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Helping Accelerate the Global Maritime Professional Body of Knowledge up the S-Curve of Innovation

Paul Szwed [1, *] and Graham Benton [2]

[1] *Massachusetts Maritime Academy, Buzzards Bay, Massachusetts, USA*
[2] *California State University Maritime Academy, Valejo, California, USA*
[*] *Corresponding author:pszwed@maritime.edu*

Abstract:
In a visionary effort to help guide maritime education and training (MET) institutions in readying their students for an evolving future resulting from an information revolution, the International Association of Maritime Universities (IAMU) released the inaugural edition of Body of Knowledge for Global Maritime Professionals (GMP BoK) in 2019. It was intended that the GMP BoK be a "living resource" that is revised and improved periodically. In that light, we have reviewed the GMP BoK using a use case analysis. Specifically, we examined the essential GMP competency of academic research using a generic MET institution. From this analysis, we observed two categories of potential improvements: product enhancements and product extensions. In the end, this use case analysis uncovered a potential need for additional flexibility within future editions of the GMP BoK as well as a need for future product extensions (e.g., companion versions – one that focuses on instructional/learning methods and another that focuses on learning assessment).

Keywords: Global Maritime Professional, Innovation, Alignment, Product Enhancement, Product Extension

1. Introduction

In 2019, the International Association of Maritime Universities (IAMU) released its inaugural edition of the Body of Knowledge for Global Maritime Professionals (GMP BoK). This visionary effort was intended to help guide maritime education and training (MET) institutions in readying their students for an evolving future resulting from an information revolution. The GMP BoK was meant to address the overarching purposes articulated in the original Agreement of IAMU and in subsequent statements (i.e., as emphasized in the 2014 Tasmanian Statement and clarified in the 2016 Haiphong Statement) to develop a well-prepared global maritime work force. As noted in the Forward to the GMP BoK, the intent was to provide a:

> "shared description of a global maritime professional, an articulation of competencies required to master the new maritime work environment, a set of recommended learning outcomes, and suggestions for curriculum development" [GMP BoK p. vii].

The GMP BoK built upon the research of those attempting to universalize maritime education and training with the understanding that a collective global and unified MET system is not only beneficial to an industry that is, by its very nature, multinational, interdependent, and fragmented, but also more efficient and innovative. As is now commonly recognized, such an undertaking suffered because of the complex nexus of national rules and regulations, diverse accrediting bodies, and particular missions and visions of individual MET institutions around the world. The GMP BoK successfully circumvented many of the issues that plagued earlier attempts for curricular unification by emphasizing outcomes, rather than standardized curricula (i.e., model courses, syllabi, lesson plans, standardized exams and the like). Such an orientation was crucial to establish the multi-tiered construct by focusing on the desired end result, and not on the means by which that result was attained.

Beside the substantive work done on universalization of MET prior to the publication of the GMP BoK, since 2019 more scholarship has been devoted to the application and analysis of this framework. Even with the disruption of intellectual activity brought about by a global pandemic, maritime educators began to apply the GMP BoK framework to various programs – see e.g., Benton's "The Application of the Global Professional Framework on an MET Program" (2021); Bolmstem's "Maritime Innovation Management – A Concept of an Innovative Course for Young Maritime Professionals" (2021); Mednikarov's "Current Trends in the Maritime Profession and their Implications of the Maritime Education" (2021); Loginovsky's "Global Maritime Professional: University Course of Risk Assessment" (2021); Baylon's "Sustainable Development in Maritime Education and Training (SDiMET) Towards Global Maritime Professionals (GMP) Development" (2021), and many others.

Thus, while the problem of the standardization of the acquisition of knowledge and skills has been probed for some time, the critical application, reception, and interrogation of the GMP BoK itself is relatively new. Within this nascent body of work, there are parallel (and overlapping) trajectories – one strand that seeks to apply the framework to an existing program in order to see how that program aligns with the standards and outcomes of the GMP BoK, and another strand that seeks to critique the methodology of that framework. This is, of course, the nature of intellectual work, and we are cognizant of the fact that an appraisal of the efficacy of the framework may be premature in that the data surrounding the application of the framework on current programs has not matured. However, we also feel that an analysis of the work – with criticism wholly meant to be constructive – is consonant with the spirit with which the BoK was created:

> "The Body of Knowledge is not intended to be a singular, static document, but rather a living resource that adapts and evolves so as to be a key resource for al stakeholders" [GMP BoK p. 65].

We offer possible adaptations and revisions to the GMP BoK with the knowledge that we have not yet fully exhausted the potential inherent in this inaugural edition. There is much that can be learned from further applications of the current model that many maritime institutions are still considering. Rather, this analysis is meant to provoke ways of thinking about the future of the GMP project – as thought experiments to increase the utility of the framework for both the specific institution using it as an assessment tool and for the collective organization of institutions desirous of a shared objective.

In the following sections, we begin first with a theoretical turn from conceiving the GMP BoK not merely as a pedagogical tool, but as a *technology* so we can historicize its evolution and better see where it lies in on the spectrum of adoption. From this perspective, attention is then given to the learning outcomes themselves. It will be argued that a turn from Bloom's classic taxonomy toward that of Anderson and Krathwohl may provide for a more robust classification. This will be explored by reviewing the same case study used in the GMP BoK. By using this context, a simple use case analysis will be performed. Finally, the authors will suggest some ideas for future editions and volumes of the GMP BoK. All this is presented by way of suggesting improvements to a framework that has already proven to be useful in fostering debate on how to educate maritime professionals in a dynamic and volatile globalized industry.

2. Reconceptualizing GMP BoK as Technology

While the GMP BoK is indeed an important pedagogical tool and framework, it may also be viewed as a *technology*[1]. In this case, the technology of the GMP BoK is the application of pedagogical knowledge (particularly that which is evidence-based) to enhance the state of MET systems for creating global maritime professionals. Most technological innovations follow a predictable pattern of growth and adoption, commonly referred to as the S-curve of innovation (see Figure 1), where the horizontal axis represents the time horizon and the vertical axis represents some adoption. Like other incipient technologies, the GMP BoK lies at the bottom of the S-curve of innovation (i.e. point A) where growth and adoption are slow. The goal of most

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1 According to Oxford Dictionary of English Languages, the first listed definition of technology is "the application of scientific knowledge for practical purposes, especially in industry." It is much broader than the common understanding of technology as "machinery or equipment" (the second listed definition).

technological innovations is to climb the S-curve and realize exponential growth and adoption (i.e., point C). In general, the S-curve of innovation follows the notions of diffusion of innovation as it pertains to markets as follows:

A. Early Market (prior to any recognized adoption except “innovators”)

B. Early Adoption (where adoption is driven by “early adopters”)

C. Mass Adoption (where adoption is driven by first and early then “late majority” of adopters)

D. Late Adoption (where adoption continues with “laggard adopters”)

Additionally, after the late stages and technology or product maturity, adoptions begin to decline as the adopters seek other alternatives. At this point, new technologies or products are released to extend adoptions into another S-curve of innovation (the bottom of which is represented with the dashed line in Figure 1).

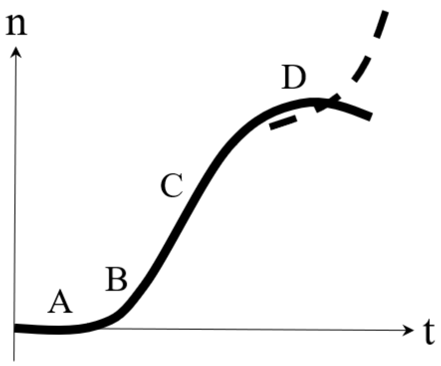

Figure 1: S-Curve of Innovation/Adoption

However, when a technology is in early stages (i.e. at points A or B like the GMP BoK), it is unclear if adoption will be sufficient to initiate mass adoption. In these cases, additional effort and expense (such as through positioning and promotion) are unlikely alone to yield advancement up the S-curve of innovation. Instead, continuing improvements (or product enhancements and extensions[2]) of the GMP BoK will be needed to enable significant growth and adoption. In this spirit of continuous improvement, this paper will now explore opportunities for enhancing and extending the GMP BoK.

3. Use Case Analysis

It is often instructive to test a technology using a specific use case. While use case analysis if frequently used in designing products and their requirements, they may also be applied retroactively to determine effectiveness and usefulness of that product from the user perspective. In this case, we will examine the technology of the GMP BoK from the perspective of a user using the foundational competency of “academic research” as the object of the case study. In other words, we will consider a fictitious MET institution program and use the GMP BoK to help identify relevant learning outcomes. However, we will also take the opportunity to explore potential product/technology enhancements and extensions along the way.

The GMP BoK provides an implementation framework (Figure 2) that employs a four-step procedure for extracting learning outcomes.

[2] Product enhancements are typically viewed as improvements or additional features to existing products; whereas, product extensions are often entirely new, but related products that build upon the brand and adoption of existing products in the same category (e.g., introduction of Vanilla Coke).

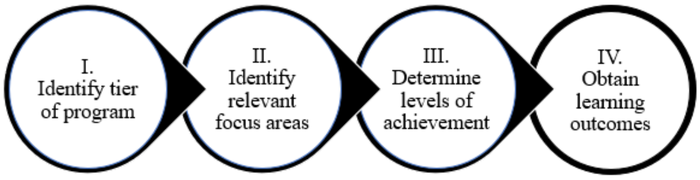

Figure 2: GMP BoK Implementation Framework (adapted from GMP BoK p. 52)

I. *Identify tier of program*. In this step, program administrators identify which tier most closely matches the type(s) of program(s) they are offering. In this use case analysis, we will consider the example of a first academic degree with an operational level competency (i.e., ***GMP Tier A***).

The four tiers match many of the types of programs currently offered at MET institutions, particularly within the IAMU membership. However, unless the definition of global maritime professionals is intended to exclude ratings, there could ostensibly be other tiers that might include seafarers who possess operational or management level certifications without academic degrees. Likewise, there may be global maritime professionals working in non-seafaring roles that would have academic degrees (particularly advanced degrees) without the requirement for operational or management level certification. Additionally, the tiers are largely based on the context of today. Assuming the regulatory framework is responsive to the emerging technologies, consider the case where future ships are fully autonomous and operated remotely. The notions of operations and management may become blurred and potentially other competencies may emerge, making the tiering structure obsolete.

Based upon these observations, several questions emerge:

- Should additional tiers be added?
- Should professional certification and education be decoupled?
- Should additional flexibility be provided within the tiers?

II. *Identify focus areas which correspond to the program*. In this step, program administrators review the objectives of the program to be delivered and identify which of the 28 focus areas apply. As was demonstrated in the GMP BoK, this use case analysis will consider the fundamental competency of ***academic research***.

In the broader context, resulting from a preliminary survey, the focus areas represent a snapshot in time. As the pace of change remains unabated and even accelerated in certain areas, the nature of the focus areas will need be responsive and changing. For example, looking at 2020 Future of Jobs Report by the World Economic Forum, many of the top 15 skills for 2025 are reflected in the focus areas (e.g., #3 complex problem solving, #4 critical thinking and analysis, #6 leadership and social influence, and #11 emotional intelligence), while others are not (e.g., #2 active learning and learning strategies, #7 technology use/monitoring/control, #14 systems analysis and evaluation). In the autonomy example introduced earlier, it would seem many of these future skills would be requisite. As recognized within the GMP BoK, these focus areas should be continually examined and updated periodically (perhaps every five years). Furthermore, it might be beneficial to provide an option to allow program administrators to use the framework to explore focus areas not listed.

Based upon these observations, several questions emerge:

- How often should the competencies of a GMP be reviewed?
- How far into the future should the competencies be predicted?
- Should there be an option for program administrators to include competencies not listed or envisioned by the GMP BoK?

III. *Determine the Levels of Achievement*: In this step, program administrators determine which levels of achievement are identified for their program tier (step 1) and focus areas (step 2). By examining Tables 1, 2, and 3 (cognitive, affective, and psychomotor domains respectively); program administrators look up which levels of achievement (column header) applies to specific focus areas (row header) based upon identified program tiers (table body).

In this use case, for Tier A programs, the ***cognitive process dimensions of remembering, understanding, and applying*** were identified (see Figure 2 on p. 53 of the GMP BoK) and the

receiving, responding, and valuing categories of the affective domain were identified for Tier A programs (see Figure 3 on p. 54 of the GMP BoK). There were ***no psychomotor aspects*** associated with academic research (see Figure 4 on p. 54 of the GMP BoK). While there is some ordering to each of the domains (e.g., increasing complexity of the cognitive processes for the cognitive domain), it seems insufficient to consider these dimensions as "levels of achievement." As noted in the revision to Bloom's taxonomy for cognitive objectives (Anderson & Krathwohl, 2001), higher order dimensions (such as evaluating and creating) are often used to achieve objectives in lower order dimensions (e.g., remembering and understanding). Similarly, it does not seem reasonable that tier assignment would be strictly progressive and non-overlapping. For example, while the affective dimensions are primarily sequential, it would seem that internalization may be the ultimate objective of learning is such a domain for any tier program, and not reserved for Tier D programs. Considering the "principle of parsimony" which indicates that models should be as simple as possible, it is understood why such a mapping has been devised, but perhaps a note could be provided that the identified "levels of achievement" are illustrative and program administrators may desire to include additional dimensions or categories based upon their specific circumstance and context.

Based upon these observations, several questions emerge:

- What unintended impacts might result from considering the categories of a taxonomy as linear sequence of levels of achievement?
- Is there an effective way to allow gaps and overlaps within and between program tiers?
- How might program administrators deviate from the illustrative tables?

IV. *Obtain required learning outcomes*: In this step, using mapping from step 3, program administrators use tables 4, 5, and 6 (cognitive, affective, and psychomotor domains respectively) to obtain required learning outcomes.

The use case analysis will now examine the learning outcomes that resulted for *academic research* at Tier A programs. Given that *remembering, understanding, and applying* were the given cognitive process dimensions for a Tier A program in academic research, the following objectives were indicated (Figure 5):

- ***Identify different methods.***
- ***Describe processes required for conducting academic research.***
- ***Explain rationale, procedures, and implications of academic research.***
- ***Prepare clear hypotheses.***
- ***Conduct a literature review.***
- ***Cite sources appropriately.***
- ***Employ appropriate quantitative and qualitative methods.***
- ***Conduct research.***
- ***Report results.***

While this is a substantial list, by its nature, it will be incomplete. For example, it is not exhaustive of the learning outcomes needed for academic research. Outcomes such as the following appear missing and may be included:

- Recognize four levels of measurement. (Remember)
- Evaluate suitability of particular methods for given data. (Evaluate)
- Design the research. (Create)

Note that the second and third additional objectives listed above are higher order and would be entirely appropriate for a Tier A program, even though these cognitive process dimensions were not indicated in step 3.

Similarly, for the affective domain, a series of learning outcomes focused on ethics have been prescribed. While ethics is a necessary value for academic research, it is not sufficient. Attitudes, emotions, and values such as curiosity or tenacity might be equally (or more) necessary for conducting academic research. Finally, depending upon the type of research, if experimentation is involved, a certain form of dexterity or psychomotor competency might be required (e.g., to manipulate an apparatus, to demonstrate a movement protocol, to retrieve physical data). The point here is that it would not be possible to distill *academic research* competencies into a dozen or so outcomes because each type of research is context dependent. Again, this would indicate a need to note that the outcomes are illustrative and not intended to be a complete representation. Further, if this case study is representative, it would seem each focus area (and the associated outcomes) would benefit from additional work. Perhaps the concept is that the GMP BoK framework is viewed as a beta-release and that each implementation will yield enhancements to incorporate in the future.

Taken together, the use case analysis has uncovered (or perhaps highlighted) several potential product enhancements for future revisions of the GMP BoK, which might help accelerate this technology up the S-curve of innovation. The next section will now focus on a specific set of product extensions that were identified in the use case analysis.

4. Additional discussion

The GMP BoK clearly states its focus is exclusively on learning outcomes:

> "Further action on the determination of curricula (syllabi, learning activities, assessment methods) to achieve these learning outcomes, rests with the different member Universities" [GMP BoK p. 5].

However, as was the case with learning outcomes, there is a clear need for additional guidance as it pertains to selection of learning activities and assessment methods. While MET institutions and communities have started to focus more exclusively on outcomes (e.g., IMO development of action verb taxonomy for model courses, or IAMU development of the GMP BoK), more work needs to be done regarding how the outcomes are put into practice (i.e., the types of instruction and learning used to achieve those outcomes, the means of assessing whether and how well the objectives were achieved). There is a long history of aligning learning outcomes, instructional (learning) activities, and learning assessment (e.g., Wiggins, Wiggins, & McTighe, 2005; Biggs, 2003, 1999; Spady, 1994; Tyler, 1951). Often these three elements are considered interrelated parts of a larger whole (Figure 3).

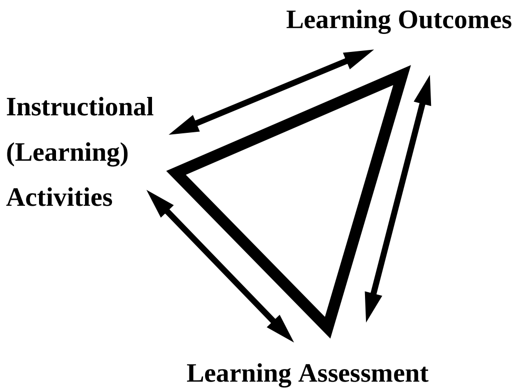

Figure 3: Illustration of Coherence

Even if the proper learning outcomes are appropriately identified, this does not ensure they will be achieved (without the corresponding design of aligned learning activities and learning assessment methods). As a result, there is an important opportunity to *extend* the product of the original GMP BoK. The GMP BoK has already adopted Bloom's revised taxonomy for the cognitive domain – which represents a spectrum of objective categories. While the revised categories of *cognitive processes* were adopted, the corresponding second dimension of *knowledge* was not included in the GMP BoK. This may be for reasons of complexity. However, objectives are typically stated as a verb (i.e., action which is representative of the cognitive process) in combination with a noun (i.e., object which is representative of the type of knowledge to be obtained). For example, using the learning objective from the use case analysis, one objective of academic research is to:

"Identify (verb or cognitive process) different methodologies or methods… (noun or knowledge)."

In the revision to Bloom's taxonomy, Anderson and Krathwohl (2001) present a "taxonomy table" where the six cognitive processes are listed across the top and the four knowledge types are listed down the side, creating a 6 x 4 matrix. Each learning objective is then placed into one of the 24 different positions on the taxonomy table. Similarly, instructional designers and instructors may locate instructional (learning) activities into any one of the 24 positions on the taxonomy. Likewise, the learning assessment methods may be placed on the taxonomy table. The benefit of using the taxonomy table in this way is that alignment (and also misalignment) becomes immediately apparent. For a more complete description of how this alignment can be examined using taxonomy tables, readers are encouraged to read the paper entitled "Proposing a Validation Tool for IMO Model Courses to Evaluate Alignment of Outcomes, Activities, and Assessment" in these proceedings.

By mapping each outcome, activity, and assessment is such a way using the taxonomy table provided in the revision to Bloom's taxonomy, alignment may be examined and even ensured. Applying such an analysis to MET courses and the requisite lesson plans would demonstrate a strong commitment to outcomes-based education. However, in order to effectively perform this mapping, it would be highly beneficial for program administrators and faculty at MET institutions to have additional resources such as a volume of the GMP BoK devoted to instructional methods (or learning activities) and another volume devoted to learning assessment. These two additional volumes of the GMP BoK (i.e., product extensions) would not be an insignificant undertaking, but would represent a considerable advancement in the technology for the MET community.

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