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A Proposed Protocol for GMP-BoK Implementation Gap Analysis – Case Study at AASTMT

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Abstract

Purpose: *Maritime Education and Training (MET) plays a crucial role in maintaining the safety and sustainability of the maritime industry. However, it remains behind the industry expectations to fulfill the gap regarding the required level of maritime capacities to safely control efficient new technology and keep them sustainable and effective during the industrial revolution era.*

The International Association of Maritime Universities (IAMU) developed the Global Maritime Professional Body of Knowledge (GMP-BoK) to address the current gap between the maritime industry expectations and the delivered Maritime Education and Training (MET) programs.

Design/methodology/approach: *This paper briefly introduces the GMP-BoK and proposes a protocol for a new analogous instrument to efficiently implement the GMP-BoK via a user-friendly method developed at the Arab Academy for Science, Technology and Maritime Transport (AASTMT). The developed analogous instrument helps maritime universities and institutes to digitalize and develop an integrated curriculum framework that is based on robust evaluation and data analysis to develop strategic plans to improve seafarer capabilities. Moreover, the paper suggests a protocol for mapping and analysis of maritime programs and courses, enabling educators to reliably perform gap analysis and identify repetitions within delivered courses and programs based on the GMP-BoK recommended practices. As a case study, the proposed protocol was validated utilizing the Maritime Engineering Technology Program (METP).*

Findings: *The findings of this study revealed that the examined METP includes 30% repetition and focuses on the cognitive and psychomotor methods of education, with little focus on the affective technique.*

Key-words:
GMP-BoK, Higher education, Maritime Education and Training (MET). STCW.

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1. INTRODUCTION

The success and sustainability of any service industry such as the maritime industry are entirely subject to securing and preserving highly qualified human resources through effective Maritime Education and Training (MET). Effective education and training in the maritime sector are derived from scientific and academic rigour and the development of a clear link between practical skills, management techniques, and a focus on quality. Indeed, several industry-influencing factors determine the future of the international maritime industry and formulate the character of the next generation seafarer and the optimum MET curriculum.

The International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW) was the first international standards for seafarer training, certification, and watch keeping. However, the convention's first version had many flaws, and later significant changes in 1995 and 2010 attempted to align the standards with the changing nature of the industry, legislation, and socio-cultural dynamics. Seafarer education and training nowadays are centred on the technical and affective competencies proposed by the STCW 1978, as amended (IMO, 2017).

The 2016 International Association of Maritime Universities (IAMU) Haiphong Statement recommends that in the context of IAMU,

> ***"Degrees for seafaring officers should include educational outcomes well above and beyond the minimum requirements of the STCW to prepare future seafarers for a rapidly changing industry."***

IAMU embarked on a bold initiative to formulate a comprehensive guideline for the next generation of leaders under a new title "The Global Maritime Professional (GMP)" and formulated a task force to set up the action plan for the GMP initiative and establish the required roadmap.

In the same year, a new working group (WG) was established by experts from three universities; The World Maritime University (WMU), The Arab Academy for Science, Technology and Maritime Transport (AASTMT), and Satakunta University of Applied Sciences (SAMK), in addition to the executive director of the IAMU, to align the curricula of the IAMU member universities with the agreed Intended Learning Outcomes (ILOs) concept at national and regional levels taking into consideration their academic freedom and requirements of their jurisdictions.

In 2017, the WG gave its final report to the IAMU International Executive Board (IEB) in Varna, Bulgaria. The report recommended preparing a Body of Knowledge in detail, including its content and the action plan for accomplishing the task.

Subsequently, the working group set up two Fundamental Principles for establishing the GMP. The first was to identify the learning outcomes deemed common for optimizing human resource competency for the maritime industry across all national boundaries by focusing on student ability and constructive alignment learning outcomes-based education as opposed to objectives-based education. Based on the internationalization principle of respecting the IAMU member universities' academic freedom and jurisdictional sovereignty, the second principle was to leave the determination of specific curricula, syllabi, and learning activities to individual Higher Education systems in sovereign states.

The project passed through several stages, starting with the initial phase of establishing the GMP-BoK down to the final stage of developing a self-evaluation system for confirming whether a member university of the IAMU embodies the philosophy of the GMP-BoK.

The GMP-BoK initiative provides the underpinning philosophy of higher education by envisioning significant curricular improvements in academic preparation and adds a new element, leadership, and ethics; both are increasingly necessary as technology and globalization continue to disrupt the IAMU profession. Preparing maritime students for this new environment is crucial for the near-coming digitalization era of the international maritime industry.

In 2019, IAMU established a new WG for "GMP implementation" to support the proper adoption of this new concept by IAMU member universities. AASTMT was selected as an advisor to the "GMP implementation" WG team members. Subsequently, AASTMT decided to adopt the GMP concept and therefore established an internal GMP-SC(GMP-SC) to establish and supervise the implementation process.

This paper aims to highlight the importance of the GMP-BoK, the AASTMT vision for implementation. In particular, the research focuses on the gap analysis process that was conducted as a part of the GMP-BoK implementation process in parallel with the MET development policy of AASTMT.

2. GMP-BOK CONCEPT AND METHODOLOGY

The GMP-BoK concept came to take the MET system from the traditional objective-based education to the modern outcome-based educational concept. The outcomes-based educational approach is an "Active" approach that focuses on the student who is learning, which focuses on student ability, Constructive alignment, and Learning outcomes and not learning objectives (Biggs & Tang, 2011).

To do so, the educator must first identify which educational domain this newly added focus area represents, therefore, the GMP-BoK presents a set of tables clarifying each educational domain in the selected focus area.

2.1. Educational Domains

Every learning process can be generally categorized into three educational domains, Cognitive –Affective – Psychomotor, where every subject matter may contain one or two or even all three domains. The educator must identify the educational domain in the subject matter that best suits the learner in a specific educational phase or level (Bloom et.al., 1956).

The first of these domains, the cognitive domain, contains learning skills predominantly related to mental (thinking) processes and the improvement of intellectual skills of the learner through a simple learning process focused mainly on mental abilities to remember, understand, memorize, and, later on, recall and apply the information into different applications.

The affective domain describes how certain issues are dealt with emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. Affective is the stimulus for the action; it is a monitor and a controller of the cognitive processing activities. Without the affective domain, learners will find learning difficulties, knowledge will not be processed well, and cognitive activities will not run efficiently.

The psychomotor domain merges physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, procedures, or techniques in execution. Thus, psychomotor skills range from manual tasks, such as digging a ditch or washing a car, to more complex tasks, such as operating a complex piece of machinery. This domain is much accounted for in MET, but if not well integrated with previous domains, the psychomotor domain will be fragile and poorly performed.

2.2. Taxonomies adopted by the GMP-BoK

To have a sensible progressive and accumulative procurement of information or data in a single educational domain, the domain was dissected into gradual "Levels of Achievements" (LoA), best explained by the Taxonomy of Learning or educational domains formulated by a group of researchers led by Benjamin Bloom. Bloom's taxonomy was first developed and described between 1956-1972 (Bloom et. Al., 1956) and revised in 2001 by Anderson and Krathwohl.

The GMP-BoK adopts Bloom's taxonomy in both the cognitive and affective domains. However, due to the vocational nature of the MET, Simpson's taxonomy was adopted for the psychomotor domain. The following three figures illustrate the LoAs for each learning domain, showing the gradual nature of these levels. All levels are cumulative and cannot be dependable, as skipping one level could lead to improper assimilation of the domain (Anderson & Krathwohl, 2001) (Simpson, 1972).

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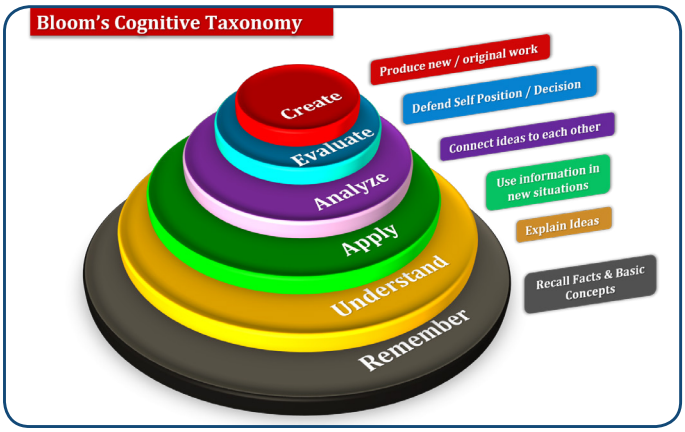

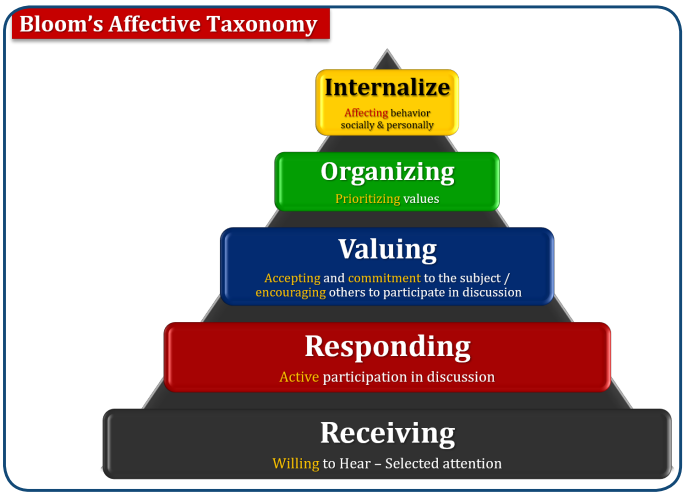

Figures 1 & 2: Bloom's Taxonomy – Levels of Cognitive Domain – Levels of Affective Domain.

Source (modified): Anderson & Krathwohl, 2001

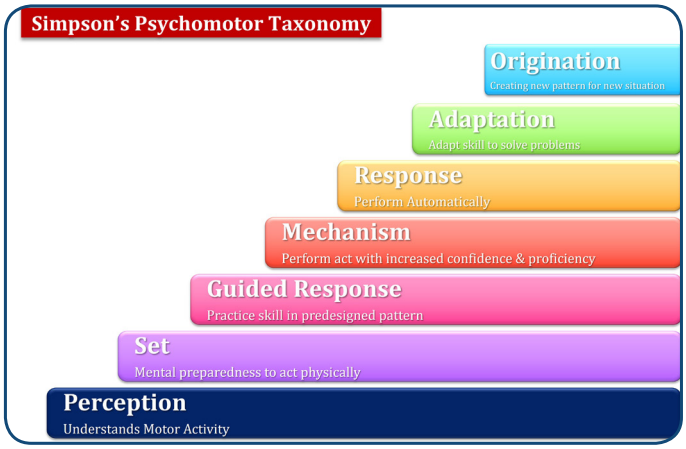

Figure 3: Simpson's Taxonomy – Levels of Psychomotor Domain.

Source (modified): Simpson, 1972

2.3. ILOs in Each Level of Achievement

As a final step of the methodology, the GMP-BoK created a table for each of the three domains containing the newly added focus areas that the GMP-BoK adopted. Each table contains the domain's LoAs as described in the taxonomy.

Table 1 illustrates an example of a "Ship Stability" focus area. The table shows the LoAs for a single domain, in this case, the cognitive domain. Each LoA has several ILOs spelled out as a brief sentence describing what the students should be able to do by the end of the respective part of the program. This ILO is intended as a guiding line for the educator to properly design an educational program covering all three domains in this focus area.

Table 1: Levels of achievement and ILOs (Cognitive Domain - Bloom's Taxonomy)

Subject	Ship Stability					
Cognitive Domain	**Remembering**	**Understanding**	**Applying**	**Analysing**	**Evaluating**	**Creating**
	To remember the list of solving equations.	**To understand** the terms, symbols & the construction of the equations.	**To apply** different scenarios to test ships' stability, e.g. by shifting weights.	**To analyze** key factors affecting ships' stability.	**To evaluate** the weight of relevant factors influencing ships' stability.	**To create** new techniques for analyzing ships' Stability.

Although, there are no hard rules to the number of learning outcomes, normally 1 to 12 PLOs are about right per program and from 4 to 6 CLOs per course. There are many available open-source websites for writing a learning outcome, such as the learning outcome generator and easy generator. All tools share the concept that every learning outcome should be composed of action verbs, content, context, and demonstrable outcome (see Table 2).

Table 2: Showing examples of writing a constructive learning outcome (UNSW, 2022).

Action Verb	Content/ Topic	Context	Demonstrable Outcome
Construct	a reference list	using an appropriate disciplinary style	Construct a reference list using an appropriate disciplinary style
Demonstrate	effective negotiation	with health care providers	Justify solutions to case studies set in hospitals with an identified health care provider
Apply	principles of good learning & teaching	in higher education	Detail your approach to teaching, drawing on your own students' learning experiences
synthesize	elements of a claim of defence	according to law	Prepare court documents in accordance with relevant court rules within the required timeframes

2.4. GMP-BoK Tiers

The GMP-BoK categorizes the learning outcome requirements at four levels or tiers: A, B, C, & D.

- **Tier A:** Operational level certificate of competency (STCW) and a Bachelor of Science Degree.
- **Tier B:** Management level certificate of competency (STCW) and a Bachelor of Science Degree.
- **Tier C:** Management level certificate of competency (STCW) and a Master of Science Degree.
- **Tier D:** Management level certificate of competency (STCW) and a Doctoral Degree.

Each tier acts as a prerequisite to that which follows.

The GMP-BoK sets out tables that show the different GMP tiers as they relate to the relevant taxonomies levels and the specific knowledge, skills, and attitudes (KSAs), as shown in Table (3).

Table 3: Distribution of the GMP tiers on the levels of achievements for the specific KSAs

Principles and Practices Related to;	Levels of Achievement in the Cognitive Domain					
	1 Remembering	2 Understanding	3 Applying	4 Analysing	5 Evaluating	6 Creating
Foundational Elements						
1. Mathematics	A	A	A			
2. Natural (physical) sciences	A	A	A			
3. General humanities and social sciences	A	A	A			
4. English language and maritime communication	A	A	A			
5. Computing and informatics	A	A	A			
6. Physical and mental fitness	A	A	A			
Academic Elements						
1. Problem recognition/ solving	B	B	B	B	C	D
2. Critical thinking	A	A	B	B	C	D
3. Academic research	A	A	A	B	C	D
4. Contemporary global issues	A	A	B	B	C	D
Professional – Technical Elements						
1. Technical competencies as per international requirements (STCW)	A	A	A	B	C	D

Source: GMP-BoK (IAMU, 2019)

3. IMPLEMENTATION OF THE GMP-BOK AT AASTMT

AASTMT has a long history in developing international standard MET programs. Since its inception, AASTMT's purpose has been "to strengthen and develop the maritime sector in each of the participating countries [of the League of Arab States]" through high quality MET (Moukhtar, 1974). Fifty years later, AASTMT continues to serve its purpose not only in the Arab world but as part of a growing global network of maritime universities, the IAMU, seeking to propel the maritime industry into the future by providing the maritime industry with the

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highest quality maritime professionals as described within the GMP-BoK.

The successful implementation of the GMP-BoK, therefore, requires a whole institute approach that considers the needs and connectivity of the various administrative and educational levels. The AASTMT Implementation GMP-SC set up a roadmap for the initial implementation of the GMP-BoK (Phase 1) as a model bearing in mind the core GMP concept; the connection among the three parties of the Triple Helix concept.

3.1. GMP-BoK Phase 1 Implementation Roadmap

Phase 1 plan passed through three stages. The first stage commenced with several seminars and workshops to introduce the GMP concept to the AASTMT maritime sector and the relevant national and regional stakeholders. The second stage aimed to set the targets and provide a roadmap for an implementation model (Figure 4). This implementation model was applied to a chosen program within the maritime sector, and the same model was later proposed to the IAMU GMP Implementation WG. Finally, the first phase ended by presenting a GMP Implementation model to the IAMU Presidents Forum during the IAMU Annual General Assembly (AGA21) events in October 2021 in Alexandria, Egypt. Currently, the AASTMT GMP-WG is working with the AASTMT maritime sector entities to implement the GMP approach completely within the next phase.

3.2. Implementation Hierarchy and Concepts

A simple Plan-Do-Check-Act (PDCA) cycle for implantation is used as four discrete processes are envisioned: planning, implementation, monitoring and reporting, and reviewing. The implementation process requires both a top-down approach and a bottom-up approach. Figure 5 shows both approaches as they are being applied to implementing the GMP-BoK in AASTMT.

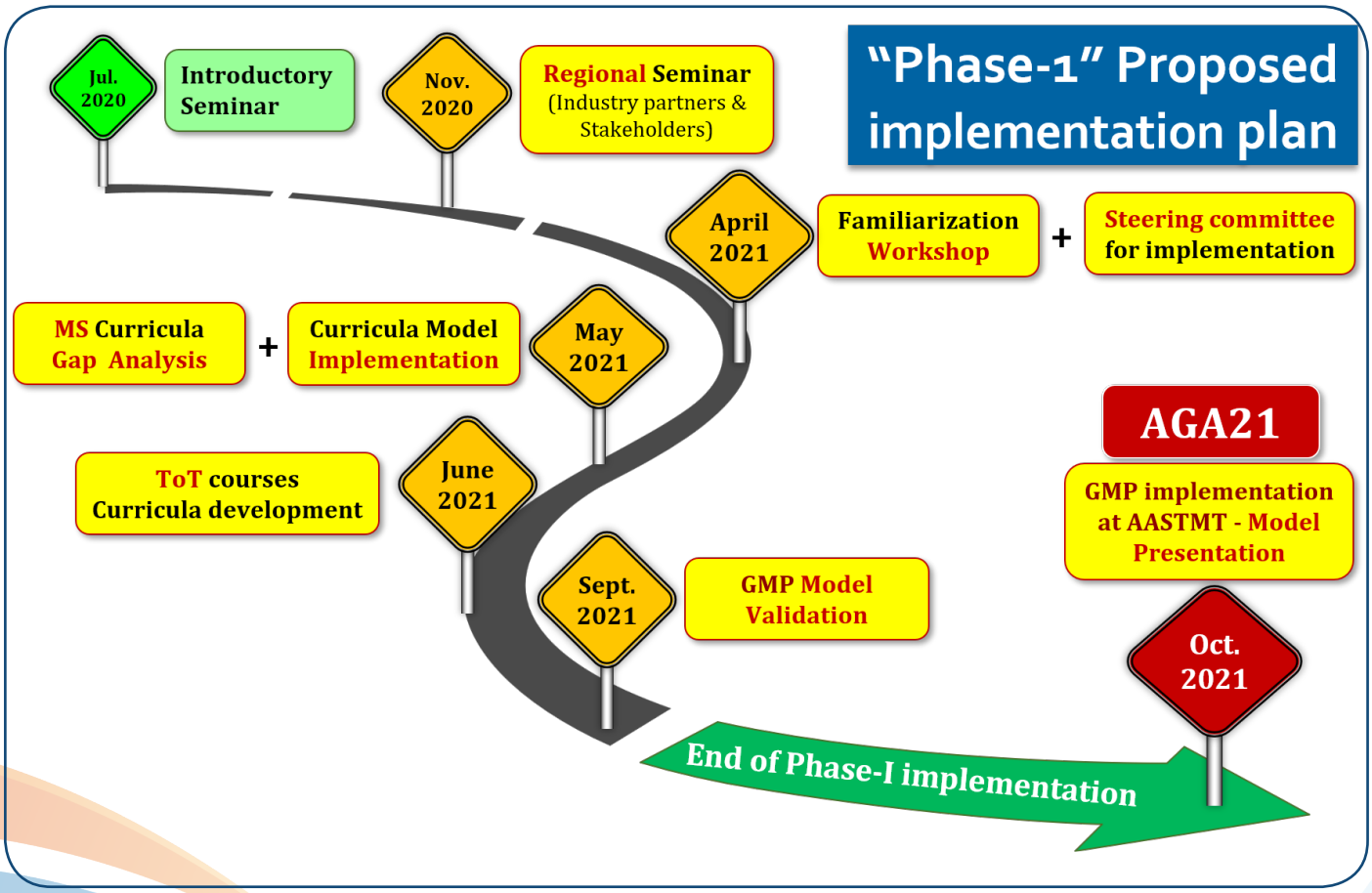

Figure 4: AASTMT Implementation Plan – GMP (Phase I)

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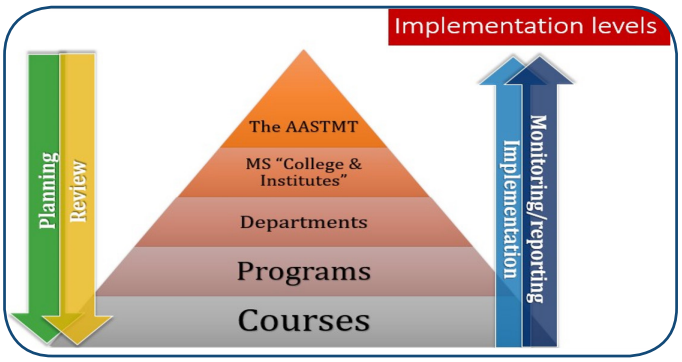

Figure 5: The AASTMT GMP-BoK Implementation Hierarchy

The initial planning process naturally follows a top-down approach where the strategic directions of AASTMT's Maritime Sector (MS) are spelled out. Each entity within MS then incorporates these strategic directions into its own strategic plan which is consequently reflected in the aims and learning outcomes of its programs (PLOs) and subsequently the courses (CLOs) fulfilling these programs. In this regard, AASTMT has created a GMP-SC responsible for overviewing the GMP planning process.

The implementation process follows the reverse direction, a bottom-up approach, starting with applying the GMP-BoK at the course level to realize each Course Learning Outcomes (CLOs) and working the way up to fulfilling AASTMT's strategic targets. Concurrently, monitoring of the implementation process and reporting follow the same direction. Subsequently, the GMP-SC reviews the previous procedures and makes necessary recommendations. AASTMT also realizes the importance of maintaining a solid link with the government represented by the Egyptian Maritime Safety Authority (EMSA) and industry represented by AASTMT's many partners in the maritime field. First introduced by Etzkowitz and Leydesdorff (1995), this triple-helix approach to MET is especially critical in this era of continuous technological disruptions as presented by the ongoing fourth industrial revolution (4IR). AASTMT understands that the envisioned GMP should be at the heart of the triple-helix model (Figure 6).

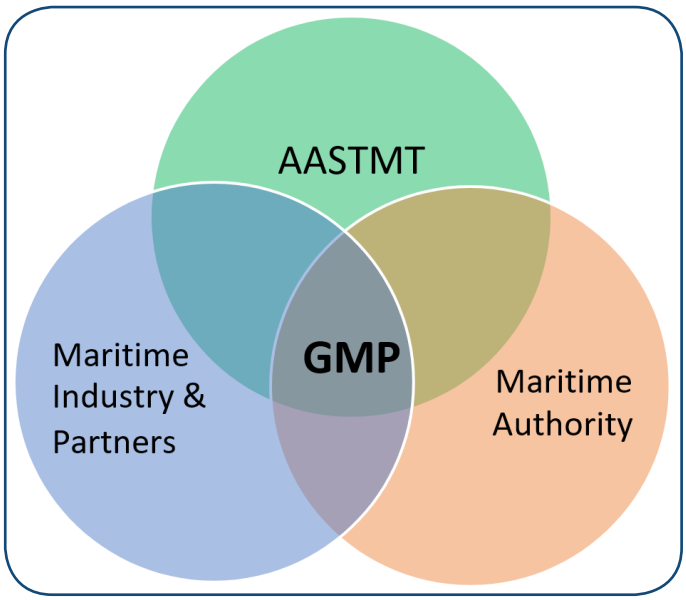

Figure 6: AASTMT Triple-Helix approach to the GMP

3.3. GMP-BoK Implementation Mechanism at AASTMT

As previously mentioned, AASTMT moved towards the GMP concept implementation in the curriculum and programs of the AASTMT maritime education and training institutes.

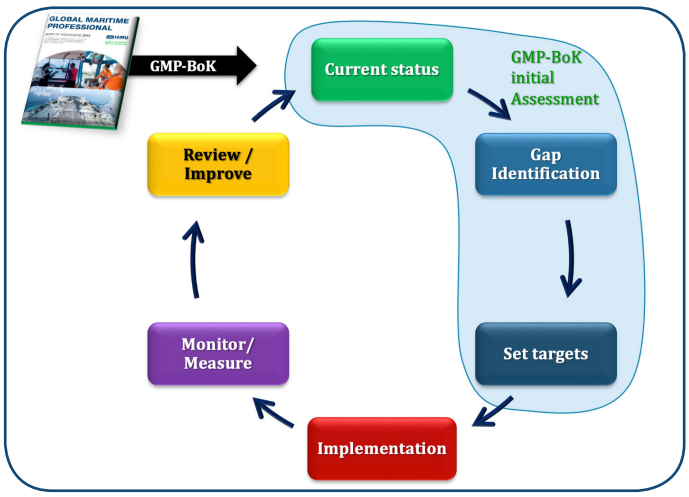

Figure 7: AASTMT GMP Implementation – Self-Assessment Loop

Following the successful validation of the initial implementation model, the AASTMT GMP-SC set up a five-year action plan for the GMP-BoK full implementation. The procedure commenced by evaluating the current status to identify the gap between the present and the targeted level of achievement. The implementation process is presented as a continuous self-assessment loop, as shown in Figure 7.

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4. GAP ANALYSIS AND MAPPING

Based on the proposed self-assessment loop, the gap analysis is one of the main processes for validating and revalidating the implementation procedures. In accordance with the five-year action plan for the GMP-BoK full implementation, AASTMT has developed a protocol for gap analysis and mapping for maritime programs and courses. The protocol allows educators, course coordinators, and program coordinators to reliably perform gap analysis and identify repetitions within delivered courses and programs based on GMP-BoK recommended practices.

The developed analogous instrument (mapping tool) helps maritime universities and institutes to digitalize and develop an integrated curriculum framework based on robust evaluation and data analysis to develop strategic plans to improve seafarer capabilities. The instrument balances the three key learning domains of cognitive, affective, and psychomotor practices while focusing on different levels of achievement in four enabling focus areas, e.g., fundamentals, academics, profession and soft skills required for a competent seafarer, as shown in Figure 8.

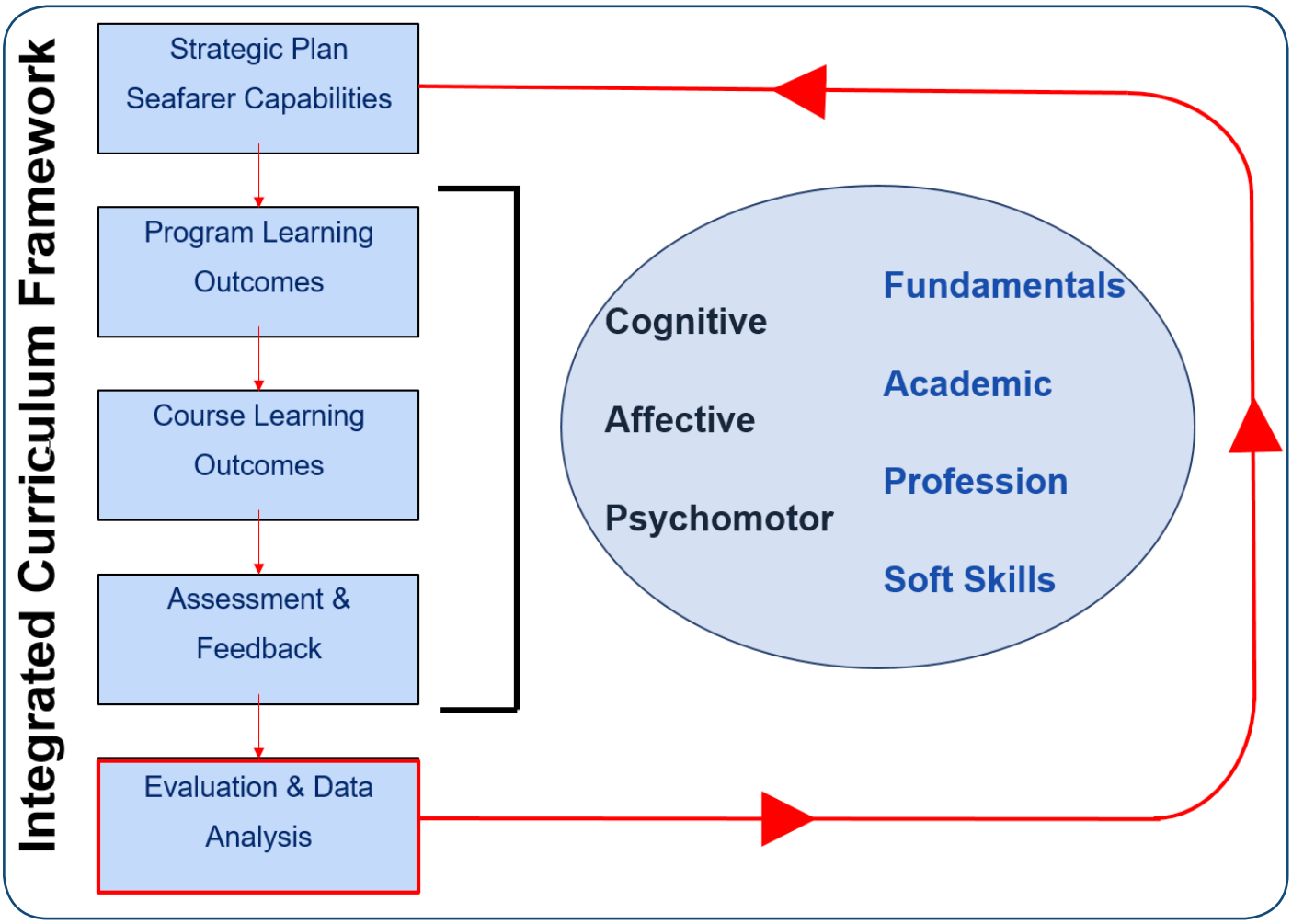

Figure 8: Showing a line diagram of a proposed integrated/digitized curriculum development framework

The mapping tool takes into consideration that the recommended procedure, data structure, and coding strategy can be easy to implement on paper or electronically and convenient for analysis and data post-processing for faculty.

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All maritime programs and courses, e.g., of the four defined tiers in section 2.4 of this manuscript, should align and contribute to one/or a number of the targeted focus areas as defined in the GMP-BoK, and presented in Figure 9.

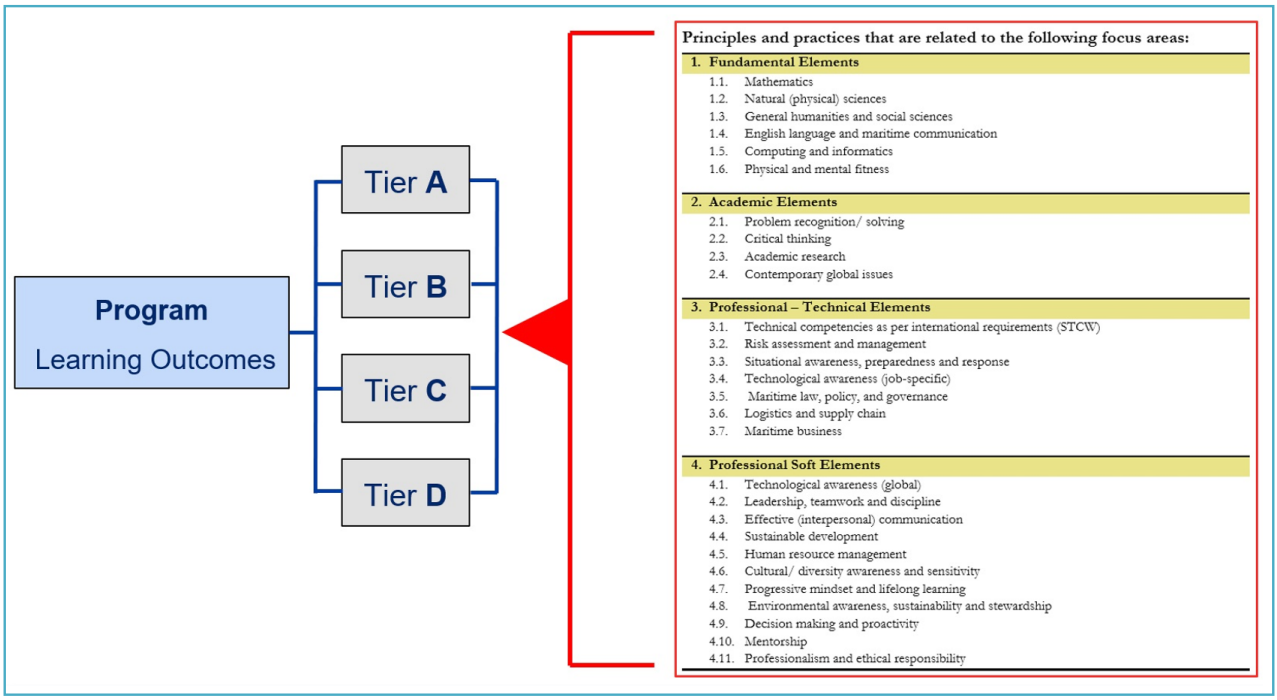

Figure 9: Showing the focus areas as defined in the GMP-BoK.

For this study, the Maritime Engineering Technology Program (METP) in AASTMT was selected to perform both mapping and gap analysis studies utilizing the developed mapping tool. To accomplish this, the PLOs of the METP program were inserted into the mapping tool and the output data were analyzed robustly.

To achieve this, each METP's PLO was mapped with the recommended focus areas shown in Figure 10, and just a symbol/s were selected in the corresponding box, as shown in Figure 10, where CO refers to cognitive, AF = affective, and PS = Psychomotor.

This Analogous Instrument is Developed in the Arab Academy for Science, Technology and Maritime Transport (AASTMT), by (A.Swidan, 2021), to Assist IAMU Members and Maritime Universities Worldwide in Mapping Maritime Programs, Courses and Units with Corresponding GMP-BOK' Teir Level.

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Date:	26th Oct 21	Program Name:	Mapping GMP-BOK	Coordinator:	Professor Gamal Ghalwash	No. students:	Large	Developed by:	Dr Ahmed A. Swidan
Type of Instituition:	College of Maritime Transport	GMP Tier:	GMP Tier A			Degree:	Bachelor of Technology (BT)		
Service:	Education	Classroom Arrangement:	On-campus						

	1. Foundational						2. Academic				3. Professional - Technical							4. Professional - Soft										Comments
Sub Elem.	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	3.5	3.6	3.7	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11	
PLOs																													
a	CO	CO			CO		CO		CO		CO		CO					CO										CO	
b							CO	CO AF PS																					
c	CO PS	CO PS			CO PS		CO PS												CO PS	CO PS						CO PS	CO		
d			CO AF							CO PS	CO PS	CO PS	CO	CO AF				CO PS			CO AF	CO AF	CO AF		CO PS			CO	
e	CO PS	CO PS		CO	CO	CO	CO PS	CO PS		CO PS	CO PS	CO PS		CO PS				CO PS											
f							PS	PS			PS	PS	PS	PS				PS											
g															CO	CO	CO		CO	CO						CO			
h			CO			CO															CO			CO			CO		
i			CO	CO PS		CO				CO			CO		CO				CO PS	CO PS		CO PS	CO PS			CO PS			
j																			CO	CO		CO	CO				CO	CO AF	
k												CO PS	CO PS						CO PS	CO PS						CO PS	CO PS	CO PS	

Figure 10: Mapping of the METP

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5. GAP ANALYSIS RESULTS AND DISCUSSION

5.1. Results

The results of this study are presented in Figure 11, showing that the cognitive method of education is dominant with over 61%, while the affective technique is the lowest percentage at 6%, and the Psychomotor reaches 33%. The data display was also capable of identifying levels of repetition within the PLOs as shown in the summary report in Figure 11, where light blue refers to a gap, medium blue refers to covered once, and dark blue refers to that PLO covered for a couple of times, and the red highlights a repetition for more than two times.

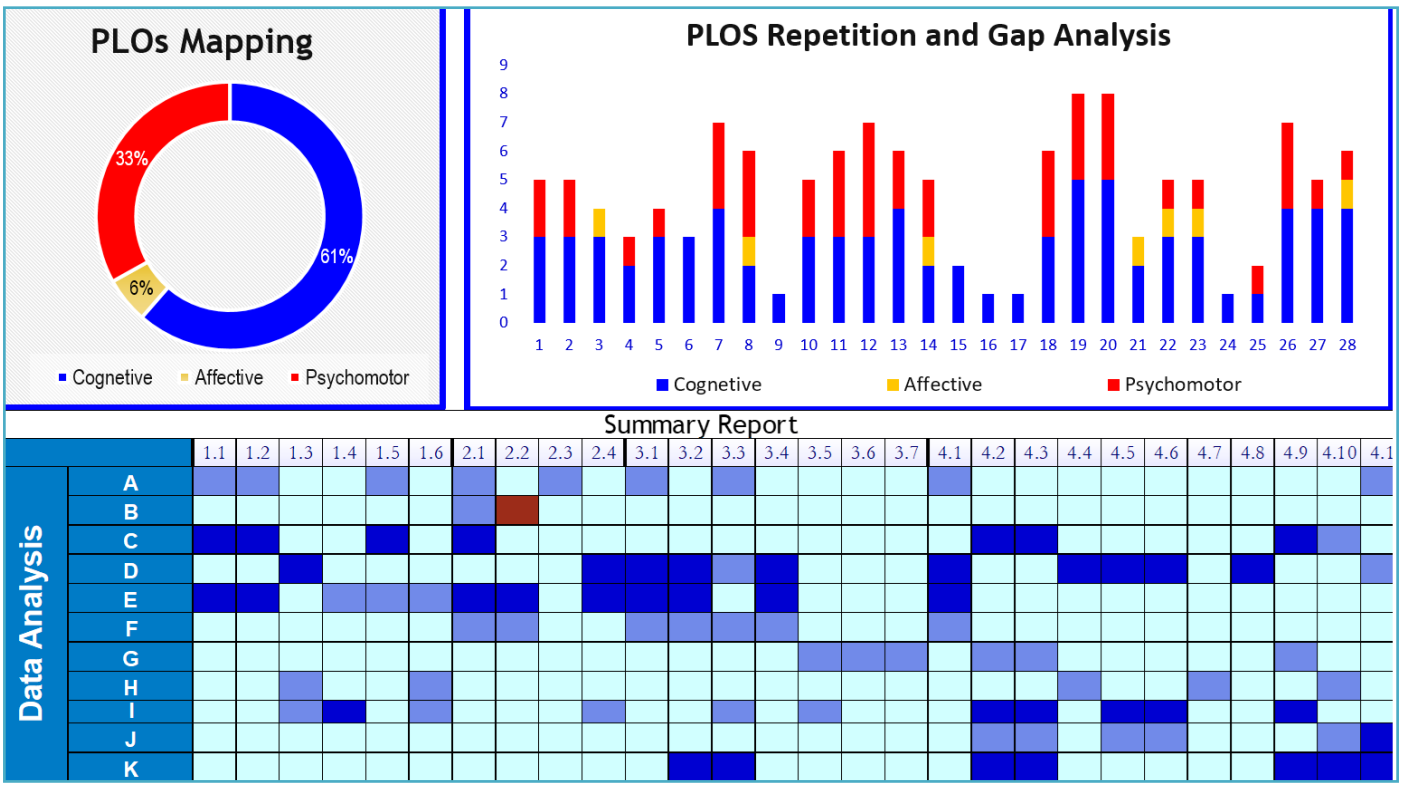

Figure 11: GMP-BoK mapping tool – Summary Report for level of competencies of the METP

5.2. Discussion

Based on the above outcomes, the cognitive domain in the METP program shows the highest level of presence especially compared to the affective domain, an expected outcome due to the current international MET system, which does not explicitly consider the required affective attitudes. On the other hand, the psychomotor domain displayed an expected rate suitable and in consistence with the vocational skills requirement for a dynamic industry such as the maritime industry.

6. CONCLUSION

Maritime industry-influencing factors determine the future of the field and formulate the character of the next generation of seafarers and, therefore, the required MET curricula.

The GMP-BoK was mainly established to enhance curriculum design in IAMU member universities by adding new focus areas to the MET process. It is based on two principles: firstly, to identify the learning outcomes focusing on student ability and learning outcomes-based education. Secondly, to leave the determination of specific curricula, syllabi, and learning activities to individual higher education systems in sovereign states.

The implementation of the GMP-BoK by AASTMT is applied through a simple cycle for as four discrete processes are envisioned: planning, implementation, monitoring and reporting, and reviewing.For the purpose of this study, the METP program in AASTMT was selected to perform both mapping and gap analysis studies utilizing the developed GMP-BoK mapping tool.

The mapping process results show that the METP program focuses mainly on the development of cognitive skills followed by psychomotor skills. While results indicate the need for future enhancements regarding affective attitudes. The mapping process was also capable of identifying levels of repetition in the chosen program.

As a result, the METP Curriculum design was enhanced by adding newly selected focus areas from the GMP-BoK. Finally, the user-friendly GMP mapping tool developed by AASTMT may help other member universities inside the IAMU community to effectively implement the GMP-BoK.

Future work will include a thorough assessment of the taught programs at AASTMT from tier A to tier D to align with AASTMT's strategic plan.

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