Refocusing on the Operational Level of Pedagogy: A Military Analogy for Bridging Educational Strategy and Classroom Tactics

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Innovations in Engineering Education

To effectively fight and win our nation's wars, the U.S. armed forces draw clear distinctions between strategy (the general direction and overall plan), operations (actions or processes that lead to mission success), and tactics (techniques and procedures actually employed on the battlefield to accomplish a goal). To increase the chances for military success, all three must be working in unison and in a complementary fashion towards the support of our national policy directives. In the same manner, the opportunity for pedagogical excellence can be strengthened when educational strategy, operations, and tactics are all harmoniously directed towards the same goals and objectives. Unfortunately, much of today's educational research delves primarily on just two areas--focusing on either broad idealistic educational strategies or exclusively on suggested interactions that make for better classroom tactics. As a result, it should come as little surprise to learn that there is very little widespread coordination taking place for appropriate operational instructional activities and material that could be employed to synergistically link strategy and tactics so that students can be inspired about what they are learning. While there is considerable literature on the importance of educational content, much of the research does little to critically examine the nature and scope of *what* is being taught. This paper attempts to refocus attention on the operational level of pedagogy and address ways instructors can introduce operational initiatives that help make classrooms more effective learning environments. Instructors will find that these initiatives are relatively straight-forward and simple to implement, and students will benefit by becoming more actively engaged in what they are learning.

Introduction

To prepare our students for success in the twenty-first century, the undergraduate curriculum must focus on skills such as problem solving, reasoning, and critical thinking. In their book *Themes and Issues in Faculty Development*, Vic Rentel and Allan Dittmer assert that "substantial increases in [such] student achievements are vital to [our] national well-being" [1]. However, Rentel and Dittmer also acknowledge that "there appears little agreement on what factors account for educational performance and even less resolve or agreement on how to improve it," and they further concede, "literally dozens of reform reports have urged varying

solutions, some coherent and complementary, others contradictory" [2]. Fortunately, much of engineering education attempts to foster academic environments that promote higher-order reasoning skills such as analysis, synthesis, and evaluation. As described in Benjamin Bloom's taxonomy of cognitive abilities [3], these intellectual endeavors encourage students to go beyond the simple recall of information, and they advance them beyond what they already know and what they can already do. Recognizing *why* engineering education is important is one matter; knowing *how* to teach it effectively is another consideration; understanding *what* to teach is an equally important factor that helps ensure our students develop the capacity to solve tomorrow's problems. When *all three* are aligned towards the same goals, we improve our chances for enhanced student achievement.

The works of John Dewey and Alexander Meiklejohn in the 1920s helped to shape much of the educational strategy for today's American colleges. While Dewey emphasized the importance of individuality and pragmatic educational aims that bolster the skills needed for a strong democratic society, Meiklejohn stressed the need for commonality and philosophical educational goals that inspire intellectual synthesis for a vibrant democratic society [4]. Together, the contrasting ideas between Dewey and Meiklejohn have helped define the *why* of the American undergraduate education—to build and stimulate a citizenry with the passion and intellectual skills that that can continue to promote democratic ideals.

The study of classroom tactics to improve teaching effectiveness has become arguably the most visible area of reform in American higher education. William Perry's work detailing the nine stages of adult cognitive development has become an important study providing educators with considerable context in adjusting, changing, and customizing procedures for teaching to learners in different stages of development [5]. David Kolb's work describing the four-stage experiential learning paradigm that adults have a natural proclivity towards has also provided educators with the impetus to focus on techniques that improve undergraduate education [6]. As a result, we find no shortage of literature documenting, listing, and cataloging the *how* of improving college teaching.

Classroom content, which was once thought to be the crux of educational differentiation and distinction, has seen its value erode within pedagogical reform. Maryellen Weimer points out two teaching fallacies that have become widespread throughout today's colleges. 1) "if you know it you can teach it", and 2) "faculty teach content" [7]. With the explosion of information, the knowledge of content is being replaced with more lasting and durable learning skills. Today's more learner-centric learning environments have also helped to shift faculty mission towards teaching students rather than simply teaching the material. While this is arguably the correct evolutionary change in American colleges, this shift away from content—especially content improvement—has, however, exposed vulnerability within educational reform. As James Spillane and Karen Seashore Louis succinctly put it, "*What* gets taught is a strong predictor of student achievement" [8]. Consequently, a re-examination of *what* we teach in our engineering classrooms can enhance and perhaps even complement not only our existing pedagogy, but a reassessment *what* we teach can also enrich student learning.

This paper refocuses on the operational level of pedagogy to serve as a bridge between strategy and tactics by employing a military analogy. It examines ways that instructors can improve the classroom content to align it with educational strategies and classroom tactics. When all three are working in unison and in a complementary fashion, the combined effect of their interactions will be greater than the sum of the individual effects taken independently. As a result, the chances for educational improvement and success increase in a synergistic fashion.

Strategy, Operations, and Tactics Defined

Much of the literature on education reform uses the term pedagogy as an all-inclusive term that broadly refers to educational strategy, operations, and tactics. Consequently, there is confusion and disagreement over the meanings of each of these terms. Adding to the difficulty is the fact that many researchers use the terms interchangeably without distinction and specificity. To remedy these concerns, this paper makes use of U.S. military definitions to delineate, clarify, and segment what is meant by strategy, operations, and tactics.

The U.S. Army's *Field Manual Number FM 3-0, Operations*, defines the strategic, operational, and tactical levels of war in order to help military "commanders visualize a logical flow of operations, allocate resources, and assign tasks" [9]. While there is an acknowledgement that these three levels have "no finite limits or boundaries between them," it is the "interdependent relationship of all three" that helps to generate military victory. What follows are excerpts from *FM 3-0* that serve to define what is meant by battlefield strategy, operations, and tactics [10]:

Strategic Level

> The strategic level is that level at which a nation, often as one of a group of nations, determines national and multinational security objectives and guidance and develops and uses national resources to accomplish them. Strategy is the art and science of developing and employing armed forces and other instruments of national power in a synchronized fashion to secure national or multinational objectives. The National Command Authorities translate policy into national strategic military objectives. These national strategic objectives facilitate theater strategic planning. Military strategy, derived from policy, is the basis for all operations.

Operational Level

> The operational level of war is the level at which campaigns and major operations are conducted and sustained to accomplish strategic objectives within theaters or areas of operations. It links the tactical employment of forces to strategic objectives. The focus at this level is on operational art—the use of military forces to achieve strategic goals through the design, organization, integration, and conduct of theater strategies, campaigns, major operations, and battles. . . . A major operation is a series of tactical actions (battles, engagements, strikes) conducted by various combat forces of a single or several services, coordinated in time and place, to accomplish operational, and sometimes strategic objectives in an operational area. These actions are conducted simultaneously or sequentially under a common plan and are controlled by a single commander. Operational art determines when, where, and for what purpose major forces are employed to influence the enemy disposition before combat. It governs the deployment of those forces, their commitment to or withdrawal from battle, and the arrangement of battles and major operations to achieve operational and strategic objectives.

Tactical Level

> Tactics is the realm of close combat, where friendly forces are in immediate contact and use direct and indirect fires to defeat or destroy enemy forces and to seize or retain ground. Exposure to close combat separates Army forces from most of their counterparts. Army forces fight until the purpose of the operation is

accomplished. Because of this, they are organized to endure losses, provided with combat service support to generate and sustain combat power, and trained to deal with uncertainty.

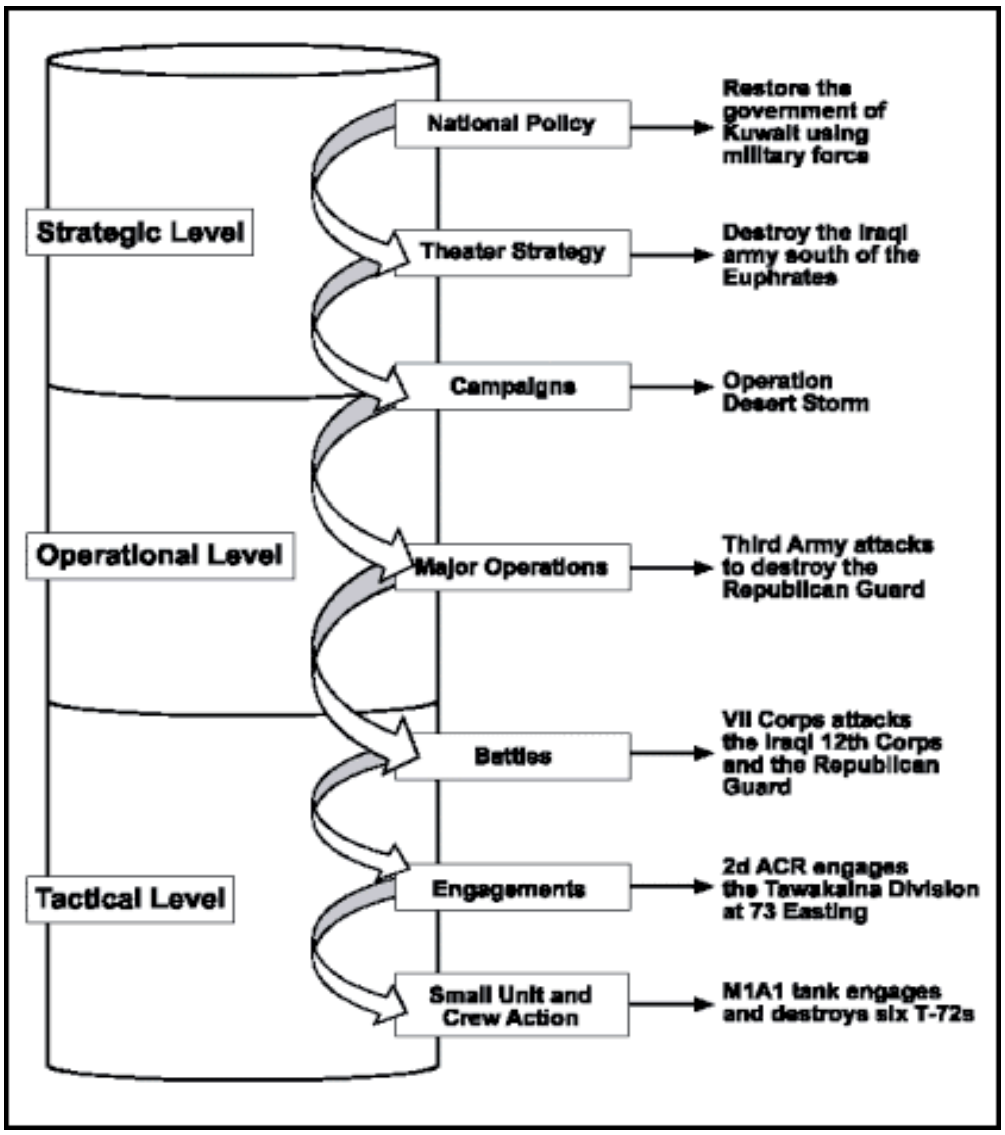

Figure 1: A military delineation of strategy, operations, and tactics [11]

According to military theorist Carl von Clausewitz, "Tactics is the art of using troops in battle; strategy is the art of using battles to win the war." [12]. As depicted in Figure 1, it is the operational level that links the strategic with the tactical. Within education, it is the instructional content—or the operational level of instruction—that links pedagogical vision with classroom tactics. In short, educational strategy helps to answer *why* colleges exist and *why* we teach. The operational level of teaching deals with instructional content and addresses *what* we teach. Classroom tactics deal with the techniques and procedures we utilize during the actual instruction of *how* we teach. Effective and enduring pedagogical reform intimates that we address *all three* areas. The U.S military's use of a "plan-prepare-execute" cycle, shown in Figure 2, can also serve as a way to continually improve education:

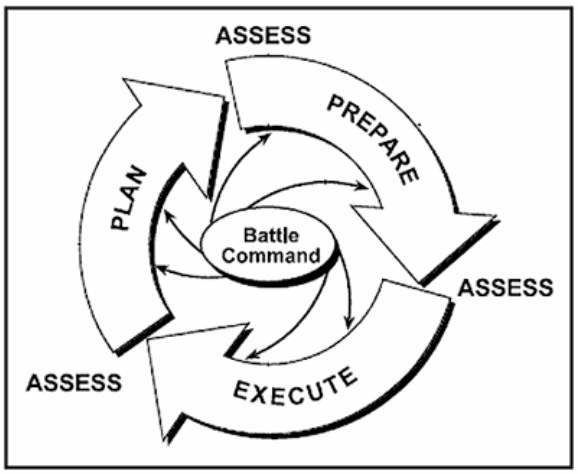

Figure 2: The military operations process [13]

In order to achieve systematic reform, a concerted effort to enhance undergraduate education must examine educational strategy, operational content, as well as classroom tactics. Continual assessment in all three areas will also help to ensure we are able to achieve the proper alignment between educational strategy, operations, and tactics.

Operational Initiatives to Gain Synergistic Interactions

In order to help undergraduate juniors and seniors enrolled in an introductory quantitative Systems Engineering class better understand key principles and various tools for analyzing and interpreting alternatives as part of the engineering design process, I implemented three operational initiatives. These initiatives served to bridge some of the theoretical concepts in the class with practical applications that the students could more easily relate to. I discovered that not only did they provide my students with greater relevancy to what I had been teaching, the initiatives also made the learning experience more enjoyable and engaging for many of them. Shown in Figure 3, the end-of-course feedback from the students enrolled in the course indicates an overall positive response to the three operational initiatives.

First, I helped to design an engineering economy project that required students to perform time value of money calculations involving their own finances [14]. I decided on this specific approach because I hoped to: 1) stimulate interest in the project by drawing on the students' own financial circumstances, 2) provide the students with a fiscal awareness of what would be in store for them upon graduating from college, and 3) allow the students to discover how they could employ spreadsheets to solve real-world problems. This project empowered my students to use the spreadsheet as a powerful tool for modeling loan payments, credit card debt, and their expected future budget. It also helped provide my students with the ability to successfully leverage what they had learned in the classroom and apply it to the solution of problems pertaining to their own financial circumstances. As one student commented, "I liked the project; it gave me a chance to actually figure out which course of action to take instead of me knowing exactly which decision making process to use."

Second, I tasked my students to make actual investment recommendations as part of a classroom exercise on Monte Carlo simulation [15]. Their ideas which included savings

accounts, mutual funds, individuals stocks, bonds, real estate, and even gambling in poker allowed me to construct a financial portfolio through which the class could analyze its projected returns in a spreadsheet simulation model. By analyzing their simulation results, the students improved their understanding of probabilities and learned about the benefits of diversification--while simultaneously learning about the mathematics inherent in several financial principles. "I wish I had more classroom exercises like this," wrote one student.

Third, I introduced students to the annual federal income tax requirements by constructing a simple spreadsheet model that they could use to effectively manage this seemingly laborious and time-consuming process [16]. While designed primarily to alleviate the apprehension many students have with the income tax filing requirements, the spreadsheet model also served three additional purposes: 1) it demonstrated to the students that spreadsheet modeling techniques could extend to practical applications, 2) it affirmed to the students that the software skills they were acquiring in class could also personally benefit them financially, and 3) the spreadsheet model provided them with a robust tool that they could use in the future to proactively manage their annual income tax requirements. Rather than simply learn how to fill out a 1040EZ form, the spreadsheet model allowed them to discover that they possessed the capacity to adjust their finances to reduce their tax burden. "I never realized how simple doing taxes could be," mentioned one student. "Up until now, I had always figured I would pay [an accountant] to do this for me."

Answers: [5] Strongly Agree [4] Agree [3] Neutral [2] Disagree [1] Strongly Disagree	Course – SE350 (Spring 2005) [n=123]					
	Answer [5]	Answer [4]	Answer [3]	Answer [2]	Answer [1]	(no rsp)
A1. This instructor encouraged students to be responsible for their own learning.	42 (42%)	48 (48%)	9 (9%)	0 (0%)	0 (0%)	0 (0%)
A2. This instructor used effective techniques for learning, both in class and for out-of-class assignments.	37 (37%)	48 (48%)	12 (12%)	2 (2%)	0 (0%)	0 (0%)
A3. My instructor cared about my learning in this course.	43 (43%)	49 (49%)	6 (6%)	1 (1%)	0 (0%)	0 (0%)
A4. My instructor demonstrated respect for cadets as individuals.	56 (57%)	37 (37%)	5 (5%)	1 (1%)	0 (0%)	0 (0%)
A5. My fellow students contributed to my learning in this course.	36 (36%)	42 (42%)	14 (14%)	5 (5%)	2 (2%)	0 (0%)
A6. My motivation to learn and to continue learning has increased because of this course.	29 (29%)	41 (41%)	17 (17%)	9 (9%)	3 (3%)	0 (0%)
B1. This instructor stimulated my thinking.	35 (35%)	49 (49%)	12 (12%)	3 (3%)	0 (0%)	0 (0%)
B2. In this course, my critical thinking ability increased.	33 (33%)	44 (44%)	16 (16%)	5 (5%)	1 (1%)	0 (0%)
B3. The homework assignments, papers, and projects in this course could be completed within the USMA time guideline of two hours preparation for each class attendance.	32 (32%)	54 (55%)	10 (10%)	3 (3%)	0 (0%)	0 (0%)
C1. This course helped me learn to use the engineering design process to design, manage or reengineer systems or processes.	32 (32%)	45 (45%)	16 (16%)	4 (4%)	2 (2%)	0 (0%)
C2. This course taught me to communicate effectively both orally and in writing.	32 (32%)	29 (29%)	30 (30%)	8 (8%)	0 (0%)	0 (0%)
C3. This course improved my ability to solve real-world problems through quantitative techniques.	28 (28%)	53 (54%)	13 (13%)	4 (4%)	1 (1%)	0 (0%)
C4. This course provided me with practical, problem-solving experiences applicable to my future as an Army officer.	34 (34%)	44 (44%)	14 (14%)	5 (5%)	2 (2%)	0 (0%)
C5. Course exercises and designs improved my ability to model, analyze, or prototype real-world problems or systems.	30 (30%)	54 (55%)	11 (11%)	3 (3%)	1 (1%)	0 (0%)

Figure 3: End-of-course feedback from 123 students

The feedback categories provided in Figure 3 are segmented into Academy-wide level questions (A#), Department of Systems Engineering questions (B#), and course-level questions (C#). Even though a small percentage of the class felt that the course did not advance their critical thinking or problem solving abilities, the overall positive feedback is an indicator that the operational initiatives were generally well-received. My hope is that the three examples I have provided will encourage instructions who are developing similar initiatives to continue to in their efforts, and to lead other instructors who find this research compelling to consider employing innovative content in their classrooms to better engage their students. Admittedly, these initiatives are not entirely novel or ground-breaking. However, I believe that by supplementing the course textbooks and class material with relevant content has helped many of my students to better grasp the significance of what they were learning. Furthermore, I hope that instructors who find that these initiatives are relatively straight-forward and relatively simple to implement will be encouraged to introduce similar operational initiatives that will excite their students into become more interested and actively engaged in the classroom. By doing so, we improve the chances of aligning educational strategy, operations, and tactics. Moreover, we are able to link strategy and tactics synergistically when we introduce operational initiatives that complement each other—where the combined effects of their interactions will be greater than the sum of the effects taken separately. The resulting outcome is a learner-centered classroom environment that encourages and expects students to become more active learners.

Conclusions

U.S. Army doctrine states that the best chance for military success occurs when strategic, operational, and tactical objectives are all aligned. American higher education reformers can apply the same principle to help achieve lasting pedagogical improvements. Analogous to the three legs on a barstool, strategic vision, operational content, and tactical interactions all serve to support educational excellence--it is nearly impossible to sit atop a chair with only one leg, very difficult to do so with just two legs, but with three legs, a chair achieves stability and steadiness.

Even though literature on educational reform correctly point out that content should not be the sole criterion for instructional improvement, content should, however, remain a key criterion when contemplating instructional improvement. In fact, operational content can serve as a synergistic link between strategy and tactics, helping to refurbish the classroom into an ideal location for the growth of knowledge. As instructors, we are obligated to ensure that we employ content as bridges to connect both theory with practice and vision with activity. Furthermore, as engineering instructors, we need to make sure that we construct such linkages so that they are not "bridges to nowhere."

The major strength of this research is how it is able to delineate educational strategy, operational content, and classroom tactics. By doing so, it provides educational researchers with greater clarity and specificity for articulating future reform recommendations. However, a considerable weakness of this research is its inability to directly link operational initiatives with student improvement. I had not intended the operational initiatives to be a scientific experiment. Rather, I intended them to simply help my students see greater relevance in what they had been studying. Consequently, future research into my claim that operational content synergistically links strategy with tactics can serve as a starting point for further investigation.

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