

How Problem – Based Discussion Sessions Are Used To Promote Cognitive, Affective, and Psychomotor Domains: A Case Study at a Maritime Higher Education and Training Institution

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ABSTRACT

“Curriculum development” has recently been an issue at academic debates of increasing significance, particularly at higher maritime education and training. Curricula are the basic means through which goals and objectives are set. If the learners are to be well-equipped with such skills as reasoning, critical thinking, problem solving, information processing, independent working, and life long learning, curricula are to be developed accordingly. The objectives set are expected to develop and sustain the cognitive, affective, and psychomotor domains, providing learners with high intellectual abilities, desired attitudes, and well coordinated physical talents all of which could be practiced in real-life problem-solving.

The purpose of this study is to analyze the instructions and/or questions that follow each part of the scenarios practiced at the problem-based discussion sessions at Dokuz Eylul University, School of Maritime Business and Management. The thorough analysis is expected to reveal to what extent the nature of the instructions / questions help improve each of the basic domains mentioned. Based on the specific findings, certain remedies will be offered to raise the favorable effectiveness.

The study consists of five parts. The first part is devoted to a thorough discussion on the importance of setting goals and objectives while forming curricula. The focus of the second part is on setting goals and objectives. The third part discusses the levels of cognitive, affective and psychomotor domains including proper examples for action verbs and expressions describing the objectives at each level. The fourth part covers the analysis of the questions / instructions used in the scenarios

accompanying an overall assessment. The fifth part comprises conclusions, discussions, and recommendations.

1. The Basic Points To Be Included in the Higher Education Curriculum

As the curriculum is the path which is supposed to lead the higher education involved to the final destined target, it should be designed with utmost care. The core of this design is to be based on the basic needs of the learners who will be the outcomes of the relevant higher education process, “a creative process on the part of the student, ... a process of personal development, ... a process of individuals becoming more individual, more of persons, in the sense that they become their own person...” (Barnett, 1994; 157). Barnett highlights the target to be destined, in the same study mentioned, as follows: “If we want our students, on leaving their courses, to be able to make their way in a changing world, with its unforeseen patterns of demand and expectation, with its shifting relationships between work and non-work activities and with the complexities of global citizenship becoming more insistent, a narrow acquisition of pure knowledge it offers, hardly seems to provide an adequate basis for framing a curriculum for the 21st century... a higher education curriculum adequate to the modern age has to be one of the both thought and action... General intellectual capacities and the student’s wider personal skills have to be developed. ... Typical of the general intellectual skills that are invoked are: analytical skills, being able to integrate (synthesize) material and see relationship within it; being able to form critical evaluations...” The skills to be enhanced with the students are also thought to include “interpersonal skills, the ability to work in a team, decision making, problem-solving, communication skills, risk taking and leadership.” Connecting the ends of higher education with the aims of student autonomy and self-realization, Barnett rightly highlights the forms of curriculum objectives in two basic views, theoretical and practical, each of which is then regarded through specific and general viewpoints. The overall evaluation seems to reveal that “in higher education over the past 30 or 50 years, we have witnessed a movement in the character of the curriculum from one that is theory based to one that is centered much more on the world of practice and action... At the same time, ... there has been a general movement to the effect that subject-specific abilities, ... cannot be sufficient for effectiveness in the modern world.”

The picture drawn points to the metacognitive domains to be regarded with and accompanied by cognitive domains, which will be dealt with in details throughout the next parts of this study. Along with the considerable significance of underlining metacognition to be developed over certain specific skills relevant to particular forms of occupation (cognitive domains), certain other general abilities such as working in groups; communication skills and intrinsic motivation (affective domains) must be included in the overall curriculum. Borich (2004; 92) introduces an interesting term, *thinking*

curriculum, “one that focuses on teaching learners how to think critically, reason, and problem-solve in authentic, real world contexts” and recommends a curriculum reform in the next decade that will enable learners to work independently and to attain more high-level thinking, conceptual, and problem-solving skills. This is inevitable particularly for the curricula to be framed for higher maritime education and training, for this industry is remarkably international and multi-disciplinary in nature.

2. Setting Goals and Objectives

The crucial task of setting goals and objectives requires, as a prerequisite, a full awareness of the relevant standards on which the goals and objectives are to be based. In an education and training program at a department of nautical science, for instance, certain standards set by the International Maritime Organization-IMO are to be the basis for the goals and objectives to be formulated. This means that the three terms (standards, goals, and objectives) are interrelated. “Standards are general expressions of our values that give us a sense of direction... Goals usually are derived from standards to more specifically direct people to what must be accomplished... Objectives convey the specific behavior to be attained, the conditions under which the behavior to be performed” (Borich, 1994; 89-90). Hence, standards must primarily be grasped, which means that the needs of the industry, maritime industry in our case, as well as the needs of the learners are to be determined so that the goals can be clarified. Goals are particularly important because, in Borich’s terms, they tell the learners why certain materials ought to be covered; they provide direction for teaching / learning; they communicate the importance of studying certain items in question; and they “energize learners to higher levels of commitment and engagement in the learning process”.

The key words in setting objectives seem to be “behavior”, “demonstration”, and “proficiency”. As Borich suggests, “for an objective to be behavioral, it must be observable and measurable” the feedback from which it provides data for monitoring the consequence of the instructional strategy. While setting objectives, the points to be kept in mind are listed, by Borich, as follows: identifying a specific goal that has an observable learning outcome; stating the conditions under which learning can be expected to occur (e.g. materials, texts, facilities, and the period of time); and specifying the criterion level. Besides, “learning outcomes must be expressed directly, concretely and observably”... For example, instead of expecting students to be informed or literate in a subject, expect them to differentiate between..., identify the results of..., solve a problem in..., compare and contrast ... etc. Still another point of particular significance to be noted is that “learning outcomes” and “learning activities” are to be distinguished. Although a behavioral objective should include an action verb that specifies a learning outcome” (e.g. identify, demonstrate, subtract, show, recall, list, write, etc.), “some are better suited to specifying learning activities” (e.g. study, watch, listen, read, practice, sing, etc.).

3. The Cognitive, Affective, and Psychomotor Domains

While setting objectives, all the three domains ought to be considered and depending upon the outcomes or activities primarily thought to be mastered, they should be deployed properly. In other words, the basic aim of education and training, from the widest view point that can be highlighted as providing learners with the required level of knowledge, attitudes, and skills must be met to the best possible extent. In Borich's terms (1994; 103), objectives can require vastly different levels not only of cognitive complexity (knowledge) but of affective (attitudes) and psychomotor (skills) complexity as well. **Figure 1** gives the levels, requirements and actions covered by the domains and the levels of complexity and authenticity faced during the structure of the domains.

3.1. The Cognitive Domain

This set of domains comprises six levels, ranging from the knowledge level (least complex) to the evaluation level (most complex). The structure of this domain is set as follows (from the lowest to the highest) knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom et al, 1984). Besides, this order of steps reflects the level of authenticity from less to more respectively. Authenticity is defined as "more likely to represent the types of performances required of your learners in the world in which they must live, work, and play" (Borich, 1994; 104). This could mean that the higher the cognitive level, the more authentic the behaviors required. The examples for each of the level of the domains are given below (Borich1994; 106-108):

Knowledge: This level covers remembering or recalling information such as facts, terminology, problem-solving strategies, and rules. Some of the action verbs that describe learning at this level are; *define, describe, identify, label, list, match, name, outline, recall, recite, select, and state.*

Comprehension: This level of objectives aims at understanding, acquiring, and grasping. The abilities required could be highlighted as changing the form of communication, translating, interpreting (seeing the relationships among the parts of a whole), restating the content if the topic in question, drawing conclusions, or making inferences. Here are some action verbs describing the outcomes at this level: *convert, defend, discriminate, distinguish, estimate, explain, extend, generalize, infer, paraphrase, predict, summarize.*

Application: This level requires the learners to use the previously acquired information. It requires the presentation of a problem in a different and often applied context. Some of the action verbs describing the learning objectives at this level are as follows: *change, compute, demonstrate, develop, modify, operate, organize, prepare, relate, solve, transfer, and use.*

Table 1. Levels of Domains

	Levels	Requirements/Objectives	Action Verbs / Expressions Describing the Outcomes	Level	Authenticity
Cognitive Domain	Evaluation	Making decisions forming judgements	Appraise, compare, contrast, criticize, defend, judge, support	Highest ↑ ↓ Lowest	Most Authentic ↑ ↓ Least Authentic
	Synthesis	Producing something unique, combining parts into whole	Categorize, compile, compose, create, design, formulate, predict, produce		
	Analysis	Identifying errors, drawing relationships comparing contrasting	Breakdown, deduce, diagram, differentiate, subdivide, distinguish, illustrate, infer, outline, point out, relate, separate out		
	Application	Presenting a problem in a different and applied context	Change, compute, demonstrate, develop, modify, operate, organize, prepare, relate, solve, transfer, use.		
	Comprehension	Understanding acquiring changing the form, translating, restating, drawing conclusions	Convert, defend, discriminate, distinguish, estimate, explain, extend, generalize, infer, paraphrase, predict, summarize		
	Knowledge	Remembering, recalling facts, terminology, rules	Define, describe, identify, label, list, match, name, outline, recall, recite, select, state		
Affective Domain	Characterization	Full consistence with learners values	Avoid, display, exhibit, internalize, manage, require, resist, resolve, revise	Highest ↑ ↓ Lowest	Most Authentic ↑ ↓ Least Authentic
	Organization	Commitment, forming a reason, making appropriate choices	Abstract, balance, compare, decide, define, formulate, select, systematize, theorize		
	Valuing	Consistence with a single attitude, no force to comply	Act, argue, convince, debate, display, express, help, organize, prefer		
	Responding	Compliance with expectations attending, reacting to stimuli	Applaud, comply, discuss, follow, obey, participate, play, practice, volunteer		
	Receiving	Being aware of and attending to phenomena	Attend, be aware of, control, discern, distinguish, hear, listen, look, notice, share		
Psychomotor Domain	Naturalization	High level of proficiency, routine, automatic spontaneous	Automatically, effortless, naturally, professionally, routinely, with ease, with perfection	Highest ↑ ↓ Lowest	Most Authentic ↑ ↓ Least Authentic
	Articulation	Displaying coordination with control, speed, and time	Confidence, coordination, harmony, integration, proportion, smoothness, speed, stability, timing		
	Precision	Accuracy, proportion balance	Accurately, independently, without errors, proficiently, with control, with balance		
	Manipulation	Imitation without direct observation	Align, balance, follow, grasp, hold, place, repeat		
	Imitation	Imitating observable actions	Align, balance, follow, grasp, hold, place, repeat		

Source: Developed from Borich, 2004 by the authors

Analysis: This level concerns identifying logical errors; differentiating among facts, opinions, assumptions, hypotheses, and conclusions; drawing relationship, and comparing and contrasting. Some of the action verbs describing the outcomes at this level are as follows: *breakdown, reduce, diagram, differentiate, distinguish, illustrate, infer, outline, point out, relate, separate out, and subdivide.*

Synthesis: Producing something unique original and combining separate elements into one whole is the basis of this level. Some of the action verbs describing the outcomes at this level are as follows: *categorize, compile, compose, create, design, devise, formulate, predict, and produce.*

Evaluation: Making decisions and forming judgments is the key points of this level and there are some actions verbs describing the relevant outcomes: *appraise, compare, contrast, criticize, defend, judge, and support.*

3.2. The Affective Domain

According to the taxonomy devised by Krathwohl et al (1999), the affective domain comprises five levels, ranging from the lowest and least authentic to the highest and most authentic: receiving, responding, valuing, organization, and characterization (Borich, 1994; 108-110). Moving from the lowest towards the highest, the hierarchy reveals more involvement, commitment and self-reliance, as apposed to having one's feelings, attitudes, and values dictated by others (See **Table 1**):

Receiving: This level concerns being aware of and attending to certain phenomena. Some of the action verbs reflecting the outcomes at this level are: *attend, be aware of, control, discern, distinguish, hear, listen, look, notice, and share.*

Responding: This level requires complying "with given expectations by attending or reacting to certain stimuli." Some of the action verbs describing the relevant outcomes are: *applaud, comply, discuss, follow, obey, participate, play, practice, and volunteer.*

Valuing: This level concerns displaying behavior "consistent with a single belief or attitude" without being forced or asked to comply. Some of the action verbs meeting the objectives at this level are: *act, argue, convince, debate, display, express, help, organize, prefer.*

Organization: This level requires a commitment, forming a reason and making appropriate choices. Some of the action verbs describing the relevant outcomes are: *abstract, balance, compare, decide, define, formulate, select, systematize, and theorize.*

Characterization: The highest and the most authentic, this level requires full consistence with the learner's values. The behavior displayed is required to be consistent with the values of the displayer. Some of the action verbs offered to meet the outcomes at this level are: *avoid, display, exhibit, internalize, manage, require, resist, resolve, and revise.*

3.3. The Psychomotor Domain

"Harrow's taxonomy delineates five levels of psychomotor behavior ranging from the imitation level (least complex and least authentic) to the naturalization level (most complex and most authentic) (Borich, 1994: 111). As can be seen from **Table 1** the levels are given below:

Imitation: This level concerns imitating an observable action. The action verbs to meet the outcomes are: align, balance, follow, grasp, hold, place, repeat.

Manipulation: This level concerns imitation without a visual model or direct observation. The action verbs are the same as those of the imitation level.

Precision: Performance at this level requires accuracy, proportion, and balance. Some of the expressions describing the outcomes at this level: accurately, independently, without errors, proficiently, with control, and with balance.

Articulation: This level requires displaying coordination of a series of related acts with control, speed, and timing. The expressions describing the relevant outcomes are: confidence, coordination, harmony, integration, proportion, smoothness, speed, stability, and timing.

Naturalization: This level requires a high level of proficiency in the skills of performances; the behavior becomes routine, automatic, and spontaneous. Some of the expressions describing this level are: automatically, effortlessly, naturally, professionally, routinely, spontaneously, with ease, and with perfection.

4. Overall Evaluation of the Instructions Through Scenarios Used at a Higher Maritime Education Institution

The core of the problem-based learning method, adopted since the year 2002 at Dokuz Eylul University, School of Maritime Business and Management, Department of Nautical Science, is the problem-based learning discussion sessions where a scenario (problem) is discussed. Certain instructions inserted through discussions aim at improving learning and meeting the outcomes at cognitive, affective, and psychomotor domains.

In order to check to what extent these three domains are sustained, the written instructions used with the scenarios (of 14 modules in total) studied at Term 1 (freshman) level have been analyzed as a case study.

the instructions used with the scenarios studied at Term 1 are given in **Table 2**. An instruction has repeated many times but it is mentioned in **Table 2** for only one time.

It should be noted herein that the instructions listed in **Table 2** are the most often used ones and repeated in various forms depending upon the specific situations encountered in each scenario. Another point to be noted is that each of these instructions is used to activate both cognitive and affective domains at the same time. Still, another point to be considered is that for any level of any of these domains, mastery of the relevant preceding levels is a prerequisite. For example, the action verbs describing the outcomes at the elevation level can be demonstrated only if the learner has the mastery of the previous levels of cognitive domain.

The list of the often used instructions with the scenarios at the department reveals that psychomotor domain is not focused during the problem-based discussion sessions. This means that such expressions describing the outcomes as imitating observable actions, imitation without direct observation; displaying coordination with control, time, and speed; accuracy, proportion, and balance; and high level of proficiency are not considered the main point of emphasis during the discussion sessions.

Table 2. Instructions Used in the Scenarios at DEU SMBM and Corresponding Domains

Instruction	Corresponding Domain
<u>Define</u> the problem	Cognitive (knowledge), Affective (organization)
<u>Develop</u> hypotheses	Cognitive (analysis)
<u>What information</u> do you need?	Cognitive (comprehension)
<u>Summarize</u> the information	Cognitive (comprehension)
<u>Review</u> your hypotheses	Affective (characterization)
<u>What</u> should I learn?	Cognitive (knowledge)
<u>Discuss</u> the new information	Cognitive (evaluation)
<u>Do you think</u>?	Affective (valuing)
<u>Why</u>?	Affective (characterization)
<u>Discuss</u> ... <u>cause and effect</u>	Cognitive (analysis)
<u>Guess</u> what the master expected.	Affective (organization)
<u>How would you</u> if?	Affective (valuing, responding)
<u>Create</u> a flow chart illustrating...	Cognitive (synthesis)
What is ...? <u>Discuss</u> .	Cognitive (evaluation)
Judge ... <u>Evaluate</u> ...	Cognitive (evaluation)
Recall other navigation aids...	Cognitive (knowledge)
<u>What did</u> ... <u>Would you</u> ...?	Affective (valuing, responding)
<u>Anticipate</u> ... <u>Predict</u> (What is the master going to ...?)	Cognitive (comprehension, synthesis)
<u>How can you</u> ...	Cognitive (application)
<u>Explain</u> the series ...	Cognitive (comprehension, application)
Do you think ...?	Affective (valuing)
<u>Compare and contrast</u> ...	Cognitive (evaluation, analysis)
<u>What do you think</u> about ...?	Cognitive (comprehension)
<u>Evaluate</u> ...trudge ... appraise the manner	Cognitive (evaluation)
<u>Draw</u> the mechanism ...	Affective (organization) Cognitive (application)
<u>Suggest</u> ... (what other ...?)	Affective (valuing)
<u>Comment</u> on ...	Affective (characterization)
<u>What else</u> could he have done?	Cognitive (analysis) Affective (valuing)
<u>Cause and effect</u> (How would you relate?)	Cognitive (analysis)
<u>Inference</u> ... drawing conclusions ...	Cognitive (analysis)
<u>List</u> the things to be done ...	Cognitive (knowledge)
<u>Anticipate</u> ...	Cognitive (comprehension)
Considering COLREG, what vessels would ...?	Affective (organization)
<u>Brainstorm</u> about ...	Affective (responding) Cognitive (synthesis)
Relate ...	Cognitive (analysis) Application

Concluding Remarks

This study highlights the crucial aspects of designing curricula, the importance of setting goals and objectives, and the effects of including in curricula the cognitive-affective-psychomotor domain elements on the outcomes aimed through the goals and objectives established. The specific address of the discussions on these points is higher maritime education in particular. Hence, a specific

application on to “what extent the elements of the three domains are involved in the curriculum practiced at a higher maritime education institution” is presented. The application mentioned is referred to a particular part of the curriculum problem-based discussion sessions.

The overall conclusion regarding the feature of curricula can be highlighted as follows: Higher education curricula are to concern both thought and action; they are to enhance interpersonal skills, the abilities to work in teams, decision-making skills, problem-solving skills, student autonomy and self-realization, and critical thinking skills. As subject-specific abilities cannot be sufficient for effectiveness in the modern world, cognitive affective and psychomotor domains are to be included in the curricula of the twenty-first century. Besides; moving the cognitive domains up to meta-cognitive levels should also be regarded as another significant point to be concerned while designing the curricula. In other words, mental processes including “invisible thinking skills such as self-interrogation, self checking, self monitoring, and analyzing” (Borich, 1994; 297) should also be included in the curricula.

Identifying basic standards, general expressions of certain values, setting goals, or determining what to be accomplished, based on the identified standards, and then determining the specific behaviors to be attained (objectives) deserves utmost care while forming higher education curricula. To be more precise, goals are important for they raise intrinsic motivation and energize learners to higher levels of commitment and engagement in the learning process; and objectives are important as they specify the behavior, demonstration, and proficiency required as an end result of any learning process.

Cognition, self-reliance, and demonstration are also to be considered in curriculum designing. In other words, it should be kept in mind that “reception, availability, and activation are three essential conditions for learning” (Borich, 1994; 219). More precisely, the six levels of cognitive domains, from the highest to the lowest and most to least authentic respectively: evaluation, synthesis, analysis, application, comprehension, and knowledge ought to be regarded in order to improve cognition. Besides, the five levels of affective domains (characterization, organization, valuing, responding, and receiving) are to be enhanced in order to promote self-reliance and high level attitudes. Moreover, in order to raise proficiency, spontaneity, accuracy, and efficiency, the level in psychomotor domains is to be promoted from imitation to naturalization.

The application carried out through the written instructions used with the scenarios studied at the Department of Nautical Science, DEU School of Maritime Business and Management, reveals that the most often used instructions serve/help to develop and improve various levels of cognitive and affective domains but fail to sustain psychomotor domain. This failure can be attributed to the nature of the activities aimed at the problem-based discussion sessions, the specific field of this particular

research. In order not to slow down and discourage the active flow of discussions, the high proficiency in psychomotor domain must have been limited; it is possible, though, for the discussion group members as well as the moderator to involve the high levels of this domain in the oral means of questioning and correcting throughout the discussion session. In fact, the authors of this research, who are actively and directly involved in these sessions, believe that it would be more effective to focus on the psychomotor domain within the activities carried out at professional practice skills sessions, one of the several complementary sessions aiming to assist and support the problem-based discussion sessions, the core of the overall problem-based learning method. Of the complementary sessions mentioned, the individual study modules (ISM) are the most effective practices through which the learners are encouraged to involve in their ISM most of the components of all the three basic domains. While preparing an individual study module at the end of each term, each individual learner has got to activate almost all components of the three domains. Besides, such a profound contribution, or an opportunity in a sense, will enable the learners to lead themselves by means of utilizing self-instruction and self-direction principles. This goal is expected to be reached through the contributions of the Individual Study Modules as well as the dissertation projects regardless of the fact that the Term 4 students at DEU SMBM Nautical Science Department are more heavily exposed to Task-Based Learning while the first three terms are exposed to Problem-Based Learning Method.

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