

Chapter 2

Instructional Strategies

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In this chapter, detailed information will be given to instructional strategies. Alongside, clues and activity samples will be given associated with each strategy. This chapter has two main sections: *Definitions*; include explanations about core concepts, *Classifications*; includes brief strategy taxonomies and their rationales to give you an idea about the classifications.

2.1 Definitions

2.1.1 Instruction, Teaching, Learning

In the related literature, there are a lot of definitions of core concepts of instructional science. It's possible to create new ones taking into account developments in society and science. To me, the instruction is a product of teaching and learning. Instruction can be defined as the whole process applied for learning to occur and for the development of the target behavior that learners are expected to have.

According to Şimşek (2011), instruction requires not only systematic guidance for learning but also a purposeful organization of experiences to help students achieve the desired change in their performances. Instruction is also known as an action taken by teachers to create a stimulating learning environment for the purpose of providing guidance along with the necessary instructional tools and carrying out activities that will facilitate learning and help develop behavior appropriate for the gains students are supposed to have (Clark and Starr 1968;

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Moore 2000). Instruction is also defined as procedures and activities planned for teaching (Canady and Retting 1996).

As can be seen, the concept of instruction has a broad definition field. You can find more of them as follow list:

- Instruction is a combination of teaching and learning activities.
- Instruction is a whole process includes facilitating the learning process and guiding the pupils.
- Strategies determine the approach a teacher may take to achieve learning objectives (Saskatchewan Education 1991).
- Instruction is an effort that supporting the individual's growth and formation (Bruner 1960).
- Act of building into the mind, knowledge of facts, relations or principles of one kind or another (Ducasse 1958).

Instruction is an activity process that is helping individual's self-actualization and self-fulfilling (Moore 2000).

It's quite difficult to separate of teaching and learning activities from each other with precise borders. According to Moore (2000), learning is a change based on experience into individual's performance capacity. Because of its nature, the concept of learning refers to individual processes. Learning of a knowledge unit, skill, behavior, and attitude is all about one's effort. So, learning is an individual process.

Depending on the context the concept of learning can be defined in different ways:

- Learning is an information acquisition process (Piaget 1972),
- Learning is a process of changing behavior (Gardner 2004; Mayer 1982; Shuell 1986),
- Learning is to make connections between neurons (Hebb 1949),
- Learning is the process of construction of meaning (Piaget 1972; Resnick 1989),
- Learning is the changes in performance capacity (Driscoll 1994; Marzano 2003).

Teaching is an interactive process includes guidance, supporting and guiding the students learning.

Sometimes instruction and teaching concepts can be used interchangeably. Gagné (1977) and Bruner (1960) have used the concept of teaching and instruction in their statements almost synonymously. According to Gage, teaching is any activity that executed by someone at any time to facilitate another one's learning. To this definition, teaching is a planned implementation that performed in the instructionprocess.

According to another definition of teaching is provide the information required in that field in agreement with a particular purpose in a certain field; arrangement of the activities that facilitate learning; providing the materials and guidance. The concept of teaching generally describes the indoor and classroom activities. As a core concept teaching is;

- An interaction between student and source
- The method of influence on student learning
- Regulation environment of the student to engage in a particular behavior under certain conditions
- Selecting and using appropriate teaching methods and techniques to reach the instructional goals

In short, teaching is guidance. Judging from these definitions we can say that teaching is a natural part of instruction process and a cross-section in the unit time of the process. Yes, this situation has put you in a bit of dilemma. It can be viewed as a way to solve the problem: instruction refers to the process, teaching relates to a cross-section of the process.

2.1.2 Nature of Instruction

Anyone can show, tells and points out something to another one. Parents tell their children what to do; doctors point out proper procedures to their patients; auto-mechanics may show how to make minor adjustments to a car. All these actions refer to the concept of teaching. At this point, we can say that everyone teaches others to do things, and so everyone is a teacher, at least in an amateur sense. According to Gunter et al. (2003), there is nothing special or unique about being a teacher considering the concept of teaching. But in the professional sense, teachers not only teach in the usual sense of a word, but they also instruct. The meaning of the word instruct derives from the root “to build” or “to structure”. The professional teachers structure classroom environments and build series of experiences for students who have a broad range of abilities, interests, and learning needs. Whereas parents, doctors and auto mechanics teach spontaneously by telling, pointing out or showing, professional educators must carefully design and plan for their teaching.

According to Smith and Ragan (1999), the instruction is the development and delivery of information and activities that are created to facilitate attainment of intended, specific learning goals. On the side, Smith and Ragan say “teaching to refer to learning experiences that are facilitated by a human being, not a videotape, textbook or computer program, but a live teacher. Instruction, on the other hand, includes all learning experiences in which the instructional support is conveyed by teaching and other forms of meditation... it means a live teacher is not essential to all instruction.”

As seen, teaching mostly needs field experience but in the professional sense, it needs instruction design. The difference starts at this point. At this point, it is not possible to ignore the concept of learning. If someone tells, shows, points out the things to someone, then someone hears, sees and notices. So, we can say, this is an interactive and some time multidirectional process. We may consider instruction as a concept formulated as follow (Table 2.1):

$$\text{Instruction} = \text{teaching} + \text{learning}$$

If the instruction refers to the whole process (sum of teaching and learning processes), as a core concept it must have some features. Some of them as follow:

- Instruction changes the learners' attitudes, motivation, and interests,
 - Instruction strengthens psychomotor, cognitive and social skills,
 - Instruction leads concepts, rules, and principle learning,
 - Instruction facilitates individual development and learning to learn skills,
 - Instruction develops off the learners' and instructors' self-evaluation skills,
 - Instruction recommends using information technologies,
 - Instruction ensures systematicity,
 - Instruction gives feedbacks to curriculum,
 - Instruction supports the governments to achieve their official and national goals.
- And, etc.

2.1.3 Instructional Strategy

According to Richardson (2001), besides the studies of early progressivism, Lev Vygotsky, Jean Piaget, Jerome Bruner and Albert Bandura studied on instructional strategies and they had created new theories. Cognitive psychology and constructivist approaches placed instructional strategies in the center of the curriculum such as exploration and research-based teaching activities.

Instructional strategies point the ways and approaches followed by the teachers, to achieve the fundamental aims of instruction. Strategies are defined in various ways in the related literature. Sources called them as “teaching strategies” or “instruction strategies.” In fact, it's hard to say flatly, that there is the existence of a concept of unity about the strategies. Nevertheless, because of our view about the concept of instruction, as mentioned previous section (Nature of Instruction), we named them as “instructional strategies”.

When the related literature is examined, it is seen that many researchers try to create a conceptual framework for instructional strategies. It could be stated that the conceptual frameworks include instructional organizers and arrangers as well as instructional strategies and tactics. Instructional organizers put forward practical ideas regarding the application of instructional activities. For instance, instructional organizers could be said to be carried out to organize instructional goals of Bloom's taxonomy or Gardner's theory of multiple intelligence. The instructional behavior that instructors have long tended to apply could also be regarded as instructional tactics. These are essential activities which are most common in the instructional process and which limit the instructional strategies of instructors. Behaviors such as directing an appropriate question, checking learners' understanding, giving examples, making visual presentations or contributing to both parties of a discussion

could be given as examples of instructional tactics. Tactics have resulted from experienced instructors' practices (Richardson 2001 in Erişti and Akdeniz 2012).

Marzano (2003) states that instructional strategies influence learners' achievement and let teachers diversify the instructional applications. According to Marzano, the effectiveness of instruction can be achieved mainly by preventing the random or mysterious occurrence of this process. The instructional process should be structured, applied and evaluated in a purposeful, planned, and systematic way.

According to another aspect of the strategies; instructional strategies are instructional methods that include specialized instructional phases in line with the particular purposes of the subject and the features of the content area so that learners can gain the target behavior (Silver et al. 1996). Instructional strategies include activities that help create the classroom environment for good-quality learning to occur. These activities should consider instructional goals as well as the content of the curriculum. Instructional strategies pointing out the components that will influence target learning are factors which have a significant impact on the quality of learning; that determine which instructional activities will be carried out in the instructional process and which instructional methods and techniques will be employed in the process (Baker and Dwyer 2005). The underlying determinants in choosing the instructional strategies and using them in the instructional process include the instructional approach, the instructional theory, and the related models that the teacher has adopted (Joyce and Marsha 2000; Richardson 2001 in Erişti and Akdeniz 2012).

Modern understandings regarding instructional strategies acknowledge that instructional goals are complex and sophisticated and that instructors are supposed to have a variety of approaches to the educational needs of students from different socio-cultural environments and to help them achieve effective learning. In this respect, it could be stated that today, instructors should prefer among various instructional strategies to help learners gain active learning experiences in cognitive, affective and kinetic fields (Williams 2004).

Instructional strategies are mostly used to apply learning theories in a useful way and to obtain the target learning outcomes. Besides, one of the related questions discussed in academic contexts in recent years is the question of which learning theory can be effectively used with which instructional strategies (Miller and Veatch 2010). Discussions between educators and community are collected at the point of the effectiveness of the method of expression or discussion, direct instruction or research-based instruction. It is not possible to say that this debate can reach a conclusion because of the instructional strategies are not implemented in the same effectiveness (Saskatchewan Education 1985, 1991).

Views are claiming that the context of instruction should be a determinant in choosing the instructional strategies. For example, Shulman (1987) asserts that different instructional strategies should be applied for different subject fields and contents. In short, the instructional strategies to be implemented in the instructional process should be chosen and applied according to the content in addition to other elements of instruction. For instance, the instructional strategies that a math teacher uses to help students understand the Pythagoras theorem will differ from the

instructional strategies that a teacher of Turkish language uses while teaching the structural features of Turkish. Similarly, when students' background knowledge and their development areas are taken into consideration, it could be stated that first-grade teachers at an elementary school will sometimes have to apply instructional strategies, methods, techniques, approaches, and tactics different from those to be applied by second-grade teachers (Erişti and Akdeniz 2012).

It can be said that learning environment may be effective the use of instructional strategies. Classrooms give the teachers and students interaction each other. At certain times, some types of classes can appropriate for instruction than other types. Both formal and informal learning are ensured using effective instructional strategies in certain environments created by instructors. For example; In the quite distinctly structured learning environment that lecture method was applied, learners are expected to observe, listening and take notes. In another example; if instructor separates the learners for collaborative/cooperative learning activities, learners are supposed to identify the interaction's direction and limit and to express themselves effectively.

Contemporary approaches into instructional strategies say the purpose of instruction carried out in schools that are complex and multi-faceted, and besides, for practical learning, instructors should be able to provide a wide variety of instructional approaches to the students from different socio-economic environments. Today, it would say the instruction based on a single teaching method is inadequate even impossible. We can say that effective teachers choose from a variety of instructional strategies for students have successful learning experience cognitively and behaviorally (Marzano 2003; Lim 2002).

2.2 Classifications

Some of the discussions regarding instructional strategies involve several headings under which instructional strategies can be classified. When the classifications put forward are examined, it could be stated that several variables played a role in doing these classifications. These variables include who is the focus of instructional activities; what methods and techniques are used in the process; whether the process is followed with an inferential, deductive or inductive understanding; and which constructs are taken into consideration in the preparation, presentation, and restructuring of the information. In addition, instructional strategies are also classified in some studies according to how the process functions; in some studies, according to how information is produced and how this information is acquired by learners; and in some other studies, they are classified based on the instructional models that act as a source for strategies.

In the topic of instructional strategies, it can be seen a number of taxonomies based on different variables in the literature. It's clear that learning and teaching approaches, theories and models have influences on the formation of strategy groups to categorize strategies.

Table 2.2 Classifications of instructional strategies

Author	Classification systems										
Saskatchewan Education (1985, 1991)	Direct instruction		Interactive instruction		Independent/individual study		Experiential instruction		Indirect instruction		
Merrill (1987)	Regulation strategies				Message strategies				Orientation strategies		
Sedgwick (1999)	Give up / Discourage		Warn / Alerted		To be informed / To inform		Volunteer / Make voluntary		Win / Bring		
Marzano, (2001)	Identifying similarities and differences	Summarizing and note taking	Reinforcing effort and providing recognition	Homework and practice	Nonlinguistic representations such as mental images, graphs, acting out content	Cooperative learning	Setting objectives and providing feedback	Generating and testing hypotheses	Activating prior knowledge via questions, cues, advance organizers		
O'Brien (2005)	Effective instructional strategies				Teacher oriented strategies			Student-oriented strategies			
Ray (2005)	Encouragement of student-centered instruction		Encouragement of student collaboration		Encouragement of effective learning	Giving prompt feedbacks	Emphasizing on-time duties		Create high expectations	Supporting implicit learning	
Huang (2006)	Brain-based strategies					Affective domain group			Physico-motor domain group		
	Whole brain str.	Left brain str.	Right brain str.	Metacognitive str.	Security and trust str.	Attention str.	Social-interaction str.	Physical environment str.			
Killen (2007)	Direct instruction str.	Discussion str.	Small group discussions str.	Cooperative instruction str.	Problem-solving str.	Inquiry str.	Role playing str.	Case studies	Writing str.		
Bazan (2007)	Student directed str.				Teacher directed str.			Without instruction design str.			
Edvantia (2005)	Macro strategies				Micro-strategies						
Eri yi & Akdeniz (2012)	Metacognition		Active student engagement			Higher order thinking		Cooperative learning		Independent practice/homework	
	Focus strategies					Process strategies					
	Instructor oriented str.	Learner-oriented str.	Problem solving-case studies str.	Discussion, brainstorming str.	Modeling, simulation, role playing str.	Thinking, criticize, comment str.	Presentation str.	Question - answer str.	Writing, summarizing, taking notes str.	Project, investigation str.	

Adapted from Saskatchewan Education (1985, 1991), Merrill (1987), Edvantia (2005), Sedgwick (1999), Marzano (2003), Killen (2007), Ray (2005), Huang (2006), Bazan (2007), Erişti and Akdeniz (2012)

When the examine the related literature we can see that in some researches each of methods, techniques, tactics and activities applied in the instructional process is considered and explained as an instructional strategy. In this way, a lot of instructional strategies have been developed (Table 2.2).

In some researchs, instructional strategies are connected with instructional models. According to this approach, strategies can be collected in three groups: presentation, inquiry, and discovery. In another approach, the strategies are collected according to the interlocutor. Some of them are teacher-centered strategies, student-centered strategies, process-based strategies; learner-oriented instruction, teacher-oriented instruction, instruction excluded design, etc.

In some new taxonomies, that we will examine them in popular taxonomies, instructional strategies are connected with brain-based learning rules. In this topic, another taxonomy collects the strategies in five groups: strategies for experimental, indirect instruction, direct instruction, interactive instruction, independent study/individual instruction. Last of all, due to the variety of classifications made, it is quite difficult to say that there is an agreement on this subject in the literature.

In this section, we're going to examine taxonomies of the instructional strategies in four categories by some criteria: traditional taxonomies, popular taxonomies, cross-disciplinary taxonomies, activity based taxonomies. In the following sections, firstly we will examine some known taxonomies widely and then others will be summarized.

2.2.1 *Traditional Taxonomies*

In this subsection, strategies are grouped into four categories: instruction through presentation, instruction through discovery, instruction through inquiry and investigation, and cooperative learning. These strategy groups generally associated with the instructional and learning models (Table 2.3).

Presentation strategies based on the Ausubel's Meaningful learning theory. The main concept of this category is meaningful learning instead of rote learning (memorizing the information). According to Ausubel, the most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity; instructional materials should attempt to integrate new material with previously presented information through comparisons and cross-referencing of new and old ideas. A major instructional mechanism proposed by Ausubel is the use of advance organizers:

These organizers are introduced in advance of learning itself, and are also presented at a higher level of abstraction, generality, and inclusiveness; and since the substantive content of a given organizer or series of organizers is selected on the basis of its suitability for explaining, integrating, and interrelating the material they precede, this strategy simultaneously satisfies the substantive as well as the programming criteria for enhancing the organization strength of cognitive structure. (Ausubel 1963, p. 81).

Meaningful learning has three phases: advance organizer, presentation of learning task or material and strengthening the cognitive organization. The main elements of the Meaningful learning as shown in Table 2.4.

Discovery strategies based on Bruner's Theory of development (Constructivism and Discovery learning). According to Bruner (1957), the outcome of cognitive development is thinking. The intelligent mind creates from experience "generic coding systems" that permit one to go beyond the data to new and possibly fruitful predictions.

The concept of discovery learning implies that a learner constructs his or her knowledge for themselves by discovering as opposed to being told about something. According to Bruner, the teacher should facilitate the learning process by developing lessons that provide the learner with the information they need without organizing it for them. This idea of discovery learning is often referred to as constructivism, which emphasizes the active role of the learner in building understanding and making sense of information (Bruner 1960).

Bruner emphasized four characteristics of effective instruction which emerged from his theoretical constructs: (1) Personalized: instruction should relate to learners' predisposition, and facilitate interest toward learning, (2) Content Structure: content should be structured so it can be most easily grasped by the learner, (3) Sequencing: Sequencing is an important aspect of the presentation of material and (4) Reinforcement: rewards and punishment should be selected and placed appropriately.

A sample discovery includes nine stages:

Table 2.3 Traditional taxonomies

Strategy	Related theory and theorists	Key points	Eligible methods and techniques
Presentation strategies	Based on D. Ausubel's Learning Theory	<ul style="list-style-type: none"> • Teacher-centered • Deductive reasoning • Informative instruction • Abstract to concrete • Preprocessing information • Acquisition 	The workshop, question and answer, lecture, case study, discussion, brainstorming, demonstration, etc.
Discovery strategies	Based on J. Bruner and J. Piaget	<ul style="list-style-type: none"> • Learner-centered • Inductive reasoning • Comprehensive instruction • Concrete to abstract • Reinforcements and samples • Discovery 	Brainstorming, role playing, question & answer, discussion, debate, drama, analogy, case study, etc.
Inquiry strategies	Based on Suchmann and J. Dewey	<ul style="list-style-type: none"> • Learner-centered • Deductive and inductive reasoning • Higher-order thinking • Experiential • Problem-solving • Analysis, synthesis, evaluation, reflection, creation 	Trip, observation, individual study, experiment, lab, case study, problem-solving, etc.
Cooperative/Collaborative strategies	Based on L. Vygotsky	<ul style="list-style-type: none"> • Learner-centered • Group studies/social interaction • Work sharing • Democratic values • Problem-solving and case studies • Analysis, synthesis, evaluation 	Student Teams-Achievement Division (STAD), Problem solving, case study, inquiry, Learning Together, Think-Pair-Share, Group Investigation investigation, teams-game-tournament, Cooperative Integrated Reading and Composition (CIRC), jigsaw, etc.

Table 2.4 Ausubel's model of meaningful learning

Phase one: advance organizer	Phase two: presentation of learning task or material	Phase three: strengthening cognitive organization
Clarify aim of the lesson	Make the organization of the new material explicit	Relate new information to advance organizer
Present the organizer	Make logical order of learning material explicit	Promote active reception learning
Relate organizer to students' knowledge	Present material and engage students in meaningful learning activities	

1. Teacher gives examples
2. Students describe the examples
3. Teacher adds new examples
4. Students describe new examples and compare them previous ones
5. Teacher gives some more cases and non-cases examples
6. Students compare opposite examples
7. Teacher emphasizes relations, rules or features created by students
8. Students explain the relations, rules, and features
9. Teacher asks for some more examples from students

Inquiry strategies mainly based on Suchman's and Dewey's studies. Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas, and observations at the center of the learning experience. Educators play an active role throughout the process by establishing a culture where ideas are respectfully challenged, tested, redefined and viewed as improvable, moving children from a position of wondering to a position of enacted understanding and further questioning. Underlying this approach is the idea that both educators and students share responsibility for learning (Scardamalia 2002).

Dictionary meaning of Inquiry is seeking knowledge, information, or truth through questioning. The inquiry process is mainly the gathering of data and information and applying them to senses like smelling, tasting, touching, hearing and seeing. There are four essential elements on which inquiry-based learning depends on, which are, first is that the patterns and meanings should not be deceptive to the beginners, second is that the useful knowledge about a field should be structured, third is that the knowledge which is structured should be applicable, transferable, and accessible to a vast range of situations, fourth is that the structured knowledge should be easily retrieved so that new information in that particular field could be gained without much effort. Inquiry-based learning can be applied to all disciplines which have been confirmed by different researchers. Learners have different perspectives of viewing the world like economic, historical, scientific, artistic, etc. The disciplines can be interrelated through inquiry-based learning, which ensures the integrity of different disciplines and the world views about them. The teachers must organize their lesson plans according to the changing, interrelating, and communicating of knowledge. A good teacher's worksheet enables the

student to increase its study skills by providing different ways of viewing the world, communicating with it, and successfully introducing new questions and issues of daily life and finding answers to them. Questioning and finding answers is an extremely important factor of inquiry-based learning as it aids you in effectively generating knowledge. In the end, inquiry-based learning is teaching the students to have a greater understanding of the world they work, communicate, learn, and live in (teach-nology.com).

A sample inquiry may include six stages:

1. Feel the problem and confront it
2. Describing the problem and making it clear
3. Collecting related data and making hypothesis
4. Finding appropriate methods and collecting substantiating data
5. Testing hypothesis through analysing data and evidence
6. Reporting results

Cooperative learning is a form of small group instruction where students work in a social setting to solve problems (Slavin 1991). While the essence of cooperative learning is easily understood. Theorists are less in agreement as to what constitutes cooperative learning. The cooperative learning experience has five factors: positive interdependence, face-to-face interaction, individual accountability, small group and interpersonal skills, and group self-evaluation. Positive interdependence is achieved when each group member comes to understand and value the need for group cooperation in the attainment of their own personal goals, the other group member's goals, and the goals of the entire group. Interdependence may take several forms including goal interdependence, task or labour interdependence, resource interdependence, role interdependence, or reward interdependence. Face-to-face interactions work in conjunction with positive interdependence. Face-to-face interactions involve individual group members encouraging and facilitating other group members' efforts to complete tasks and achieve to have successful group goals. Individual accountability involves holding each student accountable for mastering the relevant material. It involves both completing one's task within the group, and supporting the work of other group members (Doolittle 1995).

The fourth basic element of cooperative learning requires and teaches students how to use interpersonal and small group social skills. The social skills that are necessary for a student to perform competently in a small group are taught directly during cooperative learning. Simple small group social skills such as staying with one's group, speaking in a low conversational voice, trusting other group members, managing intragroup conflict, and the sharing of leadership responsibilities usually require specific and direct attention by the teacher. The purpose of group self-evaluation is to clarify and improve the productiveness of all group members in contributing to the cooperative efforts of achieving the group's goals. Group self-evaluation provides for a type of group metacognition, a process of evaluating the group's processing. Group self-evaluation should result in describing what

group member actions were beneficial and detrimental, and what group member actions should be continued or changed (Johnson and Johnson 1998; Johnson et al. 1991; Kagan 1994 in Doolittle 1995).

2.2.2 Popular Taxonomies

In this section, we have put together the taxonomies based on some properties. Here, we selected the most commonly encountered strategy classifications in related literature. Among them, we may count Saskatchewan Education's quintet classification, a sestet classification based on Bloom's taxonomy, Huang's brain-based classification, Ray's web-based classification and others. Besides some other classifications summarized in "other classifications" section. Readers can be found further sources about instructional strategies in Bibliography section.

2.2.2.1 Saskatchewan Education Taxonomy

This classification is the most common and the most used one in the related literature. In this taxonomy, instructional strategies are collected in five groups: direct instruction, indirect instruction, interactive instruction, independent study and experiential learning.

According to Saskatchewan Education (1991), decision making regarding instructional strategies requires teachers to focus on curriculum, the prior experiences, and knowledge of students, learner interests, student learning styles, and the developmental levels of the learner. Such decision making relies on ongoing student assessment that is linked to learning objectives and processes. Although instructional strategies can be categorized, the distinctions are not always clear-cut. For example, a teacher may provide information through the lecture method (from the direct instruction strategy) while using an interpretive method to ask students to determine the significance of the information that was presented (from the indirect instruction strategy).

According to Saskatchewan Education (1985, 1991), instructional strategies refer to individual and specialized fields. These fields named five different instructional strategies: Direct instruction, indirect instruction, interactive instruction, independent study and experiential instruction. There is a hierarchical link between teaching models and instructional strategies. To this link; instructional methods and techniques determined by instructional strategies. These activities will be changed by selected strategy. For example; if you execute the instructional process according to direct instruction, you use, lecture, exercises, comparisons, demonstration, and if you execute the process according to indirect instruction, then you use, problem-solving, concept mapping, reflective discussions, etc.

The Direct instruction strategy is highly teacher-directed and is among the most commonly used. This strategy includes methods such as lecture, didactic questioning, explicit teaching, practice and drill, and demonstrations. The direct instruction strategy is effective for providing information or developing step-by-step skills. This strategy also works well for introducing other teaching methods, or actively involving students in knowledge construction. *Indirect instruction* is mainly student-centered, and examples of indirect instruction methods include reflective discussion, concept formation, concept attainment, cloze procedure, problem-solving, and guided inquiry. Indirect instruction seeks a high level of student involvement in observing, investigating, drawing inferences from data, or forming hypotheses. It takes advantage of students' interest and curiosity, often encouraging them to generate alternatives or solve problems. *Interactive instruction* relies heavily on discussion and sharing among participants. Students can learn from peers and teachers to develop social skills and abilities, to organize their thoughts, and to develop rational arguments. The interactive instruction strategy allows for a range of groupings and interactive methods. These may include total class discussions, small group discussions or projects, or student pairs or triads working on assignments together.

Experiential learning is inductive, learner-centered, and activity oriented. Personalized reflection about an experience and the formulation of plans to apply learnings to other contexts are critical factors in effective experiential learning. Experiential learning can be viewed as a cycle consisting of five phases, all of which are necessary: experiencing (an activity occurs); sharing or publishing (reactions and observations are shared); analyzing or processing (patterns and dynamics are determined); inferring or generalizing (principles are derived); and applying (plans are made to use learnings in new situations). *Independent study* encourages students to take responsibility for planning and pacing their learning. Independent study can be used in conjunction with other methods, or it can be used as the single instructional strategy for an entire unit. The factors of student maturity and independence are obviously important to the teacher's planning. Independent study is very flexible. It can be used as the major instructional strategy with the whole class, in combination with other strategies, or it can be used with one or more individuals while another strategy is used with the rest of the class (Saskatchewan Education 1985, 1991).

2.2.2.2 Strategies from Bloom's Taxonomy

Anderson and Krathwohl (2001) have proposed some minor changes to include the renaming and reordering of the Bloom's taxonomy. Revised taxonomy includes instructional strategies of each stage. Strategies are presented Table 2.5.

Table 2.5 Strategies from Bloom's taxonomy

Stage	Explanation	Instructional strategies
Remember (knowledge)	Shallow processing: drawing out factual answers, testing recall and recognition	Highlighting, rehearsal, memorizing, mnemonics
Understand (comprehension)	Translating, interpreting and extrapolating	Key examples, emphasize connections, elaborate concepts, summarize, paraphrase, students explain, students state the rule, creating visual representations: concept maps, outlines, flow charts organizers, analogies, pro/congrids, metaphors, rubrics, heuristics
Apply	Knowing when to apply; why to apply; and recognizing patterns of transfer to situations that are new, unfamiliar or have a new slant for students	Modeling, cognitive apprenticeships, mindful practice, part and whole sequencing, authentic situations, coached practice, case studies, Simulations, algorithms
Analyze	Breaking down into parts, forms	Models of thinking, challenging assumptions, retrospective analysis, reflection through journaling, debates, discussions and other collaborating learning activities, decision-making situations
Evaluate	According to some set of criteria, and state why	Challenging assumptions, journaling, debates, discussions and other collaborating learning activities, decision-making situations
Create (synthesis)	Combining elements into a pattern not clearly there before	Modeling, challenging assumptions, reflection through journaling, debates, discussions and other collaborating learning activities, design, decision-making situations

Adapted from Anderson et al. (2001)

2.2.2.3 Other Classifications

It is possible to reach various classifications have been developed for relevant areas in the instructional strategies. Some strategies will summarize here in the various aspects to give you an idea.

2.2.3 Cross-Discipliner Taxonomies

Cross-disciplinary taxonomies address the strategies in different disciplines, like; personality and instruction, neuroscience and instruction, etc. In this subsection, we're going to examine the relationship between instructional strategies and personality and neuroscience disciplines (Table 2.6).

2.2.3.1 Personality and Instruction

A lot research findings show that (including author's studies) there is a strong relationship between success of instruction process (learning and teaching) and personality (Ehrman 1989; Cano and Garton 1994; Bloom 1956; Silver et al. 1996; Moore 2000; Rushton et al. 2007). Myers and Briggs conducted some studies on personality based on Jung's (1971) widely accepted the classification of personality types, stated that teachers with different personality types follow different ways in instructional and learning processes and have different preferences.

According to some personality researchers (Myers, Briggs, Silver, Strong, Hanson, Perini, and others), instructional strategies in the process may vary to the personality. In Table 2.7 (from Chap. 14), A wide relationship among some educational and instructional variables and personality types (in another saying, learner types, and teacher types) is presented.

2.2.3.2 Neuroscience and Instruction: Brain-Based Taxonomy

The brain-based approach to learning and teaching developed by researchers and educators enhance the role of the teacher as a facilitator of learning. The brain-based approach is an approach that mainly focuses on the learner's learning processes. This approach deemed the brain-based teaching strategy approach, is based on brain research theory (Huang 2006).

Table 2.6 Some instructional strategy classifications

Author	Specifications		
O'Brien, 2005	Effective Strategies, Student-based Strategies, Teacher-based Strategies		
Binkley, 2005	Class Management	Teaching/Learning Activities	Evaluation
	Traditional Strategies		Constructive Strategies
Merrill, 1987	Arrangement, Message, Orientation.		
Bazan, 2007	Teacher-directed, Student-directed, Non-designed		
DeVito, 2008	Student-centered activities, individualized instruction, teaching style based instruction, helping students to meet needs, creating classroom climate, creating unattended learning environment, and individual development		

Table 2.7 The relationship of the personality types and instructional variables

Variables	Personality types			
	ST	NT	SF	NF
How can we organize teaching tasks?	Organize factual information, practice for recall	Create a problem-solving mode where students sort out data, analyze and draw conclusions	Provide for group work or a task that involves the effect	Provide choices for completing assignments and projects or assign task that involves imagination, innovation
How can we adjust settings?	Traditional rows or pairs; teacher at focus	Teams that will create a debating atmosphere; teacher moves from team to team	Groups or pairs for collaboration; teacher meets pupils at eye level	Learning centers, pupils arranged for interest, teacher is a resource
How can we give feedbacks?	Frequent, quick, short/need to know if they are right	Infrequent but with explanation of why they received the grade they did	Frequent, quick with an emphasis on the amount of effort that is evidenced	Infrequent but with emphasis on its value; its uniqueness and creativity
What kind of homework will we give?	Provide a model of what a complete and accurate assignment look like, practice and drill	Problem-solving, analyzing work; it too must be modeled	Opportunities for articulating ideas, learning from others, develop skills of collaboration designed to convince pupils they have knowledge	Projects or opportunities to create new or different ways of looking at material, important to set criteria
How do we do assessment and evaluation?	True and false, fill in the blanks, any measure that allows to pupils to recall factual material	Critical essays, debates, research projects which measure the ability to see relationships	Interviews in and out of class. Let the pupils question you	Anything that can show what the pupils can do with what they have learned
Teacher characteristics	Trainer, informative, director-conductor	Intellectual challenger, researcher, theorist	Educator, emphasize, supportive	Facilitator, modeler, creator
Learner characteristics	Realist, practical, focusing on events and real	Logic, intellectual, knowledge-based	Syphatic, interpersonal, friendly	Curious, insight owner, imaginative

(continued)

Table 2.7 (continued)

Variables	Personality types			
	ST	NT	SF	NF
Learning environment	Purposeful study organized or competitive	Discovery, inquiry, and interdependency	Personal intimacy, interaction, and cooperation	Originality, flexibility, imagination
What will we teach?	Basic skills, concept acquisition	Critical thinking, concept developing	Positive subject, socializing	Creative thinking, moral development
Which instructional strategies, methods, and techniques will we use?	Practices and drills, convergent thinking, demonstration, making portfolio, mastery fields, team-game-tournament, memorization	Information processing, inquiry, inductive reasoning, written reports, problem-solving, research, concept acquisition, concept formation, reading, and interpreting, asking socratic questions, comprehensive planning	Group projects, group research, individual sharing, oral reports, communication activities, peer to peer sharing, class meetings, peer learning, team-game-tournament	Imagination, divergent thinking, synectic, creative/artistic explanation, describing the values, data, and information collecting, breaking mental patterns, creative problem solving, inductive learning activities
How do we do assessment and evaluation?	True and false, fill in the blanks, any measure that allows to pupils to recall factual material, objective examinations, control lists, criteria tests, uncovering original skills	Critical essays, debates, research projects which measure the ability to see relationships, open-ended questions, essays, interpretation and synthesis activities, compositions	Interviews in and out of class, let the pupils question you, personal diaries, oral reports, rubrics, structured observations, self-assessment and self-evaluation	Anything that can show what the pupils can do with what they have learned, fluency practices, flexible responses, taking into account the details, developing creative products, observations, collecting unknown data

Adapted with Myers & Myers (1997), Silver and Hanson (1996), Silver et al. (2007), Akdeniz and Erİşti (2015)

In this active teaching approach, teacher and student always interact and involve themselves in learning activities. If a teacher has knowledge of how the brain develops, learns, and organizes itself, the teacher can make better decisions about teaching, and use each learning component well. For example, a teacher understands that fear or threat causes abnormally high levels of cortisol and adrenaline to be released, which decrease semantic learning and recall (Schmitz and Galbraith 1985; Jensen 2000). The teacher, therefore, creates an enriched and safe classroom atmosphere that students perceive as non-threatening, which aids their ability to think, plan, and remember. Moreover, understanding the students' abilities or skills, the teacher provides them with material just a little beyond their level. Providing students with real-life situations and experiences such as field trips can motivate students through increased interest and curiosity, which improves long-term retention of concepts (Jensen 2000). Real-life situations also enhance the learning of abstract concepts and help students view learning as a practical component of life and not just a classroom activity (Huang 2006).

In Huang's study, brain-based teaching strategies and techniques used identified cognitive domain, affective domain, psychomotor domain, and other instructional techniques.

Cognitive domain strategies include the whole brain, left the brain, right brain, and metacognitive strategies. Huang explains the whole brain, left brain and right brain strategies as follow:

A review of the literature indicates that both the left and right brain work together; they are activated to enhance learning. For example, in math class, the student uses the whole brain. The text and lecture presentation activate the left hemisphere, and pictures, graphs, and other visual material activate the right hemisphere. Caines and Crowel (1994), states that if cooperative learning incorporates the intellect and the emotions, it calls for spontaneous adaptations to the meaningful challenge. In class, a lesson can be arranged using different activities. First, all students participate in reading aloud and discussion, then they listen to a tape. Later, in small groups, students can choose their own way to do their projects for the lesson by reading from other books or searching on the Internet. At the end of the lesson, they can present information that appeals to either left or right brain students by writing, singing songs, role playing... (p. 38)

Left brain strategies;

In language arts or other academic subjects, teachers provide structure and clear direction to assignments; offer students the chance to work alone such as Internet searches or web quests; guide students to solve a problem by breaking it down into parts and solving it by steps; provide writing and reading aloud or oral drills in lesson plans; have students write an outline and a paper to describe their research findings as they connect it to their daily life; and allow time for students to think aloud in order to identify the main idea and to make inferences (p. 39).

Right brain strategies;

Students are engaged in group work in the classroom; provided choice and incorporate hands-on activities, i.e. role-playing; offered chances to work in groups; allowed to use intuition and to solve problems in holistic ways; allowed to do assignments in a more creative way. Teachers use graphic organizers to help students to remember and organize

details. In order to activate the right brain, teachers use humor, music, art, and dance in the classroom to focus attention and influence the growth of connections between brain cells in the cortex. Teachers use these strategies in class to assist students in learning the content and in meeting the objective of the lesson. In this way, students cannot only participate in left and right brain activities and connect their strengths, but also learn to work with their less-developed side. This also helps students to create meaningful in learning by creating different paths to learning the same content (p. 39).

According to Huang, Metacognitive strategies help students to learn and remember through outlining, rehearsing, and repeating. Metacognition can facilitate learning by controlling and directing thinking process. Some of the suggested strategies are *chunking, elaboration, mental images, organize information, repetition, and reflection*.

In affective domain Huang goes to say:

The mind is a complex mix of thoughts, perceptions, feelings, and reasoning. The studies of the effects of attitudes and emotions on learning indicate that continuous stress and constant fear can impede the brain's normal circuits. Sylwester (1994), Wolfe and Brandt (1998) and other researchers confirmed that emotions could contribute to long-term memory and higher-order thinking processes, which enhance the ability to think and learn effectively. Jensen (2000) and LeDoux (1996) point out that emotions activate and stimulate our amygdala, which is critical for recall and learning. Thus, teachers should establish a relaxed, stress-free learning environment, and connect learning activities to positive emotions (pp. 41–43).

Some of teaching strategies recommended to set-up an emotional environment to help students to learn are safe feeling and motivation strategies, attention strategies, social interaction strategies. Safe feeling and motivation group include; *predication, harmonious relationship, trust and acceptance, safe environment, control and choice, movement, experience and hands-on and, mastery* strategies. Attention group includes; novelty, need, emotion, and meaning components.

According to Huang, a physical environment that is visually stimulating and that is supportive of students' physical needs require thinking and planning. To create a positive atmosphere for learning, following strategic techniques can be useful; *order, color, music, light and plants, seating space, multi-cultural theme*.

2.2.4 Activity Based Taxonomies

So far, we examined the strategies in various ways. In this subsection, we will examine the use of strategies as effectiveness in the instruction process. In some sources the strategies are connected with particular objectives: strategies for creative writing, strategies for argumentation, strategies for observation, strategies for effective researching, strategies for collaboration and cooperative learning, etc.

At the end of this section, we'll look at some of the strategy groups and then we'll examine this book's activity based taxonomy and its approach to the handling of the strategies.

2.2.4.1 Marzano's Nine Instructional Strategies

Marzano (2003) collected strategies into nine groups: Identifying similarities and differences, summarizing and note taking, reinforcing effort and providing recognition, homework and practice, nonlinguistic representations such as mental images, graphs, acting out content, cooperative learning, setting objectives and providing feedback, generating and testing hypotheses, activating prior knowledge via questions, cues, advance organizers. Explanations of the strategies as follow:

1. Identifying Similarities and Differences: This strategy helps students understand more complex problems by analyzing them in a simpler way, and also Enhances students' understanding of and ability to use knowledge by engaging them in mental processes that involve identifying ways in which items are alike and different. Sample activities related to this strategy as follow:

- Use Venn diagrams or charts to compare and classify items.
- Engage students in comparing, classifying, and creating metaphors and analogies.

2. Summarizing and Note-taking: This strategy promotes comprehension because students have to analyze what is important and what is not important and put it in their own words. This strategy also Enhances students' ability to synthesize information and organize it in a way that captures the main ideas and supporting details. Sample activities related to this strategy as follow:

- Provide a set of rules for asking students to summarize a literary selection, a movie clip, a section of a textbook, etc.
- Provide a basic outline for note-taking, having students fill in pertinent information.

3. Reinforcing Effort and Providing Recognition: This strategy Enhances students' understanding of the relationship between effort and achievement by addressing students' attitudes and beliefs about learning. Showing the connection between effort and achievement helps students helps them see the importance of effort and allows them to change their beliefs to emphasize it more. Note that recognition is more effective if it is contingent on achieving some specified standard. Sample activities related to this strategy as follow:

- Provide students with abstract tokens of recognition or praise for their accomplishments related to the attainment of a goal.
- Share stories about people who succeeded by not giving up.
- Find ways to personalize recognition. Give awards for individual accomplishments.
- "Pause, Prompt, Praise." If a student is struggling, pause to discuss the problem, then prompt with specific suggestions to help her improve. If the student's performance improves, as a result, offer praise.

4. Homework and Practice: This strategy Extends the learning opportunities for students to practice, review, and apply knowledge and enhances students' ability to reach the expected level of proficiency for a skill or process. And also provides opportunities to extend learning outside the classroom, but should be assigned based on relevant grade level. All homework should have a purpose, and that purpose should be readily evident to the students. Additionally, feedback should be given for all homework assignments. Sample activities related to this strategy as follow:

- Establish a homework policy with a specific schedule and time parameters.
- Vary feedback methods to maximize its effectiveness.
- Focus practice and homework on difficult concepts.

5. Nonlinguistic Representations: This strategy Enhances students' ability to represent and elaborate on knowledge using mental images. Sample activities related to this strategy as follow:

- Incorporate words and images using symbols to represent relationships.
- Use physical models and physical movement to represent information.

6. Cooperative Learning: This strategy Provides students with opportunities to interact with one another in ways that enhance their learning. Organizing students into cooperative groups yields a positive effect on overall learning. When applying cooperative learning strategies, keep groups small and don't overuse this strategy be systematic and consistent in your approach. Sample activities related to this strategy as follow:

- Group students according to factors such as common interests or experiences.
- Vary group sizes and mixes.
- Focus on positive interdependence, social skills, face-to-face interaction, and individual and group accountability.

7. Setting Objectives and Providing Feedback: this strategy provides students with a direction for learning and with information about how well they are performing about a particular learning objective so they can improve their performance. Setting objectives can provide students with a direction for their learning. Goals should not be too specific; they should be easily adaptable to students' own objectives. Sample activities related to this strategy as follow:

- Set a core goal for a unit, and then encourage students to personalize that goal by identifying areas of interest to them. Questions like "I want to know" and "I want to know more about..." get students thinking about their interests and actively involved in the goal-setting process.
- Use contracts to outline the specific goals that students must attain and the grade they will receive if they meet those goals.
- Make sure feedback is corrective in nature; tell students how they did in relation to specific levels of knowledge. Rubrics are a great way to do this.

8. Generating and Testing Hypotheses: This strategy enhances students' understanding of and ability to use knowledge by engaging them in mental processes that involve making and testing hypotheses. Research shows that a deductive approach works best, but both inductive and deductive reasoning can help students understand and relate to the material. Sample activities related to this strategy as follow:

- Ask students to predict what would happen if an aspect of a familiar system, such as the government or transportation, were changed.
- Ask students to build something using limited resources. This task generates questions and hypotheses about what may or may not work.

9. Cues, Questions, and Advanced Organizers: This strategy helps students use what they already know to enhance what they are about to learn and also enhances students' ability to retrieve, use, and organize what they already know about a topic. Sample activities related to this strategy as follow:

- Pause briefly after asking a question to give students time to answer with more depth.
- Vary the style of advance organizer used: Tell a story, skim a text, or create a graphic image. There are many ways to expose students to information before they "learn" it (Marzano 2001).

2.2.4.2 Consulting Psychologist Press's Strategies

In the form of "Teacher Observation Protocol and instructional strategies" developed by CPP, observation subjects are gathered in ten groups: Habits of mind, Metacognition (Students' thinking about their thinking), Student discourse and collaboration, Rigorously challenged ideas, Student preconceptions and misconceptions, Conceptual thinking, Divergent thinking, Interdisciplinary connections, Pedagogical content knowledge, and Multiple representations of concepts. This instrument is included here in order to give an idea to the reader about in-class instructional strategies (Table 2.8).

2.2.4.3 Explicit Teaching Strategies for Scientific Argumentation

"Explicit teaching strategies for scientific argumentation", developed by Park, Young-Shin, for his doctoral dissertation. We will present Explicit Teaching Strategies from her dissertation. The form (Table 2.9) displays Mr. Field's explicit teaching strategies with the name of each instructional strategy and a description of its implementation in the classroom.

Table 2.8 Teacher observation protocol and instructional strategies^a

Activity	Focus	Teacher activity N/O: 1 2 3 4	Student activity N/O: 1 2 3 4
Encouraging the students to seek and value various modes of investigation or problem-solving	Habits of mind	<ul style="list-style-type: none"> • Presented open-ended questions • Encouraged discussion of alternative explanations • Presented inquiry opportunities for students • Provided alternative learning strategies 	<ul style="list-style-type: none"> • Discussed problem-solving strategies • Posted questions and relevant means for investigating • Shared ideas about investigations
Encouraging the students to be reflective about their learning	Metacognition (Students' thinking about their thinking)	<ul style="list-style-type: none"> • Encourage students to explain their understanding of concepts • Encourage students to explain in own words both what and how they learned • Routinely asked for student input and questions 	<ul style="list-style-type: none"> • Discussed what they understood from the class and how they learned it • Identified anything unclear to them • Reflected on and evaluated their own progress toward understanding
Interactions reflected collaborative working relationship and productive discourse among students and between teacher and students	Student discourse and collaboration	<ul style="list-style-type: none"> • Organized students for group work • Interacted with small groups • Provided clear outcomes for group 	<ul style="list-style-type: none"> • Worked collaboratively or cooperatively to accomplish work relevant to task • Exchanged ideas related to lesson with peers and teachers
Intellectual rigor, constructive criticism, and the challenging of ideas were valued	Rigorously challenged ideas	<ul style="list-style-type: none"> • Encouraged input and challenged students' ideas • Wan non-judgmental of student opinions • Solicited alternative explanations 	<ul style="list-style-type: none"> • Provided evidence-based arguments • Listened critically to others' explanations • Discussed/challenged others' explanations

(continued)

Table 2.8 (continued)

Activity	Focus	Teacher activity N/O: 1 2 3 4	Student activity N/O: 1 2 3 4
The instructional strategies and activities probed students' existing knowledge and preconceptions	Student preconceptions and misconceptions	<ul style="list-style-type: none"> • Pre-assessed students for their thinking and knowledge • Helped students confront and/or build on their ideas • Refocused lesson based on student ideas to meet needs 	<ul style="list-style-type: none"> • Expressed ideas even when incorrect or different from the ideas of other students • Responded to the ideas of other students
The lesson promoted strongly coherent conceptual understanding in the context of clear learning goals	Conceptual thinking	<ul style="list-style-type: none"> • Asked higher level questions • Encouraged students to extend concepts and skills • Related integral ideas to broader concepts 	<ul style="list-style-type: none"> • Asked and answered higher level questions • Related subordinate ideas to broader concept
Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence	Divergent thinking	<ul style="list-style-type: none"> • Accepted multiple responses to problem-solving situations • Provided example evidence for student interpretation • Encourage students to challenge the text as well as each other 	<ul style="list-style-type: none"> • Generated conjectures and alternate interpretations • Critiqued alternate solution strategies of teacher and peers
Appropriate connections were made between contending and other curricular areas	Interdisciplinary connections	<ul style="list-style-type: none"> • Integrated contents with other curricular areas • Applied content to real-world situations 	<ul style="list-style-type: none"> • Made connections with other content areas • Made connections between content and personal life
Teacher had a solid grasp of the subject matter content and how to teach it	Pedagogical content knowledge	<ul style="list-style-type: none"> • Presented information that was accurate and appropriate to student cognitive level • Selected strategies that made content understandable to students • Was able to field student questions in a way that encouraged more questions • Recognized students' ideas even when vaguely articulated 	<ul style="list-style-type: none"> • Responded to instruction with ideas relevant to target content • Appeared to be engaged with lesson content

(continued)

Table 2.8 (continued)

Activity	Focus	Teacher activity N/O: 1 2 3 4	Student activity N/O: 1 2 3 4
Teacher used a variety of means to represent concepts	Multiple representations of concepts	<ul style="list-style-type: none"> • Used multiple methods, strategies, and teaching styles to explain a concept • Used various materials to foster student understanding (models, drawings, graphs, concrete materials, manipulative, etc.) 	

Adopted from Park (2005), Analyzing explicit teaching strategies and student discourse for scientific argumentation (p. 239, 240)

^aLike this protocol, there are some other “teacher observation protocols” in the literature. One of the best is Marzano, Carbaugh, Rutherford, and Toth (2014), *Marzano Center Teacher Observational Protocol for The 2014 Marzano Teacher Evaluation Model. Updated observation protocol is designed to meet rigorous standards, including CCSS, for deep implementation across subjects and grade levels. Please refer to this source for further information* <http://www.marzanoocenter.com/Teacher-Evaluation-2014-Model.pdf>

Table 2.9 Mr. Field’s explicit teaching strategies for scientific argumentation

Teacher actions		Framework	Classroom observations
Develop ideas for open-ended question	Differentiate dependent from independent variables	Daily science	In this section, Mr. Field provided chances for students to express their different ideas every day at the beginning of the lesson. The content of Daily Science included subject matter in asking the conceptual knowledge and scientific inquiry to assess students’ procedural skills
Develop the claim and hypothesis		Claim-evidence approach	In this section, Students are given chances to develop their own claims and hypotheses based on general principles from the textbook. Students predict the results to explain what would happen and why it would happen. Students develop their background information with Mr. Field through reading and discussing some topics related to the content
Predict, observe and explain		Explicit reflective assessment (inquiry guideline)	In this section, Mr. Field emphasizes students’ opportunity to reflect on what they have done in their experiments, such as if their data gave support to answer the questions if their conclusions were based on their collected data, and if their claims of hypotheses reflected on their content. Mr. Field uses the self-designed Inquiry Guideline for this purpose
Provide two competing issues			
Construct argument (warrant)			
Reflect on investigation as a holistic way	Find the pattern from the data	Johns Hopkins learning model	In this section, Mr. Field uses this model to assign students into new groups with specific students’ roles in each
Find limitation in experimentation			
Assign students’ roles in groups	Discuss the current scientific issue	Wednesday’s oregonian	In this section, Mr. Field discusses the current scientific topic from the local newspaper with the emphasis on students’ skills or interpreting scientific symbols and gaining extended knowledge. These whole class discussions are supposed to take place every Wednesday
Differentiate evidence from data		Scoring guide	In this section, Mr. Field discusses Oregon Scoring Guide with students so that they could understand how their lab reports are assessed based on what criteria
Differentiate higher order thinking from lower		Bloom’s taxonomy	In this section, Mr. Field discusses Bloom’s Taxonomy so that students could understand what higher-order thinking and lower thinking is

Adopted from Park (2005), Analyzing explicit teaching strategies and student discourse for scientific argumentation (p. 131, 132)

2.2.4.4 Some Other Classifications

In some other instructional strategy approaches; some instructional methods, techniques, and tactics have been accepted as instructional strategies, like; Berg's English learning strategies (2005); Differentiated instruction strategies Gregory and Chapman (2002); Tomlinson (1995a, b, 1999), and others (Table 2.10).

2.2.4.5 Beristi and Akdeniz's Focus and Process Instructional Strategies Classification

The information contained herein has been added to the section with the permission of Erişti and Akdeniz (2012).

According to them, instructional strategies are supposed to meet certain criteria to consider them within a scientific systematicity. It may be better to regard applications failing to meet these criteria not as instructional strategies but as methods, techniques, and tactics in line with their pattern. They created some basic criteria created depending on the review of the related literature constitute the basis for the classification of instructional strategies developed in their study. These criteria are as follows:

Table 2.10 Some other activity-based instructional strategy classifications

Author	Specifications
Ray (2005); Web-based teaching strategies based on Seven Principles for Good Practice (Chickering and Gamson 1987)	Encourages contact between students and faculty, develops reciprocity and cooperation among students, encourages active learning, gives prompt feedback, emphasizes time on task, communicates high expectations, respects diverse talents and ways of learning
Merrill (1983, 1994)	Component display theory: presentation (tell), demonstration (show), recall (ask), and apply (do). For kinds of content the presentation tells a definition (information); the demonstration shows an example (portrayal); the recall is remembering the definition (information), and the application is classifying a new example (portrayal)
Joyce et al. (2014)	Social, information processing, personal and behavioral systems. Social strategies include cooperative learning, peer tutoring, project-based learning, reciprocal teaching. Information processing strategies include concept formation, inquiry learning, and synectics. Personal strategies include individualized instruction and nondirective teaching. Behavioral system strategies include mastery learning, direct instruction, computer-assisted instruction

1. Strategies should be able to explain how information will be processed;
2. Strategies should be able to be associated with instructional models;
3. Strategies should be able to explain how the instructional process will be applied (Erişti and Akdeniz 2012; adapted with permission).

They have identified three basic questions to assess their teaching strategies: How is information obtained/created/taught?; How is information obtained/created/taught?; Based on which instructional models are strategies developed?

Let's see their explanations.

How is information obtained/created/taught? Another possible grouping of strategies focuses on teaching and obtaining/gaining/creating the information. In this respect, two dimensions appear. The first dimension focuses on the question of how is information taught? While in the second dimension, the question of how is information obtained/gained/created is important. The literature acknowledges the constructivist and behaviorist theories as a response to these two questions. According to the behaviorist theory, information exists, and the learner obtains information in various ways, or the information in question is taught to the learner in a planned way. According to the constructivist theory, information is not refined, and the learner processes, shapes and constructs it depending on his or her internal processes. In this way, the learner internalizes the information and transforms it into permanent knowledge.

How is the instructional process operated? Do classifications seek an answer to the question of how is the instructional process operated? Examine instructional strategies under two dimensions: (1) Learner-focused/student-oriented strategies, and (2) instructor-focused/teacher-oriented strategies. When the instructional process is executed on the learner-focused basis, the instructional activities are planned and carried out mostly in line with the learners' interests, needs, skills, learning pace, and their other characteristics. However, when the process is executed on the instructor-focused basis, the instructional activities are carried out based on the instructor's individual characteristics and preferences and in the ways determined in the curriculum and teaching plans.

Based on which instructional models are strategies developed? Instructional strategies could be gathered into four groups, though more in number, depending on the instructional models that could act as a source for them. These are information processing, behaviorist, individual, and social strategies. Behaviorist strategies are designed to develop learners' basic knowledge and skills. Information processing strategies mostly aim at organizing the process of learners' obtaining and using the information. Social strategies try to strengthen the consciousness of community and to facilitate learning via social skills. As for the individual strategies, they mostly emphasize awareness and reinforcement of personal development.

In their study, instructional strategies are taken into consideration from a composite perspective involving the characteristics of the three groups previously mentioned. In this respect, instructional strategies are gathered into two groups: *the focus* and *the process*.

The classification of instructional strategies formed divided strategies into two basic groups: Focus and Process strategies. Instructional strategies concern what an instructor sometimes does, how he or she achieves it and for what purpose he or she does so. In this respect, in constructing the instructional process, how and for what purpose an instructor carries out the activities reveals to whom he or she bases the instructional process on or based on whom he or she executes the instructional process; in other words, which really constitutes the focus of the instructional process. The strategies revealing based on whom the instruction was made are called *focus strategies*. Focus strategies gather instructional strategies under two groups: instructor-focused and learner-focused. Instructor-focused instructional strategies refer to application and execution of basically teacher-oriented instructional activities during the instructional process. The learner-focused instructional strategies show that the instructional process has a learner-oriented structure and that instruction is designed in line with the learner's needs, interests, desires, and skills.

The responses were given to the question of “what and how did I teach?” to determine which of the components of the process and to what extent the instructor includes in the activities he or she carries out in the instructional process will point out the process strategies and the components of these strategies. In the grouping, the strategies revealing “how” the instruction is executed are called *process strategies*. Process strategies include eight basic instructional skills which the instructor applies and which can be classified as the knowledge and skills regarding teaching profession. These are Problem Solving-Sample Event, Discussion- Brainstorming, Modeling/Role Playing/Simulation, Making Pupils Think/Interrogate/Interpret, Presentation, Question-Answer, Making Write/Take Notes/Summarize, Research/Project.

2.3 Strategy Activities

In this section, we show some instructional activities and its clues that refer to theoretical basis and practical views. Activities based on the classification of instructional strategies created by Erişti and Akdeniz (2012; adapted with permission). Each activity sample has its clues and prompts. Activities divided into two sections: focus and process. Activities of the focus strategies are divided into two subsections: learner-focused and instructor-focused.

2.3.1 Focus Strategies

The strategies revealing based on whom the instruction was made are called focus strategies. Focus strategies contain learner—focused and instructor—focused strategies. The following section will provide application examples of instructional strategies based on activities (Tables 2.11 and 2.12).

Table 2.11 Learner-focused instruction activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Use peer learning + teaching activities! • Transform instructional practices to the games! • Give immediate feedbacks! • Encourage the pupils to cooperation as much as possible! • Keep group sizes small! • Support solidarity! 	<ol style="list-style-type: none"> 1. Benefiting from metaphors in the instructional process 2. Choosing real-life examples related to the learning context by taking the students' characteristics into consideration 3. Explaining instructional goals of the course to the students 4. In the instructional process, preferring to use cooperation and discussionskills effectively rather than teachingsimply 5. In the instructional process, establishing a relationship between the students' background knowledge and what they have just learnt 6. Helping students determine the contents of subjects for student independent studies 7. Encouraging students to direct more questions and to state their views 8. Having students discuss the problem-solving strategies they apply in the learning process 9. Having students make their learning preferences on the basis of their interests in the subject being taught

2.3.2 Process Strategies

The strategies are revealing “how” the instruction is executed are called process strategies.

There are a number of learning skills connected with process strategies. Some of them are: explains, solves, shows, thinks, transfers, gives examples, explains, makes statements, makes comments, develops proposals, solves problems, asks questions, answers questions, finds, plays a role, develops projects, explores, reveals product and improves it. In this category we have eight group of instructional strategies: problem solving-sample event, discussion-brainstorming, modeling/role playing/simulation, making pupils think/interrogate/interpret, presentation, question-answer, making write/take notes/summarize, research/project. Below, will provide application examples of instructional strategies based on activities (Tables 2.13, 2.14, 2.15, 2.16, 2.17, 2.18, 2.19 and 2.20).

Table 2.12 Instructor-focused instruction activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Be a facilitator! • Make a positive class climate! • Take into account of your personality! • Control amount of the information! 	<ol style="list-style-type: none"> 1. Teaching by considering all the students in the class and their individual differences 2. Assigning the same duties and responsibilities to the students in class regarding the content of instruction 3. Correcting the deficiencies and mistakes in students' products 4. Having students take notes regarding the subject during the lesson 5. Having the whole class acquire all the gains envisaged in the curriculum

Table 2.13 Problem solving and sample event activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Focus the real life issues! • Break down the problem into smaller pieces! • Come up with more than one solution! • Simplify the issues! • Focus on core event! • Improve intrinsic motivation! • Take complete responsibility! 	<ol style="list-style-type: none"> 1. Regarding a specified problem, having students discover the basic causes of that problem 2. Having students obtain information from various sources regarding a problem they believe it exists 3. Having students provide suggestions for solutions to a certain problem in the light of the information they have obtained 4. Having students develop hypotheses regarding the solution to a specified problem, find evidence supporting the hypotheses and test these hypotheses 5. Having students share the solutions with teachers and other students in order to solve the current problem 6. Telling students sample events regarding the instructional context 7. Having students share daily-life examples related to the subject

Table 2.14 Discussion and brainstorming activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Always make the pupils well-prepared! • Make clear the border of discussion! • Use effective feedbacks! • Address distracting behaviors! • Make a safe zone! 	<ol style="list-style-type: none"> 1. Forming student discussion groups regarding the instructional context 2. Encouraging students to share their thoughts to help them reach broader concepts and generalizations 3. Encouraging students to put forward as many views as possible about the subject in the instructional process 4. Having students make evidence-based discussions 5. Having students discuss their views with each other

Table 2.15 Modeling and role playing and simulation activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Use sources effectively! • Choose the surviving-competitive materials! • Focus on details! • Encourage the pupils to make drafts! 	<ol style="list-style-type: none"> 1. Clothing as appropriate to the subject of the lesson and dramatizing the situation 2. Having students develop a role model regarding the subject students are interested in and having them present this role model in class 3. Having students develop a process model for laboratory studies and test the process model they have developed 4. Having students develop a solution model regarding a problem/subject as a result of their structured observations 5. Having students prepare an application plan covering the goal, content, instructional processes, measurement and evaluation criteria regarding the learning context

Table 2.16 Thinking and interrogating and interpretation activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Direct the pupils use both of hemispheres! • Engage the pupils to challenging situations! • Support individual experience! • Control environmental factors in class! • Constraints the pupils time to time! • Use compare and contrast activities! 	<ol style="list-style-type: none"> 1. Having students emphasize the unanticipated dimensions of a salient problem 2. Having students interrogate the strategies applied by the teacher and other students to solve a problem 3. Having students make predictions regarding a new situation and provide alternative related explanations 4. Encouraging students put forward their contrary views and challenge other students' views 5. Encouraging students use their imagination power and creativity regarding a subject 6. Helping students revise their views when their views are not in line with their knowledge or with their personal observations

Table 2.17 Presentation activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Take into account the attention limits! • Consider the technical environment! • Prepare yourself! • Control mediaand process! • Keep it simple! 	<ol style="list-style-type: none"> 1. Teaching a subject in an audio/visual way to students by using various instructional materials 2. Having students present their subject-related studies to the teacher and other students 3. Supporting students' story-development and story-telling studies 4. Having students read the subject-related sources from a critical perspective and share the results they have obtained with other students 5. Having students provide additional information about the subject and elaborate the information they present 6. Teaching the subject to students non-verbally by using appropriate instructional materials

Table 2.18 Question and answer activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Bring into play the questions of WH! • Encourage the pupils to ask compelling questions! • Make the questions and answers are clear! 	<ol style="list-style-type: none"> 1. Encouraging students to direct appropriate questions to each other 2. Randomly choosing the students to ask questions during the lesson 3. Having students wait for a while before they direct consecutive questions 4. Asking open-ended/unfinished questions to students 5. Having students prepare questions about a subject that interest students and provide answers to these questions 6. Having students ask the subject-related questions they have prepared to each other and provide answers to these questions

Table 2.19 Making write and taking notes and summarize activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Avoid stereotype habits! • Encourage the pupils to summarize! • Encourage the pupils to write every single day! • Encourage the pupils to emulate the syntactic structure of famous writers! 	<ol style="list-style-type: none"> 1. Having students write down an original essay regarding how to solve a problem 2. Having students write down an article/essay about a subject they have determined and evaluate this product according to the writing criteria 3. Having students form an original process map that shows the teaching phases of a subject 4. Having students form graphical organizers related to the subject (mind, knowledge and concept maps) 5. Having students take notes regarding the important points of the subject being taught and create remindful signs

Table 2.20 Project and research activities

Tips	Activities
For effective instruction <ul style="list-style-type: none"> • Focus the pupils to make good proposals! • Encourage group projects! • Encourage the pupils to write a well-prepared study plan! • Advice the pupils being careful about appraisal, assessment and evaluation processes! • Direct the pupils work step by step! 	<ol style="list-style-type: none"> 1. Having students prepare a project draft regarding a subject that interests' students 2. Having students apply and test the project draft they have prepared 3. Having students inform the teacher and other students about the results of a project they have applied 4. Sharing subject-related previous sample studies with students 5. Having students obtain information by examining various sources regarding a subject that they are interested in 6. Having students hold interviews regarding the subject they are investigating 7. Having students share the results of a study they have conducted with the teacher and other students 8. Having students make structured observations in designed or real-world environments regarding a certain research subject

2.4 Conclusion

In this chapter, the concept of instruction was examined. Definitions, conceptual frame, and its own nature were discussed. This chapter accepts the concept of instruction as a combination of teaching and learning processes. And formulate it as;

$$\text{Instruction} = \text{learning} + \text{teaching}$$

The second main concept of this chapter is an instructional strategy that comes from the teaching models. After describing instructional strategies detailed and clearly, strategy classifications were examined.

It's possible to say that there are various classifications of instructional strategies in the related literature. Some of these classifications were developed on the basis of an instructional model; some in line with instructional theories; and some were developed on the basis of instructional methods and techniques.

In the chapter, we addressed the strategy classifications in four categories: traditional, popular, cross-disciplinary, and activity-based. At least two examples were examined in detail, and some others summarized for each category.

At the end of the chapter, we presented this book's instructional strategy classification. The strategy classification and its philosophy explained in detail, and some practical tips were given for each group. According to the classification; instructional strategies collected into two groups: focus and process. Focus strategies refer to the center of the instruction process, and it puts the teachers and pupils in the center. The other groups, process strategies collect the instructional strategies into eight subgroups: problem-solving, sample-event, discussion-brainstorming, modeling/simulation/role taking, thinking/interrogating/interpreting, presentation, question-answer, writing-note taking-summarizing, and research-project.

Glossary

Activity	is a practical study, implemented as a part of the process that served concrete objectives (Şimşek 2011).
Adaptation	An equilibrium between the action of the organism on the environment (Piaget 1972).
Affective Domain	That area of learning devoted to developing attitudes, values, or appreciations (Morrison et al. 2001).

Alternative Assessment	An evaluation that applies to any and all assessments that differ from the multiple-choice, timed, one-shot approaches that characterize most standardized and many classroom assessments (Marzano et al. 1993).
Assessment	Assessment is the process of gathering data on student learning or the measurement of pre-determined criteria (Sherman 1999).
Attitude	A learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object (Fishbein and Ajzen 1975).
Authentic assessment	An evaluation that conveys the idea that assessments should engage students in applying knowledge and skills in the same way they are used in the world outside of the school setting (Marzano et al. 1993).
Behaviorism	Learning theory in which subject content is divided into a series of small steps; the learner participates actively, receives feedback on effort, and is guided to success (Morrison et al. 2001).
Behaviour	Observable actions that can be seen and counted (Moore 2000).
Classifying	The process of grouping things that are alike in categories on the basis of their characteristics (Marzano et al. 2001).
Cognitivism	Philosophical orientation based on the belief that people actively construct their knowledge of the world through experience and interaction rather than through behavioral conditioning (McNergney and McNergney 2009).
Collaborative Learning	“An instruction method in which students at various performance levels work together in small groups toward a common goal” (Gokhale 1995). A planned interaction working with other learners for a shared purpose.
Collaborative Teaching	The simultaneous presence of two or more educators in the general education classroom, jointly planning for, instruction and evaluating heterogeneous groups of students (Hourcade and Bauwens 2002).

Collaborative	Cooperative group activities that tap the social power of learning better than competitive and individualistic approaches (Daniels et al. 2001).
Comparing	The process of identifying similarities and differences between or among things or ideas (Marzano et al. 2001).
Constructivism	View of knowledge as constructed by individuals acting within a social context that molds knowledge but does not determine absolutely what constitutes knowledge (McNergney and McNergney 2009).
Creating Analogies	The process of identifying relationships between pairs of concepts, in other words, identifying relationships between relationships (Marzano et al. 2001).
Creating Metaphors	The process of identifying a general or basic pattern in a specific topic and then finding another topic that appears to be quite different but has the same general pattern (Marzano et al. 2001).
Curriculum	Courses constituting an area of specialization in the secondary educational institution (Canady and Retting 1996).
Demonstration	An action in which a trainer shows learners how to successfully perform a given task through illustration, explanation, and skill performance.
Differentiated Instruction	An approach to teaching in which teachers proactively modify curriculum and content, teaching methods and processes, resources, learning activities and student products to effectively address the diverse needs of individual students or groups to maximize learning opportunities.
Direct Instruction	The foundation for most instructional models, which includes six steps: review previously learned material, state the objectives for the lesson, present new material, provide guided practice with corrective feedback, assign independent practice with corrective feedback, and review both during and at the end of the lesson (Canady and Retting 1996).

Distributed Education	Often used to describe programs in which courses are taught online and collaboration and “virtual interaction” among students in the same course are encouraged (Connick 1999).
Diversity	The ethnic background of students. Learners who are different based on their age, race, class, gender, or handicap (Banks et al. 2001).
Effective Instruction	Instruction that enables students to acquire specified skills, knowledge, and attitudes, and which students enjoy (Reiser and Dick 1996).
Effective Teacher	The result of a combination of many factors, including aspects of the teacher’s background and way of interacting with others, as well as specific teaching practices (Stronge 2002).
Epistemology	Branch of philosophy concerned with the nature of knowledge or how we come to know things (McNergney and McNergney 2009).
Evaluation	The formal reporting about a system, practice, individual, or group and a performance grade within the report (Danielson and McGreal 2000). Evaluation is a decision made about a student at some temporal point based on data accumulated during assessments. As Sherman (1999) stated, based on the information received from assessment tools such as rating scales or rubrics, “The teacher’s judgments are translated from assessment to evaluation, from a measurement to a letter grade” (Bazan 2007).
Experiential Learning	A training strategy in which participants are active learners involved in the concepts of knowledge, activity, and reflection of information.
Explanation	Activities (lecture, review of previous materials, demonstration, board work, video clips, and reading assignments) currently observed in a traditional setting (Canady and Retting 1996).
Facilitator	A person assisting in needs identification and learning strategies for students (Knowles 1980).

Feedback	Providing the learner with answers to exercises and other information about progress in learning (Morrison et al. 2001).
Individualized Instruction	Instruction tailored to the individual abilities of students. Means of individualizing instruction include allowing each student to proceed through instruction at his or her own pace, providing different instructional materials for different students, and allowing different students to work on different objectives (Reiser and Dick 1996).
Inquiry Group	is a form of professional development where teachers meet in collaborative groups to discuss topics and issues within their practice and give and receive feedback on their practice as needed. Teachers are producers and decision makers of the knowledge received (Tillema and Imants 2005).
Inquiry Learning	Answering and solving problems by analyzing data and creating and testing theories and hypotheses to expand the conceptual system with which one processes information (McNergney and McNergney 2009).
Instructional Activities	The steps (events) that take place when the instruction is presented to students (Reiser and Dick 1996).
Instructional Models	Deliberate, explicit, complete plans for teaching that can be fitted to students and objectives (McNergney and McNergney 2009).
Instructional Objective	Statement is describing what the learner is specifically required to learn or accomplish relative to a topic or task (Morrison et al. 2001).
Instructional Strategy	The daily transactions that occur between teachers and students which lead to the attainment of the identified outcomes. These transactions should include multiple materials, techniques, and activities supported by modeling, intensive coaching, supervised practice, and monitoring.

Instruction	Planned action, practice, or procedures for teaching (Canady and Retting 1996).
Intelligence	Mental adaptation to new circumstances (Piaget 1972).
Interactive Group	is a form of professional development where teachers interact with each other and an outside trainer who chooses and presents information the trainer or other outside source deems important (Tillema and Imants 2005).
Journal	Written collections of students' reflections on learning (McNergney and McNergney 2009).
Knowledge	A type (or domain) of learning outcome that focuses on the ability to recall and state-specific information (Reiser and Dick 1996).
Learner-Centered Instruction	Learner-centered also known as student-centered activities are based on the interests, needs, and desires of the students. Students are given more control of how and what they learn (Knowles 1973).
Learning Centers	Situations designed to provide individuals or pairs of students the opportunity to practice skills extend knowledge and skills beyond those gained by the typical class, rehearse knowledge and skills before assessment, and practice skills that have not been mastered in an earlier assignment or activity (Canady and Retting 1996).
Learning	The assimilation of new information into the existing structure, and accommodating or modifying the existing structure to deal with the new information (Cohen and Younghee 1999).
Lecture	A popular training method in educational institutions where an instructor or trainer stands and delivers information to be learned. One of several direct instruction approaches, which consists of delivering information verbally (Canady and Retting 1996).
Literacy	One's ability to read, write, and calculate (McNergney and McNergney 2009).
Mentee	A person being guided, advised, or tutored by the mentor (Evans 1992).

Mentors	People who assist students by being their guides, advisors, leaders, or tutors (Evans 1992).
Multiple Teaching Strategies	Instructional tactics and activities used by teachers, instructors, and other training personnel for helping learners progress from where they are to where they must be (Bonwell and Eison 1991).
Non-directed Model	Teaching strategy in which teachers act as facilitators and reflectors to encourage students to define problems and feelings, to take responsibility for solving problems, and to determine how personal goals might be reached (McNergney and McNergney 2009).
Non-instructional Behaviors	Many actions, activities, discussions, and directions occurring in a classroom are important to the flow of the class, support of the school, and establishing an appropriate learning environment, yet are not instructional in nature and do not relate directly to subject matter. Examples include talking to students about their weekend activities to establish rapport, relaying information from the school office about school events, or telling jokes to start the class in a relaxed mood. These activities are intrinsically part of any class, yet do not directly further a curriculum (Costa and Kallick 2004).
Observation	The act of using a variety of data collection techniques to track classroom events and to evaluate teacher performance.
Pedagogical Content Knowledge	Particular teaching knowledge necessary to impart content knowledge (McNergney and McNergney 2009).
Performance Assessment	Assessment based either on observation of a process while skills are being demonstrated or on the evaluation of products created (Stiggins 1997).
Personalizing Instruction	Instruction and course objectives are based on the unique needs and abilities of each student (Conti 2004).
Prerequisite Skills	The skills, knowledge, and attitudes students must possess to be ready for (capable of

Problem-Based Learning (PBL) Teaching Method

understanding) instruction on related skills, knowledge, or attitudes (Reiser and Dick 1996).

Problem-Based Learning (PBL) teaching method uses problems as a base to motivate student learning of knowledge and skills. In the PBL teaching method, students encounter a problem or dilemma and use an organized, logical method to solve the problem. This method of teaching is a student- centered and inquiry-based. According to Schwartz et al. (2001), in a standard PBL classroom, students will work in small groups, and the teacher is a catalyst for learning and guides students through the problem-solving process rather than merely acting as a dispenser of knowledge (Dobbs 2008).

Project-Based Learning

Involvement of students in relatively long-term, problem-based units of instruction that allow students to pursue solutions to problems posed by students, teachers, or curriculum developers (McNergney and McNergney 2009).

Psychomotor Domain

That area of learning devoted to becoming proficient in performing a physical action involving muscles of the body (Morrison et al. 2001).

Rubric

Scoring key (McNergney and McNergney 2009).

Self-Directed Learning

This is the educational goal of self-regulation theories and is developed through student-directed instruction where students guide and have input into, their own learning. “A self-directed person can be described as being self- managing ... self-monitoring ... (and) self-modifying” (Costa and Kallick 2004, p. 6). Strategies designed to develop these skills of independence and provide experiences for students to practice these skills are frequently student-directed.

Self-Regulation

Self-regulation consists of the cognitive processes, behaviors, and strategies involved in monitoring and controlling oneself (Ormrod 2004).

Simulations	A teaching strategy using a scenario or model to be played out by participants to provide them with lifelike problem-solving experiences (Canady and Retting 1996).
Socratic Method	Teaching through inquiry and dialogues in which students discover and clarify knowledge (McNergney and McNergney 2009).
Socratic Seminar	A strategy for provoking student thought, dialogue and ownership for learning in which students usually speak 97 % of the class time, prompted by the teacher's open-ended and provocative questions (Canady and Retting 1996).
Student-Directed Instruction	Ormrod (2004) described a student-centered instruction as instruction that "encourages students to construct their own knowledge and understandings... Discovery learning, whole-class and small group discussions, cooperative learning, and group problem-solving activities are all examples of student-centered instruction" (p. 242). Following this definition, as all instruction focuses on students, Ormrod suggested that student-directed replace the misnomers student-centered, child-centered, or learner-centered to properly describe instruction where students direct their own learning and learning activities with the teacher as guide or facilitator.
Synchronous Communication	Communication in which all parties participate at the same time. Communication occurs in "real time" (Connick 1999).
Synectics	Teaching model that seeks to increase students' problem-solving abilities, creative expressions, empathy, and insight into social situations (McNergney and McNergney 2009).
Synthesis	The connecting of the taught and applied curriculum (Canady and Retting 1996).
Tactic	Differences in the way of doing tasks (Şimşek 2011).

Teacher-Centered Instruction	A process whereby the teacher controls and directs how and what students learn (Knowles 1980).
Teacher-Centered Learning	Direct instruction, sometimes synonymous with expository or didactic teaching, in which the teacher is the major provider of information (Borich 1988).
Teacher-Directed Instruction	Ormrod (2004) described a teacher-directed instruction as instruction “in which the instructor directly presents the material to be learned – for instance, through lectures, explanations, textbooks, and educational videos” (p. 241). As all instruction centers on students, Ormrod suggested that teacher-directed properly to describe instruction where teachers’ direct student learning and activities (Ormrod 2004).
Teaching Style	Teaching styles have been defined as the range of practices by which a teacher can operate and accomplish objectives (Weng 2002). Teaching style research has found that teachers demonstrate patterns of beliefs that guide their instructional choices.
Teaching	The ability to transfer knowledge so that the learners acquire—even own—the knowledge and skills for themselves (Stronge 2002).
Traditional Teaching Methods	The term, traditional teaching methods, covers a variety of methods that most teachers use in varying degrees. These methods include: (a) teacher lecturing and student note-taking, (b) individual student pen-and-paper practice problems, (c) pen-and-paper assessment, (d) laboratory activities with predetermined outcomes in science classes, and (e) discussions (Llewellyn 2005; Morgan et al. 2000 in Dobbs 2008).

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