

The Contribution of Self-Directed Strategies to the Development of Adult Metacognition at Higher Maritime Education and Training

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ABSTRACT

Self-directed learning, “an approach enabling to engage learners in the learning process “to acquire higher-order thinking outcomes” (Borich , 2004 : 294), should be the primary focus at higher maritime education and training. This focus could be attributed to such peculiar characteristics of adult learning as the willingness to put the knowledge and skills gained immediately into practice, the high interests in learning the subject matters directly related to their profession, the wealth of experience already owned, and enthusiasm in conducting their own cognitive strategies up to metacognitive levels resulting in “higher-order thinking” and “life long learning”.

This study aims to seek possible means of engaging adult learners at higher maritime education and training in the learning process through effective use of self-directed learning strategies so as to promote their metacognition. The problem based discussion sessions are thought to provide the promising environment for this purpose. Hence, the practices conducted at the higher maritime education and training institution, where the authors teach, are analyzed, which will include the learners’ perceptions.

The study comprises four parts. The first part highlights the basic requirements in effective adult learning. The second part focuses on the importance of raising cognitive strategies up to metacognitive levels. The third part analyzes the practices experienced, which includes learners’ perceptions through “Higher-order Thinking and Problem Solving Checklist.” The fourth part highlights the results of accompanying discussions on the aspects that need to be improved.

1. Basic Requirements in Effective Adult Learning

The extensive and prevalent changes in technology, the extraordinary speed in exchange of information and widespread knowledge, seem to have given birth to the emergence of new approaches, in education favoring life-long learning. "As we approach the 21st century, education has become a life-long activity." (Smith and Pourchat, 1998 : 6). Rather than confide education to schooling alone, the new approach gives priority to acquiring certain basic competence over graduation (Davies, 1998 : 3-4), having enhanced the requirements for effective self-directed learning. Such noticeable changes in the overall outlook on teaching and learning issues have brought about certain shifts from behavioristic to cognitive approach. Both conceptual and empirical studies, having emerged in cognitive psychology, seem to have emphasized the use of pre-existing knowledge as the initial basis of learning, integrating the new knowledge with the existing one , restructuring it, and, while doing this most challenging part of the process, using deep processing approach (Brown and Atkins , 1994 : 150-156)

The search for more effective education, triggered in mid 20th century, have also shed lights on the distinction between child learning (pedagogy) and adult learning (andragogy), though "the earliest roots of educational psychology's interests in adult learning can be traced to the World War I" (Smith and Pourchat, 1998: 3). The issue has been focused more since the last quarter of the century through the certain learning theories developed by such educational physiologists as Knowles (1980), Smith (1982), Houser (1985) and Boltan(1985).

The distinctive characteristics of adult learners underlined in the relevant studies could be highlighted on such basic concepts as *experience*, *awareness*, *practice* and *motivation*. In other words, adults have a relatively great wealth of experience and background which is likely to be exploited in promoting the learning quality. Besides, adults are well aware of the actual need for improving their learning in certain particular respects, which could be attributed to the benefits of getting promoted in their profession or access to better living conditions. Furthermore, adults are usually willing to put any knowledge gained into practice so as to enjoy the awards as early as possible. Such willingness is thought to be setting the sound basis for intrinsic motivation, a must for effective learning to take place.

Considering the above mentioned basic distinctive characteristics of adult learners, Smith and Pourchot (1998:8-9) draw such a conclusion that " adults generally have greater metacognitive knowledge and are better able to regulate their cognitive skills than children". The overall conclusion also covers that "personality traits, interests and motivational skills are three domains that are likely to have some influence on adults' intellectual abilities."

Schommer (1998, 140), who discusses adults' beliefs about the nature of knowledge and learning or epistemological beliefs, states that "there is enough evidence to make it clear that epistemological beliefs are an integral part of being an adult and dealing with the complexities of an adult life." Having emphasized the role of developing sophisticated epistemological views in cognitive development, Schommer claims that epistemological beliefs guide individuals to cope with complex, contradictory, and illusive knowledge that allows them to think dialectically play a substantial role in the regulation of cognition ...and may comprise an executive control system that "guides one's planning for strategies, their monitoring of ongoing comprehension, and the evaluation of their accuracy of comprehension."

Another distinctive characteristic of adult learning could be attributed to the fact that "practical" abilities grow over the years (Torff and Sternberg, 1998 : 112-113). In other words, the more the individuals are experienced the more able they are to think, reason, and solve problems. Torff and Sternberg, in their study, relate this advantage adults might utilize with the practical intelligence maintained or increased through late adulthood which covers particularly those problems that are "often unformulated or in need of formulation, of personal interest, lacking information necessary for solution, related to everyday experience, poorly defined, characterized by multiple correct solutions, and endowed with multiple methods for arriving at a solution" (Torff and Sternberg 1998 : 117). This intelligence is also believed, through the same study, to be covering the tacit knowledge "practical know-how that is usually not directly thought or even openly expressed or stated"... with three such characteristic features as "taking the form of 'knowing how' (procedural knowledge) rather than 'knowing that' (declarative knowledge) ; directed toward attainment of goals that people value; and acquired under conditions of low environmental support... without much direct instruction."

Considering the characteristic features of adult learners, the studies on andragogic approach highlight the specifications of adult learning in such a seven-element process (Cerit 2004, Knowles 1979-1980, Howser 1985, Bolton 1985):

- The teaching and learning environment should provide a decent medium for interpersonal respect, support, openness, sincerity, trust, and confidence; cooperation and collaboration; enjoyable, encouraging and humane. In other words, adult learners should feel at rest, comfortable, free from anxiety and safe while studying.
- Adult learners should be allowed and encouraged to get involved in the prevalent planning process.
- Adult learners should be encouraged to set their own needs which would act as a basis for the learning objectives.
- Adult learners do want to formulate their own learning objectives.
- Adult learners do prefer to design themselves the pacing schedule/syllables to be implemented.

- Adult learners would appreciate being guided and scaffolded rather than directed and instructed, while implementing the pacing schedule agreed on.
- Adult learners should be encouraged to get involved in the overall assessment/appraisal process.

2. Raising Cognitive Strategies upto Metacognitive Levels

The basic elements required with the medium of adult learning imply that the cognitive strategies the learners have already gained are to be promoted to metacognitive levels. In other words not only “what strategies are to be employed?” but also “how to use such and such strategies?” should be considered. Schraw (1998; 90) terms the former as “knowledge of cognition” and the latter as “regulation of cognition”. Schraw clarifies the former, highlighting its basic components as *declarative knowledge* which includes knowledge about ourselves as learners and what factors influence our performance; *procedural knowledge* which refers to knowledge about strategies and other procedures; and *conditional knowledge* which refers to knowing why and when to use a strategy.

In order for learning to be improved, knowledge of cognition must be utilized through planning, monitoring and evaluation. In other words; it needs to be regulated. Schraw (1998,90 - 91) clarifies these steps of regulation by specifying the contents of each as follows; “planning involves the selection of appropriate strategies and the allocation of resources, and budgeting time; monitoring includes self-testing skills necessary to control learning and evaluation refers to appraising the products and regulatory process of one’s learning.”

How and to what extent knowledge of cognition is regulated seems to be based on the methods of teaching and learning rather than the existence of any certain abilities or domain knowledge, as a prerequisite. Nor is it thought to be innate. Schraw refers to a number of studies (such as Brown 1987, Garner 1987, Garner and Alexander 1989, Swanson 1990) while suggesting that, “Studies examining younger children typically report poor metacognitive regulation. In contrast, studies of older children and adolescents report a far greater degree of metacognitive regulation as well as some explicit metacognitive knowledge about learning... Children seem to acquire this knowledge through reflection on extended practice and observation of skilled peers and experts.”

As metacognitive regulation is based on, or is the regulation of knowledge of cognition, cognitive strategies could be regarded as a prerequisite for acquiring metacognitive knowledge. This might mean that metacognitive awareness and regulation is unlikely to appear effectively at the early stages of child learning. Instead, it is more likely to develop “and continue into adolescence and adulthood... Thus growth of metacognitive knowledge is an incremental by-product of practice and developing expertise within a domain”(Schraw 1998:98).

While designing teaching / learning activities aiming to develop and sustain metacognitive knowledge, the distinct characteristic of child learning and adult learning should be taken into account. It should be kept in mind, for instance, that “adults are described as more self-directed, self-reflective and able to change perspectives than are children... They are also described as more disposed to bring their own life experience to what they learn and the way they learn.” Whatever teaching /learning method employed, it should be “practice-oriented and based in real life tasks and situations” as “adults need to be more personally involved in what they are learning” (Pascual - Leone and Irwin 1998 : 36).

Schraw (1998, 98-100) suggests three approaches in this aspect: direct learning, peer regulated learning, and autonomous learning. Of these, direct learning is believed to be “one helpful way to demonstrate an expert’s metacognitive and conceptual knowledge for those who are less expert” which promotes acquisition but “passive in nature.” The second, peer regulated learning, seems to be more effective in adults’ metacognitive development as well as death of adolescents.” Proponent of peer learning believe that students learn best from interacting with other students who are slightly more advanced. Many of these programs are based on Vygotsky’s notion of the zone of proximal development, which assumes that optimal learning occurs just beyond one’s current level of independent functioning”. The third one suggested, autonomous learning, which underlines self regulation, is to be enhanced especially with adult learners likely to promote life-long learning as it “refers to environments in which individuals spontaneously construct strategies and knowledge with only limited external support. When a learner has internalized the mentor/ mediatorthen we can speak of self-mediated learning / instruction as a process account of adult trainers’ self directedness: their ability to set goals, their learning autonomy, their problem posing and problem solving their self defining of objectives, and their ability to set their own criteria and curriculum.... At this point learners are truly independent learners, for they possess metaexecutives to be self-directed in the acquisition of skills or abilities as well as to monitor their own low-road learning by means of high-road monitoring structures.... Without this high-road style of monitoring one has only the behaviorist acquisition of skills without critical evaluation” (Pascual - Leone and Irwin 1998 : 61).

Self directed learning is actually what is termed by Pascual - Leone and Irwin as self-mediated learning wherein the main purpose is to “engage students in the learning process to acquire higher-order thinking outcomes.... help them construct their own understanding and help them to reason, problem solve, and think critically about the content” through such activities as predicting, questioning, summarizing, and clarifying (Borich 2004 ; 294).

When direct learning is carried out as a means of scaffolding, however, it “facilitates the acquisition of essential knowledge that can be used to construct higher-level knowledge and does so quickly and efficiently” but for “novice learners” particularly. As any misleadings are to be avoided / prevented in

direct learning, a different paradigm of learning should be carried out “where a tutor or mentor arranges the learning situation to minimize misleadings by way of externally monitoring the learner’s mental attention ... to concentrate relevant aspects of the situation in the manner convenient for the learning to take place” (Pascual - Leone and Irwin, 1998 : 60).

3. Utilizing Problem-Based Learning Sessions in Sustaining Higher-Order Thinking and Raising Metacognition

The core of the problem – based learning method, which has been adopted by the higher maritime education institution subject to this study, is the problem - based learning sessions carried out by small groups of eight learners each with a mentor/ mediator called tutor. The discussions conducted at the sessions are based on a scenario comprising real life or near real life problems. The basic steps could be highlighted as defining the problem, developing hypotheses on the probable causes, revising the hypotheses through the further data provided, determining learning objectives, having reached the limits of the existing knowledge, and hence, having triggered to exploit the relevant resources to expand learning.

The overall structure of each discussion session is designed and arranged in a sense that meets the requirements matching the distinctive characteristics of adolescents and early adult learning .

3.1 The Aim of the Research

The research aims at finding out the extent to which the problem – based learning sessions, actually are likely to contribute to raising the cognitive knowledge up to metacognitive knowledge. In other words, to what extent the learners become able to get the ability to regulate their cognitive knowledge, plan their own learning, monitor and implement and then evaluate their own learning is the core aim of the research.

The research also aims to check if there exists any difference among the perceptions of the four groups of the students (levels of learners) on the contributions of the problem based learning sessions to their gaining cognitive and metacognitive knowledge.

3.1.1. The Model and the Hypothesis of the Research

The higher maritime education institution where the research has been conducted is a four-year undergraduate education institution with three departments: Department of Maritime Administration, Department of Nautical Science, and Department of Marine Engineering. The research has been carried out through the Department of Nautical Science only. The levels of the students who have been subject to the research are indicated in the model as “term” standing for “academic year”.

The conceptual model of the research is given in **Figure 1** and hypotheses of the study could be highlighted as follows:

H₀ : There exists no meaningful differences among the perceptions of the students studying at different terms on the contributions of the problem-based discussion sessions to their gainings in cognition and metacognition.

H₁ : There exists certain differences among the perceptions of the students studying at different terms on the contributions of the problem-based discussion sessions to their gainings in cognition and metacognition.

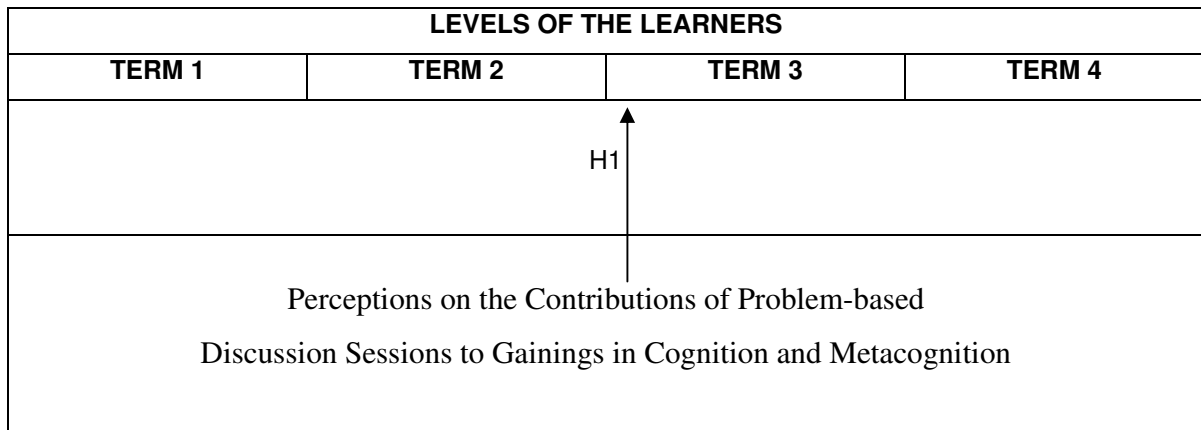


Figure 1. Conceptual model of the study

3.1.2. Data Collection

The data collection instrument is a questionnaire consisting of 62 variables derived from the literature. The variables cover the statements on *Application of Knowledge* (statements 1-7), *Analytical Skills* (statements 8-22), *Synthesis/Creativity* (statements 23-27), *Evaluation/ Metacognition* (statements 28-35), *Dispositions* (statements 36-56), and *Values* (statements 57-62). The statements that are

given in **Table 2** are developed as the sub-hypotheses of **H₁**. The variables are put on a 5 point Likert scale and the students are asked to choose one of such five choices for each variable: **5** (Great Extent), **4** (Fair Extent), **3** (Some Extent), **2** (A little), and **1** (Not at all).

The questionnaires were handed in/distributed during December 18-28,2006 to the moderator/tutor of each problem based session group prior to the session time and were collected at the end of the sessions. The moderators were asked to convince the students to devote the time required to the questionnaires and respond to the statements attentively.

The total number of the questionnaires handed in to the moderators is 193(59,43,50 and 41 for Terms 1,2,3 and 4 respectively). The total number of the responses received is 128 (46,24,27 and 31 from Terms 1,2,3 and 4 respectively) corresponding to a response rate of 66.3 percent (See **Table 1**).

Table 1. Responses and response rates during data collection

Levels	Handed in (Distributed)	Collected	Response Rate
Term 1 (Freshman)	59	46	77.9 %
Term 2 (Sophomore)	43	24	55.8 %
Term 3 (Junior)	50	27	54.0 %
Term 4 (Senior)	41	31	75.6 %
Total	193	128	66.3 %

3.1.3. Data Analysis

The method used for data analysis in the research is Analysis of Variance (ANOVA), a statistical technique for examining the differences among means for two or more populations. Means for every statement are also calculated.

3.2. The Results of the Research

The findings of the research are highlighted in two basic groups in accordance with the two basic aims of the research.

3.2.1. An Overall Evaluation of the Perceptions

The items that have received highly favorable perceptions (over 4.00) could be highlighted as follows: 5,7,9,13,19,20,22,23,25,26,37,39,40,45,47,49,50,52,56,60,61 and 62: The skills corresponding to

these items respectively are as follows: communicate the results, consult a variety of knowledge sources to gather information (application of knowledge): compare a problem to problems encountered previously; identify and articulate errors; explain the reason for conclusion; find corroborating evidence from among different data sources; place an interpretation of a problem in the context of prevailing circumstances(analytical skills); generate new ways of viewing a situation outside the boundaries of standard conventions; brainstorm new applications of content; anticipate potential problems (synthesis/creativity); share and take turns; provide assistance to others; engage in tasks; demonstrate persistence in tackling difficulties; display enthusiasm for learning; collaborate with others in team; provide assistance to others when asked; listen attentively to others; set goals that are achievable(dispositions); maintain self discipline in dealing with difficult situations; care and concern for others; act responsibly in dealing with tasks and people (values).

The items concerning 'evaluation/metacognition' seem to have received perceptions over 3.38 (ranging from 3.38 to 3.88), corresponding to a moderate extent. An overall analysis of the perceptions of each group on the items reflecting 'evaluation/metacognition' reveals that five out of eight items receive over 4.00 from the students of the first two terms, and slight falls appear in the responses received from the last two terms.

Table 2. Perceptions on Cognition and Metacognition

Statements	Overall (n=128)	Term 1 (n=46)	Term 2 (n=24)	Term 3 (n=27)	Term 4 (n=31)
1. Search his/her memory for what is already known about a problem.	3,84	3,93	3,96	3,67	3,74
2. Draw a picture or diagram that shows what was learned or observed	3,67	3,76	3,83	3,48	3,58
3. Construct and interpret graphs, charts, tables.	3,87	3,96	4,25	3,54	3,73
4. Classify/categorize things into definable attributes.	3,83	3,98	4,04	3,63	3,65
5. Communicate the results of what was observed in written and oral format.	4,01	4,13	4,29	3,96	3,65
6. Apply given rules to reach a conclusion.	3,84	3,96	4,04	3,63	3,68
7. Consult a variety of knowledge sources to gather information.	4,13	4,35	4,37	3,96	3,74
8. Identify similarities and differences among various elements.	3,72	3,93	3,96	3,54	3,35
9. Compare a problem with problems encountered before.	4,00	4,22	4,13	3,96	3,61
10. Understand the relationship of each component to the whole.	3,89	4,02	4,17	3,78	3,57
11. Make reasonable conclusions from observation or analysis of data.	3,90	3,98	4,25	3,81	3,58
12. Identify and articulate errors in their own thinking or in that of others.	4,09	4,35	4,30	3,78	3,84
13. Explain the reasons for a conclusion.	4,09	4,28	4,21	3,96	3,81
14. Predict what will happen given the information you have.	3,98	4,33	4,13	3,96	3,35

Table 2. Continued

Statements	Overall (n=128)	Term 1 (n=46)	Term 2 (n=24)	Term 3 (n=27)	Term 4 (n=31)
15. Plan a way to test one's prediction.	3,70	3,91	4,04	3,59	3,23
16. Distinguish the most important elements of a problem	3,94	3,98	4,33	3,96	3,55
17. Organize a conclusion about a problem in a logical fashion.	3,98	4,17	4,09	3,93	3,65
18. Identify criteria for evaluating a problem solution.	3,77	3,98	3,96	3,63	3,45
19. Gather information or evidence to solve a problem.	4,09	4,37	4,29	3,85	3,74
20. Find corroborating evidence from among different data sources.	4,00	4,35	4,17	3,67	3,65
21. Determine the reliability of the evidence.	3,79	3,83	4,08	3,67	3,61
22. Place an interpretation of a problem in the context of prevailing circumstances.	4,05	4,15	4,50	3,96	3,65
23. Generate a new ways of viewing a situation outside the boundaries of standard conventions.	3,99	4,39	4,17	3,56	3,65
24. Reformulate a problem to make it more manageable.	3,92	3,98	4,21	3,81	3,71
25. Brainstorm new applications of content.	4,07	4,28	4,25	3,81	3,84
26. Anticipate potential problems.	4,04	4,22	4,33	3,81	3,74
27. Accurately summarize what is read or others have said, orally and in writing.	3,96	4,15	4,33	3,54	3,74
28. Ignore distractions that interfere with goal attainment.	3,38	3,35	3,50	3,48	3,26
29. Make appropriate revisions on bases of feedback.	3,78	4,11	4,00	3,33	3,52
30. Assess risks involved in a solution.	3,81	3,96	4,00	3,67	3,57
31. Monitor the outcome and revise a strategy where appropriate.	3,74	3,89	3,96	3,42	3,63
32. Judge the credibility of evidence.	3,80	4,00	4,00	3,56	3,55
33. Evaluate the revise what is written.	3,76	4,00	3,71	3,56	3,63
34. Ask questions to oneself about ideas he/she is unsure of.	3,87	4,00	4,08	3,70	3,65
35. Catch fallacies and contradictions.	3,88	4,13	4,17	3,48	3,65
36. Meaningfully praise the performance of others.	3,66	3,78	3,63	3,67	3,52
37. Share and take turns.	4,07	4,22	4,25	3,85	3,90
38. Help keep others on- task.	3,94	4,13	4,04	4,04	3,48
39. Provide assistance to others when needed.	4,09	4,28	4,13	4,07	3,77
40. Engage in tasks even when answers or solutions are not immediately apparent.	4,03	4,17	4,37	3,92	3,65
41. Seek accuracy.	3,95	4,24	4,04	3,78	3,61
42. Is flexible to change viewpoint to match the facts.	3,96	4,18	4,04	3,89	3,65
43. Demonstrate restraint over impulsive behaviors	3,95	4,00	4,17	3,81	3,84
44. Compose drafts and tryouts in attempts to solve a problem.	3,87	4,00	4,00	3,78	3,67
45. Demonstrate persistence in tackling difficult tasks.	4,06	4,24	4,25	4,04	3,67
46. Use a constructive tone when responding to others.	3,94	4,11	3,96	3,89	3,74
47. Display enthusiasm for learning.	4,04	4,17	4,17	4,07	3,71
48. Ask for feedback when needed.	3,98	4,20	4,17	3,69	3,77
49. Collaborate with others in team.	4,02	4,20	4,29	3,78	3,77
50. Provide assistance to others when asked.	4,13	4,39	4,30	3,89	3,81
51. Demonstrate independence in completing a project.	3,84	3,74	4,25	3,89	3,65
52. Listen others attentively.	4,06	4,22	4,17	3,88	3,90
53. Ignore distractions that interfere with goal attainment.	3,87	3,96	3,96	3,89	3,65
54. Keep record on one's own progress toward important goals.	3,87	4,04	4,17	3,48	3,71

Table 2. Continued

Statements	Overall (n=128)	Term 1 (n=46)	Term 2 (n=24)	Term 3 (n=27)	Term 4 (n=31)
55. Realistically evaluate own performance.	3,92	3,93	4,21	3,74	3,84
56. Set goals that achievable within a specific span of time.	4,02	4,30	4,13	3,78	3,74
57. Demonstrate awareness of ethical concerns and conflicts	3,84	3,91	4,21	3,74	3,52
58. Adhere to codes of conduct.	3,96	4,17	4,00	3,78	3,77
59. Show an ability to resolve ethical dilemmas and conflicts.	3,99	4,11	4,13	4,07	3,65
60. Maintain self-discipline in dealing with difficult situations.	4,02	4,20	4,25	3,85	3,71
61. Behave in a manner that communicates care and concern for others.	4,01	4,17	4,29	3,70	3,81
62. Act responsibly in dealing with tasks and people.	4,16	4,39	4,42	3,89	3,84

3.2.2. Comparative Analysis of the Perceptions

An overall evaluation reveals that there exists certain significant differences among the perceptions of the four different groups of learners. This fact proves the estimation reflected through Hypothesis 1.

As can be seen from **Table 3** among the sub-hypothesis 35 out of 62 items reflect meaningful differences in the perceptions. The numbers of items reflecting significant differences are as follows: *Application of knowledge*, 2 out of 7; *Analytical skills*, 12 out of 14; *Synthesis/creativity*, 4 out of 5; *Evaluation/metacognition*, 3 out of 8; *Dispositions*, 10 out of 21; and *Values*, 4 out of 6.

Table 3. Results of the Hypotheses Tests

Sub-Hypotheses	F	Significance	Results
H ₁₁ . Search his/her memory for what is already known about a problem.	0.875	0.456	Not supported
H ₁₂ . Draw a picture or diagram that shows what was learned or observed	0.868	0.460	Not supported
H ₁₃ . Construct and interpret graphs, charts, tables.	2.976	0.034	Supported p≤0.05
H ₁₄ . Classify/categorize things into definable attributes.	1.734	0,164	Not supported
H ₁₅ . Communicate the results of what was observed in written and oral format.	2.658	0.051	Not supported
H ₁₆ . Apply given rules to reach a conclusion.	1.698	0.171	Not supported
H ₁₇ . Consult a variety of knowledge sources to gather information.	3.090	0.030	Supported p≤0.05
H ₁₈ . Identify similarities and differences among various elements.	3.498	0.018	Supported p≤0.05
H ₁₉ . Compare a problem with problems encountered before.	3.293	0.023	Supported p≤0.05
H ₁₁₀ . Understand the relationship of each component to the whole.	3.371	0.021	Supported p≤0.05
H ₁₁₁ . Make reasonable conclusions from observation or analysis of data.	2.404	0.071	Not supported
H ₁₁₂ . Identify and articulate errors in their own thinking or in that of others.	4.047	0.009	Supported p≤0.05
H ₁₁₃ . Explain the reasons for a conclusion.	2.735	0.046	Supported p≤0.05

Table 3. Continued

Sub-Hypotheses	F	Significance	Results
H ₁₁₄ . Predict what will happen given the information you have.	8.198	0.000	Supported p≤0.05
H ₁₁₅ . Plan a way to test one's prediction.	4.650	0.004	Supported p≤0.05
H ₁₁₆ . Distinguish the most important elements of a problem.	4.553	0.005	Supported p≤0.05
H ₁₁₇ . Organize a conclusion about a problem in a logical fashion.	2.158	0.096	Not supported
H ₁₁₈ . Identify criteria for evaluating a problem solution.	2.752	0.045	Supported p≤0.05
H ₁₁₉ . Gather information or evidence to solve a problem.	3.737	0.013	Supported p≤0.05
H ₁₂₀ . Find corroborating evidence from among different data sources.	5.052	0.002	Supported p≤0.05
H ₁₂₁ . Determine the reliability of the evidence.	1.171	0.324	Not supported
H ₁₂₂ . Place an interpretation of a problem in the context of prevailing circumstances.	5.227	0.002	Supported p≤0.05
H ₁₂₃ . Generate a new ways of viewing a situation outside the boundaries of standard conventions.	7.444	0.000	Supported p≤0.05
H ₁₂₄ . Reformulate a problem to make it more manageable.	1.849	0.142	Not supported
H ₁₂₅ . Brainstorm new applications of content.	2.816	0.042	Supported p≤0.05
H ₁₂₆ . Anticipate potential problems.	3.316	0.022	Supported p≤0.05
H ₁₂₇ . Accurately summarize what is read or others have said, orally and in writing.	4.322	0.006	Supported p≤0.05
H ₁₂₈ . Ignore distractions that interfere with goal attainment.	0.351	0.788	Not supported
H ₁₂₉ . Make appropriate revisions on bases of feedback.	5.323	0.002	Supported p≤0.05
H ₁₃₀ . Assess risks involved in a solution.	2.026	0.114	Not supported
H ₁₃₁ . Monitor the outcome and revise a strategy where appropriate.	2.000	0.118	Not supported
H ₁₃₂ . Judge the credibility of evidence.	2.735	0.047	Supported p≤0.05
H ₁₃₃ . Evaluate the revise what is written.	1.914	0.131	Not supported
H ₁₃₄ . Ask questions to oneself about ideas he/she is unsure of.	1.483	0.222	Not supported
H ₁₃₅ . Catch fallacies and contradictions.	4.064	0.009	Supported p≤0.05
H ₁₃₆ . Meaningfully praise the performance of others.	0.536	0.658	Not supported
H ₁₃₇ . Share and take turns.	1.583	0.197	Not supported
H ₁₃₈ . Help keep others on- task.	3.667	0.014	Supported p≤0.05
H ₁₃₉ . Provide assistance to others when needed.	2.344	0.076	Not supported
H ₁₄₀ . Engage in tasks even when answers or solutions are not immediately apparent.	4.504	0.005	Supported p≤0.05
H ₁₄₁ . Seek accuracy.	3.957	0.010	Supported p≤0.05
H ₁₄₂ . Is flexible to change viewpoint to match the facts.	2.896	0.038	Supported p≤0.05
H ₁₄₃ . Demonstrate restraint over impulsive behaviors	0.845	0.472	Not supported
H ₁₄₄ . Compose drafts and tryouts in attempts to solve a problem.	1.073	0.383	Not supported
H ₁₄₅ . Demonstrate persistence in tackling difficult tasks.	3.101	0.029	Supported p≤0.05
H ₁₄₆ . Use a constructive tone when responding to others.	1.005	0.393	Not supported
H ₁₄₇ . Display enthusiasm for learning.	2.124	0.090	Not supported
H ₁₄₈ . Ask for feedback when needed.	2.708	0.048	Supported p≤0.05
H ₁₄₉ . Collaborate with others in team.	2.686	0.049	Supported p≤0.05
H ₁₅₀ . Provide assistance to others when asked.	4.588	0.004	Supported p≤0.05
H ₁₅₁ . Demonstrate independence in completing a project.	1.682	0.174	Not supported
H ₁₅₂ . Listen others attentively.	1.347	0.262	Not supported
H ₁₅₃ . Ignore distractions that interfere with goal attainment.	0.901	0.443	Not supported
H ₁₅₄ . Keep record on one's own progress toward important goals.	3.103	0.029	Supported p≤0.05

Table 3. Continued

Sub-Hypotheses	F	Significance	Results
H ₁₅₅ . Realistically evaluate own performance.	1.198	0.313	Not supported
H ₁₅₆ . Set goals that achievable within a specific span of time.	3.326	0.022	Supported p≤0.05
H ₁₅₇ . Demonstrate awareness of ethical concerns and conflicts	2.829	0.041	Supported p≤0.05
H ₁₅₈ . Adhere to codes of conduct.	1.842	0.143	Not supported
H ₁₅₉ . Show an ability to resolve ethical dilemmas and conflicts.	2.218	0.089	Not supported
H ₁₆₀ . Maintain self-discipline in dealing with difficult situations.	3.617	0.015	Supported p≤0.05
H ₁₆₁ . Behave in a manner that communicates care and concern for others.	3.266	0.024	Supported p≤0.05
H ₁₆₂ . Act responsibly in dealing with tasks and people.	3.986	0.009	Supported p≤0.05

Concerning the items reflecting *evaluation/metacognition*, the items for which the perceptions reveal meaningful differences are: make appropriate revisions on the basis of feedback, judge the credibility of evidence, and catch fallacies and contradictions. On the other hand, the only item concerning “analytical skills”, the perceptions for which reflect no meaningful difference is H₁₂₁: determine the reliability of the evidence, which seems to contradict a part of the data related with “evaluation/metacognition”. This contradiction might have derived from confusing the difference between the terms “reliability” and “credibility”.

CONCLUSIONS

This study concerns how to develop adult metacognition. Believing that providing learners with the basic “knowledge of cognition” such as *declarative, procedural and conditional knowledge* is likely to make little sense unless it is regulated and raised to metacognitive knowledge. The knowledge gained is to be promoted so that learners are able to plan, monitor, assess and evaluate their own learning.

The students studying at higher education are considered adolescents and/or early adults. Hence, while arranging facilities for their learning, certain distinctive characteristics and needs of such adults should be taken into account. The distinctive features these learners have gained could be categorized into such umbrella terms as “experience” “awareness”, “practice” and “motivation”.

An overall search through the methods of teaching and learning for the most effective means reveals that direct learning, peer regulated learning, and autonomous learning could be the best for such

early adult learners studying at higher maritime education institutions. A further probe into the various practices of these learning methods indicates that self directed learning approach would yield the most fruitful outcomes. This approach helps engage learners in the learning process to acquire higher-order thinking outcomes, construct their own understanding reason, problem-solve, and think critically about the content.

The problem-based learning sessions, practiced at Izmir Dokuz Eylül University Department of Nautical Science, are believed to respond to the distinctive features of early adult learners and meet the requirements of self-directed approach aiming at encouraging learners to get involved in the learning process to acquire higher-order thinking outcomes. To test this belief, and to find out the extent to which the problem-based learning sessions promote the learners acquiring higher-order thinking, a research has been conducted through the students studying at the Department of Nautical Science.

For the research, "Higher Order Thinking and Problem Solving Checklist" (Borich, 2004,294) (Beyer 1995;Hester 1994) has been used. The perceptions of the learners on the effects of the problem based discussion sessions on development of their cognition and metacognition have been received through the questionnaire. The overall results revealed that the method mentioned is most likely to promote the *application of knowledge* particularly in communicating the results and consulting a variety of knowledge sources to gather information; enhancing such analytical skills as comparing a problem to problems encountered previously, identifying and articulating errors, explaining the reasons for a conclusion and interpreting a problem; to improve *synthesis/creativity* through generating new ways of viewing a situation, brainstorming new applications, and anticipating potential problems; and to raise involvement(*dispositions*) in sharing and taking turns, providing assistance to others, engaging in tasks, tackling difficulties, displaying enthusiasm for learning, collaborating with others in team, listening attentively to others, and setting achievable goals; and to develop such *values* as maintaining self discipline in dealing with difficult situations, caring and concerning others, and acting responsibly in dealing with tasks and people. Another important result yielded by the research is that perceptions of the four different levels of learners reflect meaningful differences, which could mean that self directed learning method, particularly when complemented by problem based learning method is likely to promote higher order thinking not in a static and routine manner but in a dynamic and changing pattern in differing levels.

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