories into initial science teacher training. The constructivist perspective is becoming a dominant paradigm in the field of the science education. This approach in the initial science teacher training is not still too common at many European teacher training institutions. With this project we would like to introduce new pedagogical methods based on constructivist approach in science teacher training. Therefore we designed and produced five new modules for science teacher training in the international cooperation between higher institutions of initial teacher training in five European countries. Modules produced can be used by lecturers with their students at science teacher training institutions.

This *Description of the Units for Direct Teaching* contains the description of the units for direct teaching in initial science teacher training in higher education institutions. Each unit has the similar structure: number, topic, goals, time, materials, strategy/method, reflection/comments, developed competencies of constructivist science teacher. This description is based on the best experience of the members of the project team. This material is only recommendation for trainers of prospective science teachers. The aim of this material is only to help trainers in their teaching. Under this project we published also the following training materials for students:

Development Procedural Skills in Science Education – constructivist approach
Zhelyazka Dimitrova Raykova

Floating and Sinking of an Object in a Liquid- Based on Socio-cognitive Constructivism
Nicos Valanides, Charoula Angeli, Stella Chadjiachilleos

Assessing Science for Understanding - a constructivist approach
Danuše Nezvalová

European Dimension in Integrated Science Education
Vincentas Lamanauskas, Margarita Vilkonienė

Using Laboratory to Enhance Student Learning and Scientific Inquiry
Osman Pekel

The Units in the *Description of the Units for Direct Teaching* are designed for the training of science teacher students which in the training materials mentioned above are used. These five training materials are connected with *Description of the Units for Direct Teaching* and support each other. These training materials and *Description of the Units for Direct Teaching* can be used independently.

All the project materials can also be found at the webpage of the project: http://www.iqst.upol.cz

Project Team

The project participants are the initial teacher training institutions in five European countries: Palacký University Olomouc (Czech Republic), University of Cyprus (Cyprus), Siauliai University (Lithuania), University of Plovdiv "Paisii Hilendarski" (Bulgaria), Ataturk University (Turkey).

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Pekel Feyzi Osman, assistant professor, Bayburt Faculty of Education, Ataturk University, (TK)

Development Procedural Skills in Science Education – constructivist approach

Zhelyazka Dimitrova Raykova

Description of the Unit 1

Seminar	Activities
Number	1
Topic	**Scientific and Technology Literacy. Components and Levels of Scientific Literacy**
Goals	To get acquainted with the meaning of the concept "science literacy"; To define the levels of science literacy; To get acquainted with the Bulgarian Educational standards for physics content and to discus the possibility of science literacy in it.
Time	2×45 minutes
Materials	Study material for the Module: Scientific and technology literacy, Unit 1
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - answer the questions.
Reflection/ Comments	Are suggested questions clear? Which changes do you suggest?
Developed Competencies of Constructivist Science Teacher	Competence to explain what science literacy means and to give examples for the levels in the context of physics education. Competence to choose and apply various ways for formation of science literacy.

Description of the Unit 2

Seminar	Activities
Number	2
Topic	**Constructivist Approach in Science Education**
Goals	To understand the concept of constructivism; To apply constructivist theory on physics teaching; To find differences between traditional physics teaching and constructivist approach in physics teaching;
Time	2×45 minutes
Materials	Study material for the Module: Constructivist approach in Science education, Unit2
Strategy/ Method	Independent reading; Discussion – summary, main ideas;
Reflection/ Comments	Can I understand the differences between traditional and constructivists approach on physics education? Which strategies I can apply for instructions in constructivist classroom? Can I formulate questions for learners?
Developed Competencies of Constructivist Science Teacher	Competence to design questions as a constructivist teacher. Competence to understand function of constructivist classroom and to find consistence between goals, action and assessment. Competence to use information from students to improve own teaching and facilitate professional growth. Competence to reflect own teaching and identify ways and means through which he/she may grow professionally.

Description of the Unit 3

Seminar	Activities
Number	3
Topic	**Building and Developing Scientific Process Skills**
Goals	To be trained according to the contemporary concepts of building and developing process scientific skills; To know their importance, variety and be able to create and develop main process skills in their students;
Time	2×45 minutes
Materials	Study materials for the Module: Building and developing scientific process skills, Unit3
Strategy/ Method	Independent reading; Discussion-summary, main ideas; Group work – designing of the example of the building of science process skills; Portfolio
Reflection/ Comments	Are the examples suitable? Which changes I should suggest?
Developed Competencies of Constructivist Science Teacher	Competence to design the plan of building and developing science process skills; Competence to work with National educational Standards and Syllabus about formation of science process skills in the science education. Competence in identification of science process skills and knowledge of the ways for their forming.

Description of the Unit 4

Seminar	Activities
Number	4
Topic	**Strategies for Supporting Process Skills Development and Assessment**
Goals	To get acquainted with appropriate strategies for process skills development and assessments; To describe different strategies for supporting process skills development and assessment; To develop ability to provide feedback to students and teachers; To choose suitable strategies for supporting process skills development and assessment.
Time	2×45 minutes
Materials	Study materials for the Module: Strategies for supporting process skills development and assessment, Unit 4
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work – giving an example of part of the lesson's scenario in which it is shown how to put into practice various strategies for building of science process skills.
Reflection/ Comments	Which strategies I can apply for supporting process skills development?
Developed Competencies of Constructivist Science Teacher	Competence to choose and apply various techniques for formation of science skills for acquisition structural elements of physics knowledge. Competence to know the influence of ICT over the choosing of teaching strategies. Competence to use the various strategies of teaching and learning for formation of supporting process skills.

Description of the Unit 5

Seminar	Activities
Number	5
Topic	**Plan, Organize and Deliver an Active Learning Project**
Goals	To get acquainted with the characteristics of active teaching. To know the difficulties and hindrances to active learning. To be able to name possible active learning strategies. To become familiar with active learning and will be able to use it in their future teaching.
Time	2×45 minutes
Materials	Study materials for the Module: Plan, organize and deliver an active learning project, Unit 5
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work – giving examples how to organize active learning of the pupils.
Reflection/ Comments	Decide if the outlines of physics lessons prepared by you are due to the requirements for organization of active learning. Which techniques for active learning I could use in various units from the physics syllabus? Are the examples enough eloquent**?**
Developed Competencies of Constructivist Science Teacher	Competence to know the importance of the active learning and the most common hindrances to active learning. Competence to describe in details teachers' activity and students' activity in organization of active learning in the preparation for physics lessons? Competence to use active learning in their future teachers practice.

Floating and Sinking of an Object in a Liquid- Based on Socio-cognitive Constructivism

Nicos Valanides
Charoula Angeli
Stella Chadjiachilleos

Description of the Units

Seminar	Activities
Number	1-15
Topic	**Floating and Sinking of an Object in a Liquid- Based on Socio-cognitive Constructivism**
Goals	To understand and define the basic tenets (principles) of socio-cognitive constructivism. To design and implement teaching scenarios based on socio-cognitive constructivism and following an inquiry-based approach. To appreciate the importance of teaching scenarios that invest not only on cognitive but on affective factors well in the process of knowledge construction. To become competent in conducting small scale action research. To continually evaluate students' conceptions and use the evidence for designing more effective teaching/learning situations conducive to conceptual changes.
Time	The volume of the module and its associated credit hours or number of ECTSs (European Credit Transfer System) can vary depending on learners' prior knowledge and other characteristics. It is however estimated that it should not exceed 3 ECTS, that is, 13-15 50-minute teaching periods.
Materials	Study material for the Module: Floating and Sinking of an Object in a Liquid- Based on Socio-cognitive Constructivism
Strategy/ Method	The content of the module and the teaching / training strategies or approaches will be clarified by describing an indicative sequence of steps that should be followed during the training. This sequence clearly represents the basic principles of socio-cognitive constructivism and

	how to implement them, by providing specific examples. Learners' conceptions should be initially identified and presented to the whole group, so that the participants (teachers or prospective teachers) will be familiarized with the variety of existing conceptions among any group of learners. Any of the existing alternative conceptions or (mis)conceptions constitutes learners' explanatory frameworks and should be taken into consideration for inducing conceptual change through presenting discrepant events conflicting a learner's conceptions. Learners' conceptions should be somehow made public, so that learners' are familiarized with the spectrum of the existing (pre)conceptions, and, consequently, these should be challenged through specific experimental results, in an attempt to foster cognitive dissonance that will trigger the cognitive processes (assimilation and accommodation) for dissolving this conflict. Could all students understand the questions of student-teacher?
Reflection/ Comments	How the questions were evaluated (schoolmates and lectures)? Which changes do you suggest?
Developed Competencies of Constructivist Science Teacher	Science teachers must become competent in diagnosing their students' alternative conceptions, using mainly qualitative approaches and formative evaluation approaches. Science teachers must be able to design and develop learning environments conducive to conceptual change taking into consideration their students' conceptions. Science teachers must be able to invest on discrepant events that challenge students' existing alternative conceptions. Science teachers must be able to identify or design discrepant events that are interesting to and engaging for the students, and are well structured, so that students can be scaffolded to realize the discrepancy between

	their existing conceptions and the phenomenon. Science teachers must be competent to structure problem situations that can provide scaffolding towards possible solutions. Science teachers must be equipped with the required abilities for correctly recognizing whether their students experience cognitive conflict or not. Science teachers must have the flexibility to differentiate a problem situation according to students' characteristics (e.g., cognitive ability, performance, gender, social and cultural background, etc) in order to enable more students to experience cognitive conflict. Science teachers must be able to provide the necessary means for their students to resolve the discrepancies between the phenomena they observe and their existing conceptions. Science teachers must be able to provide valuable feedback as to the kinds of reasoning implemented by students, and to help them develop their scientific reasoning skills. Science teachers must be competent of identifying non-cognitive factors engaged in a cognitive conflict situation and to incorporate these factors productively in the learning process. Science teachers must become competent in undertaking their roles as facilitators and supporters, when students attempt to resolve their cognitive conflict situations. Science teachers must be able to promote productive social interactions among their students in ways promoting collaboration and shared responsibilities for the knowledge construction process, so that groups of students become real learning communities. Science teachers must be able of recognizing their students' conceptual change by identifying students' cognitive gains or conceptual advancement. Science teachers must be competent of evaluating their own and their students' conceptions based on criteria compatible with the tentative nature of science.

Assessing Science for Understanding - a constructivist approach

Danuše Nezvalová

Description of the Unit 1

Seminar	Activities
Number	1
Topic	**Purpose and Characteristic of Classroom Assessment**
Goals	To understand purposes of classroom assessment; To define the concept of assessment; To characterize the classroom assessment.
Time	2×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 1
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work and Role Play– 1 teacher student plays a role of constructivist teacher and formulates questions for students in class; others in the group play a role students in class. Study Case-study on page 4 and answer the questions (work in pairs).
Reflection/ Comments	Could all students understand the questions of student-teacher? How the questions were evaluated (schoolmates and lectures)? Which changes do you suggest?
Developed Competencies of Constructivist Science Teacher	Competency to design questions as a constructivist teacher; Competency to understand function of assessment in constructivist classroom and to find consistency between goals, action and assessment; Competency to use assessment as an important part of science education.

Description of the Unit 2

Seminar	Activities
Number	2
Topic	**A Constructivist Approach in Assessment**
Goals	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 mis-concepts in understanding of assessment.
Time	2×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 2
Strategy/ Method	Independent reading; Group work: discussion – Case Study and Questions on page 11 Work in pairs: watch the video on website: *http://165.224.221.98/pubs2006/timssvideo/index.asp* (research PISA-assessment of student in five different countries) and make a decision which assessment is traditional or constructivist; Portfolio;
Reflection/ Comments	Can students understand the differences between traditional and constructivist assessment?
Developed Competencies of Constructivist Science Teacher	Competency to assess students learning; Competency to understand function of assessment in constructivist classroom;

Description of the Unit 3

Seminar	Activities
Number	3
Topic	**Planning an Implementing Assessment Projects**
Goals	To develop skills to plan assessment; To plan a class assessment; To design questions for students; To evaluate assessment.
Time	1×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 3
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work – designing of the assessment project; Presentation of the project; Portfolio;
Reflection/ Comments	Are suggested questions clear? How the project was evaluated (schoolmates and lectures)? Which changes I should suggest?
Developed Competencies of Constructivist Science Teacher	Competency to design questions as a constructivist teacher; Competency to plan constructivist assessment.

Description of the Unit 4

Seminar	Activities
Number	4
Topic	**Techniques for Assessing Knowledge and Skills**
Goals	To describe different technique; To understand purpose of the technique; To choose technique related teaching goals, content and abilities of students; To develop ability to provide feedback to student and teacher.
Time	2×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 4
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work (4 groups) each group applies 1 strategy (Background Knowledge Probe, Misconception/Preconception Check, Minute Paper, Concept Maps) in real situation using microteaching;
Reflection/ Comments	Which strategies I can apply for assessing in constructivist classroom? Was the group successful in microteaching and why?
Developed Competencies of Constructivist Science Teacher	Competency to use multiple assessment tools and strategies to assess students´ knowledge and skills.

Description of the Unit 5

Seminar	Activities
Number	5
Topic	**Techniques for Assessing Learner Attitudes, Values and Self-awareness**
Goals	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.
Time	1×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 5
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work: Design small project for assessing students´ attitudes and values. Discuss your project in your working group. Portfolio;
Reflection/ Comments	Which strategies I can apply for Assessing Learner Attitudes, Values and self-awareness in constructivist classroom? Did the group design the project that I liked?
Developed Competencies of Constructivist Science Teacher	Competency to use the results of multiple assessment to guide and modify instruction or assessment process in constructivist classroom; Competency to use the results of assessment as vehicles for students to analyze their own learning, engaging students in reflective self-assessment of their own work.

Description of the Unit 6

Seminar	Activities
Number	6
Topic	**Assessing Learner Reactions to Instructions**
Goals	To describe different technique; To understand purpose of the technique; To choose technique related teaching goals, content and abilities of students; To develop ability to provide feedback to student and teacher.
Time	2×45 minutes
Materials	Study material for the Module: Assessing Science for Understanding Unit 6
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work (3 groups) each group applies 1 strategy (Electronic Mail, Feedback Group Instructional Feedback Technique, Group-Work Evaluations); Presentation of group work; Portfolio;
Reflection/ Comments	Which strategies I can apply for assessing learner reactions to instructions in constructivist classroom? Can I formulate questions for learners? Can I use the students´ answer to improve my teaching?
Developed Competencies of Constructivist Science Teacher	Competency to reflect own teaching and identify ways and means through which he/she may grow professionally; Competency to use information from students to improve own teaching and facilitate professional growth.

European Dimension in Integrated Science Education

Vincentas Lamanauskas
Margarita Vilkonienė

Description of the Unit 1

Seminar	Activities
Number	1
Topic	**A Conception of Integrated Science Education**
Goals	To have a look at the evolution of the integrated teaching idea; To define the essential elements of integrated science education.
Time	1×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 1
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work. Study Case-study on page 3 and answer the questions (work in pairs).
Reflection/ Comments	What do we know about ISE? Does the elements of the integrated science teaching are clear? How ideas of the integrated teaching has been developed? Which modern concepts of ISE do you suggest?
Developed Competencies of Constructivist Science Teacher	Competency to understand the evolution of the integrated teaching idea; Competency to understand the essential elements of integrated science education; Competency to understand importance of IST in constructivist teaching environment.

Description of the Unit 2

Seminar	Activities
Number	2
Topic	**Some Philosophic, Didactic and Social Aspects of Integrated Science Education**
Goals	To find out the impact of the well-known philosophical trends on education of the 20th century and to discover how those promoted the ideas of integrated science education. To learn how integrated science education affects the processes of students' socialization; To analyze and understand the main problems of natural science education in terms of pedagogy; To motivate the qualities of natural science education in terms of the constructive aspect of teaching/learning.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 2
Strategy/ Method	Independent reading; Group work: discussion – Case Study and Questions on page 9 Brainstorming Discussion – summary, main ideas Individual work according tasks presented in Unit 2
Reflection/ Comments	Can I explain different aspects of integrated science education? Can I explain the qualities of science education in terms of the constructive aspect of teaching/learning?
Developed Competencies of Constructivist Science Teacher	Competency to reveal the qualities and drawbacks of integrated science education; Competency to understand the impact of integrated science education on the processes of students' socialization; Competency to define the main didactic problems of integrated science education.

Description of the Unit 3

Seminar	Activities
Number	3
Topic	**The Main Tendencies of Integrated Science Education Development**
Goals	To analyze the reasons determining the need for integrated science education; To identify the basic terms describing the integration of sciences; To perceive integrating the content of subjects as the most efficient way of integration offering possibilities, advantages and links with the principles of constructivistic teaching/learning?
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 3
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 14-15; Portfolio; Research projects - students research a topic in small groups and later present their findings to the whole group. Individual work according tasks presented in Unit 3
Reflection/ Comments	Are presented tendencies of integrated science education development clear? Can you predict some new directions of IST development?
Developed Competencies of Constructivist Science Teacher	Competency to identify the basic terms describing the integration of sciences; Competency to identify the main tendencies of integrated science education development; Competency to predict possible ways of IST development in the future.

Description of the Unit 4 & 5

Seminar	Activities
Number	4 & 5
Topic	**Integrated Science Education in the Context of the Constructivism Theory.** **Integrated Science Teaching in Terms of the Constructivist Approach**
Goals	To perceive the idea of integrated science education in the context of constructivism as a theory of learning; To understand and name the specificities of integrated science education implemented following the principles of constructivistic teaching/learning; To manage to predict the possibilities of integrating the content of different subjects of science related to the specificities of students at different age stage as well as to material and human resources.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 4 & 5
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 20-21. Analyze the information presented on website at http://www.scienceonstage2.co.uk/ Individual work according tasks presented in Unit 4 & 5 Problem-solving Portfolio
Reflection/ Comments	What we want to know more about this topic? How can I connect IST and constructivist learning environments (CLEs? Is it really effective in teaching process?

Developed Competencies of Constructivist Science Teacher	Competency to perceive the compatibility requirements between integrated science education and other types of curricula; Competency to facilitate discussion in group; Competency to perceive the idea of integrated science education in the context of constructivism as a theory of learning.

Description of the Unit 6

Seminar	Activities
Number	6
Topic	**The Models of Integrated Science Education**
Goals	To meet up with and carefully analyse one of the possible models of integrated science education emphasizing the classification of the subjects taught: Define the advantages of integrated science education; Understand the levels of integration in science education.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 6
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work: design a model of integrated science teaching. Discuss your project in your working group. Case Study and Questions on page 26-28 Portfolio; Individual work according tasks presented in Unit 6
Reflection/ Comments	Can I separate (distinguish) different models of IST? What are the main criteria? Did the group design the model that I liked?
Developed Competencies of Constructivist Science Teacher	Competency to identify the models, levels and degree of integrated science education; Competency to define the advantages of integrated science education.

Description of the Unit 7

Seminar	Activities
Number	7
Topic	**The Integrated Science Education Curricula and its Designing Principles in Comprehensive School**
Goals	To perceive the integral and systemic nature of the content of science education; To analyze different types of science education curricula, to know the qualities, drawbacks and degrees of integrity of the curricula; To define the concepts of *educational content* and *educational curriculum* and to know their framing principles; To have knowledge of conditions ensuring the possibility of successful implementation of science education curriculum.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 7
Strategy/ Method	Independent reading; Discussion – summary, main ideas. Discuss ten levels of curricula integration according Fogarty, 1991; Group work – design a sketch of IS curriculum. Discuss your project in your working group. Case Study and Questions on page 37-38; Presentation of group work; Portfolio; Individual work according tasks presented in Unit 7
Reflection/ Comments	Which strategies can I apply for curriculum preparation? Can I use different types of curricula in the teaching process?

Developed Competencies of Constructivist Science Teacher	Competency to design the curricula of integrated science education (in the establishments of formal and non-formal education); Competency to design appropriate integrated science curriculum for secondary aged children utilizing appropriate goals, concepts, and evaluation; Competency to define the concepts of *educational content* and *educational curriculum* and to know their framing principles; Competency to analyze different types of science education curricula.

Description of the Unit 8

Seminar	Activities
Number	8
Topic	**The Science Education Tools and Ways of Producing them in the Collaboration Process**
Goals	To define the peculiarities of science education; To perceive that the efficiency of science education and the quality of education results are determined by a mutual collaboration between a teacher and a student; To know the tools and ways ensuring favourable conditions for a qualitative process of science education and to have knowledge of the factors determining a choice of science educations forms.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 8
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 44; Individual work according tasks presented in Unit 8 Brainstorming; Portfolio;
Reflection/ Comments	Which of the teaching methods will you suggest for the teaching of integrated science in secondary school level? How can I define the best conditions for a qualitative process of science education? How can I measure efficiency of a concrete method of teaching?
Developed Competencies of Constructivist Science Teacher	Competency to choose adequate teaching methods and tools; Competency to define the peculiarities of science education; Competency to distinguish principles of application of different teaching methods in different situations and different stages of teaching process.

Description of the Unit 9 & 10

Seminar	Activities
Number	9 & 10
Topic	**A Constructivist Approach to Integrated Science Education: Teaching Would-be Teachers to do Science.** **Designing a Integrated Science Methods Course for Initial Science Teachers**
Goals	To perceive the specificities of work experienced by a teacher following the instructions of constructivistic teaching/learning; To perceive that the specificities of work experienced by a teacher following the instructions of constructivistic teaching/learning make the impact on the process of training pre-service teachers. Find relation between the above mentioned perception and individual experience. To analyze how teacher's competence in sciences as one of the constituents of professional competence is important for the process of science education; To know the main principles of training the teachers of sciences.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 9 & 10
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 50; Portfolio; Individual work according tasks presented in Unit 9 & 10

Reflection/ Comments	How is it possible to oppose to critics of constructivist approach in preparation of science teachers? How can I explain pros and cons of constructivist science teacher preparation? Why aren't teachers using how students learn as a guide to their teaching practices?
Developed Competencies of Constructivist Science Teacher	Competency to perceive the specificities of work experienced by a teacher following the instructions of constructivistic teaching/learning; Competency to understand the main principles of training the teachers of sciences; Competency to provide opportunities for scientific discussion and debate among students.

Description of the Unit 11 & 12

Seminar	Activities
Number	11 & 12
Topic	**Contextual Teaching and Learning of Integrated Science in Lower and Upper Secondary Schools.** **The Specificities of Integrated Science Teaching in Lower and Upper Secondary School**
Goals	To perceive the specificity and significance of science education at lower and higher stages of secondary school. To find out why a positive emotional students' disposition in terms of science education is so important for the above mentioned stages of secondary school. To analyze teacher's role in the process of teaching an integrated course on sciences in the forms of lower and upper secondary school. To specify the integration levels of different branches of sciences.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 11 & 12
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 55-56; Brainstorming; Portfolio.
Reflection/ Comments	Why science learning is difficult? How can I explain this statement? How can I guarantee an effective constructivistic science teaching? How can I observe learning in my classroom?

Developed Competencies of Constructivist Science Teacher	Competency to understand contextual teaching and learning of integrated science; Competency to demonstrate and understanding of the constructivist approach through effective questioning, assessment, and reporting techniques within the science curriculum; Competency to specify the integration levels of different branches of sciences.

Description of the Unit 13

Seminar	Activities
Number	13
Topic	**The Evaluation Strategies of Integrated Science Teaching /Learning**
Goals	To perceive and define an evaluation of integrated science self/education as a systemic process. To perceive the goal, object and methodology of the evaluation of integrated science self/education; To analyze the different strategies of the evaluation of integrated science self/education; To manage to choose an optimal strategy for evaluation considering the evaluated object.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 13
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 62; Portfolio;
Reflection/ Comments	Which evaluation strategies can I apply in teaching process? Can I formulate evaluation questions for learners? Can I use the students´ answer to improve my teaching? How can I improve the self-evaluation skills of my students? What teachers should know about evaluation strategies and techniques?
Developed Competencies	Competency to choose an appropriate optimal evaluation strategy covering the fields of integrated science education

of Constructivist Science Teacher	and students` achievements; Competency to perceive and define an evaluation of integrated science self/education as a systemic process; Competency to design an appropriate evaluation plan for a specific science course and purpose; Competency to select and clearly describe the questions to be addressed in the evaluation.

Description of the Unit 14

Seminar	Activities
Number	14
Topic	**The Collaboration Peculiarities of Science Teachers**
Goals	To understand purposes of science teachers collaboration; To define the concepts of collaboration and cooperation; To characterize the main ways of collaboration.
Time	2×45 minutes
Materials	Study material for the Module: European Dimension in Integrated Science Education - Unit 14
Strategy/ Method	Independent reading; Discussion – summary, main ideas; Group work - Case Study and Questions on page 66; Portfolio; Brainstorming.
Reflection/ Comments	What is science teacher collaboration, and how does it relate to other current school practices? When science teachers say that they collaborate, are they meant many different things? How can I take part in co-teaching? Can collaborative technologies improve integrated science teaching? Does constructivistic approach improve collaboration among science teachers?
Developed Competencies of Constructivist Science Teacher	Competency to choose the best ways of collaboration in concrete teaching situations; Competency to organize collaborative integrated science teaching process.

Using Laboratory to Enhance Student Learning and Scientific Inquiry

Osman Pekel

Description of the Unit 1

Seminar	Activities
Number	1
Topic	**Constructivist Science and Laboratory Education Resources**
Goals	To be aware what constructivist science is To know the steps of constructivist science laboratory instruction
Time	3×50 minutes
Materials	Study material for the Module: Constructivist Science and Laboratory Education Resources Unit 1
Strategy/ Method	Independent reading, Team work, Role Play- one of the students plays the role of constructivist teacher and ask questions to the class; other students plays student role. But after the sample case situations, it is recommended to criticize the role of student teacher and also student. Aims, questioning styles are criticizes in order to create the best constructivist lab education. Discussion of the similar implication of the case study on page 5. Student learning and meaningful learning could be enhanced by classroom discussion in which the concepts in these lessons are applied to specific examples.
Reflection/ Comments	How can a constructivist science teaching can contribute to a better science teaching and learning? What make constructivist science lab teaching superior than the traditional science teaching and learning?
Developed Competencies	Able to use science teaching actions, strategies and methodologies.

of Constructivist Science Teacher	Able to use prior conceptions and student interests to promote new learning. Monitor students' understanding of content through a variety of assessment strategies, provide positive feedback to students to assist learning Knowledge of science and constructivist science teaching and learning

Description of the Unit 2

Seminar	Activities
Number	2
Topic	**Constructivist Science Teaching Techniques**
Goals	To foster a learning environment supporting conceptual understanding; To promote positive attitudes toward science learning.
Time	3×50 minutes
Materials	Study material for the Module: Constructivist Science Teaching Techniques Unit 2
Strategy/ Method	Independent reading, Team work, Critic points, Role Play- one of the students plays the role of constructivist teacher and ask questions to the class; other students plays student role. But after the sample case situations, it is recommended to criticize the role of student teacher and also student. Aims, questioning styles are criticizes in order to create the best constructivist lab education. Discussion of the similar implication of the case study on page 5. Student learning and meaningful learning could be enhanced by classroom discussion in which the concepts in these lessons are applied to specific examples.
Reflection/ Comments	What are the weak and strong sides of the student-teacher? What do you suggest him/her to get a better teaching style? What are your additional suggestions to promote constructivist science lab teaching?
Developed Competencies	Know the values, beliefs and assumptions inherent to the creation of scientific knowledge within the scientific

of Constructivist Science Teacher	community and compares science with other ways of knowing Analyze why curiosity, honesty, cooperation, openness and scepticism are important to scientific explanations and investigations. Able to use advanced technology to extend enhance learning Able to use prior conceptions and student interests to promote new learning Participate the activities of the professional community to include colleagues, organizations, to improve student learning. Reflect on professional practices and continuous efforts to ensure the highest quality of science instruction.

Description of the Unit 3

Seminar	Activities
Number	3
Topic	**Scientific Process Skills and Scientific Inquiry**
Goals	To improve scientific process skills; To promote positive attitudes toward learning and teaching science.
Time	4×50 minutes
Materials	Study material for the Module: Scientific Process Skills and Scientific Inquiry Unit 3
Strategy/ Method	Independent reading, Internet resources, Team work, Discussion. For Science and Science Laboratory Knowledge & Skills of 8th Grade students: http://www.internet4classrooms.com/ skills_8th_science_tx.htm This website is really a good resource for student teacher and also teacher about to guide how to teach about scientific process. After checking these case samples, students compare them with constructivist science teaching style and conclude.
Reflection/ Comments	What are your opinions/suggestions about this website teaching style on scientific process skills and scientific inquiry samples?
Developed Competencies of Constructivist Science Teacher	Analyze local, regional, national, or global problems or challenges in which scientific design can be or has been used to design a solution. Analyze how scientific enterprise and technological advances influence and are influenced by human

	activity. Understand how to plan and conduct scientific investigations. Synthesize a revised scientific explanation using evidence, data and inferential logic. Able to establish interactions with students, including questioning techniques that promote learning and achievement.

Description of the Unit 4

Seminar	Activities
Number	4
Topic	**Meaningful Learning, Nature of Science**
Goals	To comprehend the nature of science; To improve meaningful learning.
Time	4×50 minutes
Materials	Study material for the Module: Meaningful Learning, Nature of Science Unit 4
Strategy/ Method	Independent reading, Internet resources, Team work, Discussion. http://www.middleschoolscience.com/apple.htm Objectives of this website is to stress the importance of observations (nature of science) according to constructivist science teaching. (Including; thinking questions, procedures, questions for discussions, teacher notes). This website is really a good resource for student teacher to guide how to teach about nature of science. Checking such kind of websites may help student-teachers' to get different perspectives and help to develop their creativities.
Reflection/ Comments	What kind of questions we can ask to our students for promote NoS and meaningful learning, Why, answer on your sample case study.
Developed Competencies of Constructivist Science Teacher	Analyze how scientific knowledge and technological advances discovered and developed by individuals and communities in all cultures of the world contribute to changes in societies. Apply understanding of how to report complex scientific investigations and explanations of objects, events, systems and processes, and how to evaluate scientific reports. Achieving deep understanding of complex ideas that are relevant to students' lives.

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Description of the Units for Direct Teaching

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