You want them to remember? Then make it memorable! Means for enhancing operations research education

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ABSTRACT

In this article I summarize the main points I made in the keynote presentation of the same title I gave at the EURO XXIV conference in Lisbon, Portugal in July of 2010. Each of these points deals in some way with making communications between an operations research professional (academic or practitioner) and a student, client, subordinate, supervisor, or colleague more effective. Furthermore, each point is directly related to some realization (or epiphany) that I have had with regard to communication since I began teaching ORMS in 1984. It is noteworthy that these communications share a common objective; we are trying to facilitate learning. Since I have spent most of my career in academia, my primary emphasis is on communication with students (particularly those enrolled in introductory ORMS courses). However, I have also spent a great deal of time working on operations research problems outside of academia, either as an employee in private industry or as an operations research consultant to corporations and not-for-profit organizations, and I hope as a consequence my discussion is also relevant to those working in the practice of ORMS.

1. Introduction

This article is a text summary of the eponymous keynote presentation I gave at the EURO XXIV conference in Lisbon, Portugal in July of 2010 (Cochran, 2010). I welcome the opportunity to write this article for the *European Journal of Operational Research*, not only because I appreciate any occasion to discuss issues in operations research/management science (ORMS) education, but also because this article gives me a chance to (hopefully) express my thoughts in a more complete and eloquent manner.

As one progresses through a career in ORMS, whether in academia or practice, the importance of effective communication becomes ever more apparent. If those with whom we are working (be they students, colleagues, subordinates, supervisors, or clients) do not understand fundamentally what we are doing or what our results mean, then our work as operations researchers/management scientists has little value. In these communications we often have specific points we want our audience to understand and remember. At some level, whether dealing with students, clients, subordinates, supervisors, or colleagues, these communications share a common objective; we are trying to facilitate learning. For our purposes I define learning to be *the integration of cognitive, emotional, and/or environmental influences and experiences to develop, enhance, and/or modify an individual's understanding of some concept or phenomena.*

In this paper I summarize some realizations (or epiphanies) I have had about communication since I began teaching ORMS in 1984 (it is not lost on me that I am writing on the importance of clear communication for a discipline I entered in the Orwellian year of 1984!). Since I have spent most of my career in academia, my primary emphasis is on communication with students. However, I have also spent much time working on ORMS problems outside of academia (as an employee in private industry and as an ORMS consultant to corporations and not-for-profit organizations), and I hope as a consequence my discussion is also relevant to those working in the practice of ORMS (please note the author believes *all* operations researchers/management scientists are actually non-trivial convex combinations of academician and practitioner).

2. My perspective on education

I define my responsibilities as an instructor of ORMS as the creation, promotion, and fostering of human dignity. In order to accomplish this effectively through the classes I teach, I must have clear pedagogical objectives from the onset. I therefore must have identified broad goals that I want to achieve (i) with respect to education and (ii) with respect to ORMS, and I must fully integrate these two sets of goals. With respect to education, my broad objectives are to:

- stimulate students' interest;
- promote students' deep comprehension/understanding;

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- enhance students' long-term retention;
- develop students' critical thinking and problem solving skills;
- encourage students' independent thought and intellectual self-reliance;
- build students' self-confidence; and
- advance society.

These objectives strike me as universal in nature; an instructor from any discipline should strive for achievement of these objectives in each course she/he teaches.

With respect to ORMS, my broad goals are to:

- identify and solve interesting, relevant, important problems;
- extend the discipline;
- find/develop enthusiastic, bright, and creative students to encourage; and
- demonstrate the value of ORMS to colleagues, students, decision makers, and general public.

These objectives also strike me as universal in nature; every ORMS professional (academic or practitioner) should strive for achievement of these objectives in her/his professional activities.

Focusing on integration of these sets of goals has led me to develop a personal strategy for effectively teaching ORMS (summarized in Fig. 1). When initially working with students who have little background, understanding, or intrinsic interest in ORMS, I first engage them and promote their curiosity about ORMS through active learning exercises, which I define as:

Instructional strategies and activities designed to engage students through their participation in exercises that involve them in higher-order tasks such as analysis, synthesis, and evaluation of course material.

When properly designed and executed, active learning exercises are valuable tools an instructor can use to:

- recapture students' attention;
- emphasize critical points;
- encourage higher-order thinking;
- unify various concepts;
- smooth the transition between major areas of coverage; and
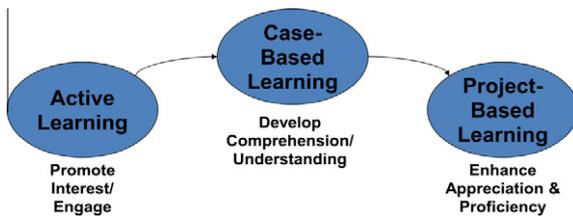- ultimately improve student comprehension and retention.

Fig. 1. A strategy for teaching ORMS.

As students progress through their ORMS studies and demonstrate that they are engaged and interested in the subject, I introduce them to actual applications through short teaching cases. Through the case teaching method the instructor can:

- provide students with experience in:
  - identifying assumptions;
  - mathematical modeling; and
  - problem solving;
- reinforce OR/MS concepts through:
  - application to realistic problems and
  - exposure to additional examples; and
- present student with opportunities to:
  - think critically;
  - be creative;
  - synthesize; and
  - integrate
    - ORMS;
    - concepts from other disciplines;
    - modeling/abstraction; and
    - computer and communication skills.

As my students progress in their ORMS studies, I assign more complex and provocative cases.

Ultimately students demonstrate the depth of understanding and comprehension necessary to work (with appropriate supervision and guidance) on live projects for real clients. We now move into the project-based learning phase of the strategy, and we work to develop appreciation for the challenges of real applications and enhance each student's ability to address these challenges.

Because of its strong emphasis on problem solving, this approach is necessarily interdisciplinary in nature and must be taught from a liberal perspective, and so the cases and class projects must evolve from a partnership of academia, government, industry, and public service organizations.

3. The epiphanies

In this Section 1 enumerate and discuss several epiphanies I have had about ORMS education that I believe apply to all ORMS courses and are generally applicable across disciplines. I have interspersed references to and examples of active learning exercises, teaching cases, and student projects throughout this discussion; these references will serve to emphasize various points.

3.1. Most students will not be clever unless you give them permission to be clever (i.e., the traditional scholastic risk and reward system discourages students' cleverness)

Carefully scan the playing cards displayed in Fig. 2, then select and memorize one card.
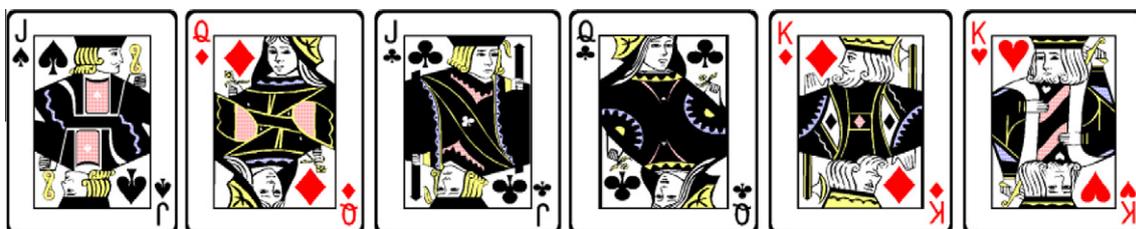

Fig. 2. Original display of six playing cards.