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REMAKING THE IT MANAGEMENT CURRICULUM:

A "NOVEL" APPROACH

Refaire le programme en management des TI : une approche « romancée »

Research-in-Progress

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Abstract

We report on an experiment in redesign of curriculum for Information Technology (IT) management courses, a synthetic approach that attempts to combine the best features of explanation- and experience-based approaches. The IVK case series is a fictitious though realitybased story about the struggles of a newly appointed, not-technically-trained CIO in his first year on the job. The series constitutes a true-to-life <u>novel</u>, intended to involve students in an engaging story that simultaneously explores the nuances of major IT management issues. Three principles guided our development of this curriculum: 1) Emphasis on the business aspects of IT, independent of underlying technologies; 2) Student derivation of cumulative management frameworks arrived at via inductive in-class discussion; and 3) Identification of a set of core issues most vital in IT management practice, as a business discipline. We report results from using the curriculum with undergraduate and graduate students, and with executives at a multinational corporation.

Keywords: Information technology; IT management education, IS education, case-based learning.

Résumé

Nous faisons part d'une expérience de reconception du programme d'un cours de management des technologies de l'information (TI) par une approche synthétique qui essaye de combiner les meilleurs moyens d'explication et des approches basées sur l'expérience. Les études de cas IVK constituent un roman fictionnel, basé sur la réalité, qui traite des difficultés d'un nouveau DSI, visant ainsi à impliquer les étudiants dans une histoire prenante qui explore simultanément les nuances des principaux thèmes du management des TI.

Introduction

Information technology (IT) management presents special challenges to curriculum designers and educators. It resides at the intersection of several technical and management subjects, many of which have been established longer and have better-defined disciplinary bases. Computer and other related sciences address the details of technologies in a "white box" manner while management subjects, such as strategy or marketing, deal primarily with capabilities that arise from IT in a "black box" manner. The tenuous position of IT management in research has been well documented (Orlikowski and Iacono, 2001); difficulties of disciplinary identity spill over into training of IT managers. If *IT management* is a legitimate, freestanding discipline, one that deserves equal standing with other disciplines, then sorting apart related technical and management issues into established disciplinary categories should leave a residual, coherent body of knowledge.

There are grounds to question whether IT management is distinct from its disciplinary relatives. During the last third of the 20th century, business schools and professors have struggled to fit IT management into professional management education curricula. Courses labeled "data processing management," "management of information systems," "informatics," and "IT management" have fallen in and out of favor, and related faculties have gained and lost status. The "Internet Bubble" of the late 1990s drove demand for curricula aimed at management of IT resources, capabilities, and content, which then subsided as the bubble deflated in the early 2000s (Nolan, 2001). Today, across the educational landscape, it remains possible to find courses under the heading of IT management that range from nearly pure business orientation, such as process re-engineering, to nearly pure computer science orientation, such as programming in Java, or even to mere technical literacy, such as how to use Microsoft Excel.

The absence of consensus on IT management content has many causes. The rapid advance of the technologies, expressed in "Moore's Law," makes keeping materials technically up-to-date difficult. Fluctuations in the fortunes of IT-based businesses motivate attention shifts by faculty, students, and administrations. The lower priority of teaching in comparison with research in many universities, and the increasingly theoretical nature of much IT research, channel faculty efforts to tasks other than training IT managers. At the same time, students, drawn to the field by interest in technology, are demanding. Even when the issues addressed by a set of materials are technology independent and timeless, students object when they encounter out-of-date facts or situations. Students enter courses with disparate technical preparation: what seems new and impossibly difficult to some seems insufferably basic to others, and course materials have diverged to address student segments diverse in this and other ways.

Whatever its causes, this absence of a consensus has consequences, specific manifestations of the overall troubled status of IT management among business school offerings. Students exhibit mixed sentiments about the importance of IT management. At our own institutions in surveys over the last decade, MBA students overwhelmingly indicate that they want IT management content in their programs of study, but these same students do not take elective courses in the area in large numbers. Student reviews on Amazon.com of the leading IT management textbooks are some of the most scathing to be found in any book category. Required courses in IT management have come under student criticism and administrative scrutiny, reaching a point in some schools at which they are, as one Dean recently put it, "retained mostly to occupy a group of IT tenured faculty."

The project that is the subject of this paper was conceived to confront difficulties of IT management education in a fresh way. We report on an experiment in redesign of curriculum for Information Technology (IT) management courses, a synthetic approach that attempts to combine the best features of explanation- and experience-based approaches. The IVK case series is a fictitious, though reality-based story about the trials and tribulations of a newly appointed, not-technically-trained CIO in his first year on the job. The series in its entirety constitutes, in effect, a true-to-life novel about IT management, intended to involve students in an engaging story that explores the nuances of major IT management issues. It is based on a philosophy and set of design principles developed from extensive experiences designing curriculum on this subject for executives and MBA students at major business schools and elsewhere. Three principles guided development of the curriculum: 1) Emphasis on the business aspects of IT, independent of underlying technologies; 2) Student derivation of cumulative management frameworks arrived at via in-class discussion; and 3) Identification of of a set of core issues most vital in IT management practice, which approximate the substance of IT management as a business discipline. We report results from using the curriculum with undergraduate, graduate, and executive students. Early results suggest that this approach may have particular advantages with a generation of "digital natives" who do not remember when IT was not a normal part of everyday life, and who have come of age in an environment crowded with engaging approaches to communication and entertainment competing for their attention.

In the balance of this paper, we describe in greater detail our efforts on this front, and some results.

Pedagogical Approach

Ambiguities in definition of the IT management field interact with the pedagogical difficulties of successfully guiding students through content ranging across technical and management issues. For the purposes of this project, we distinguish between two approaches to management education: "explanation-based" and "experience-based."

The explanation-based approach is primarily deductive; it begins with theoretical content already organized into frameworks and based, where possible, on research. It conveys organized knowledge to students for application to specific circumstances. A course designed with this approach might employ a variety of materials, including textbooks, compendia of articles, chapters, and other readings, from academic journals, books, or other sources. What distinguishes this approach is the manner in which theoretical knowledge is conveyed to students, in written descriptions and verbal presentations of frameworks already conceived by experts. Conveyance of knowledge is direct, from experts to students, and the emphasis in application of knowledge is from already formed general frameworks to specific contexts to which the framework might apply. This mode of pedagogy, associated with the "lecture method" (Marshall et al., 2006), is probably the most widely practiced in IT management education.

The experience-based approach (Marshall et al., 2006), in contrast, is primarily inductive; it begins with specific situations and encourages students to develop—through analysis, reasoning, and facilitated discussion—their own general frameworks that can be applied to other specific circumstances. Although such approaches usually employ "cases," written histories of events, this mode of pedagogy extends to learning from other descriptions of events, such as newspaper or magazine descriptions, or descriptions by practitioners (in "guest lectures" for example), and to other experiences also, such as team-building exercises, live projects, and simulations (Navarro, 2008). This approach conveys theoretical knowledge by asking students to derive theory for themselves. The role of the expert and already formed frameworks is less direct; the instructor chooses cases and directs discussion to lead students toward known theoretical ideas, but burdens of conception and organization of knowledge are borne primarily by the student. This pedagogy is practiced at many universities, but is a major emphasis at a few institutions famous for the approach (e.g., Harvard Business School, the Darden School at University of Virginia, and the Ivey School of Business at the University of Western Ontario).

Advantages and Disadvantages of Explanation- and Experience-based Approaches

Explanation- and experience-based approaches have different strengths and weaknesses. The most obvious advantage of the explanation-based approach arises from the directness with which it conveys knowledge. When this approach is effective, students learn theoretical frameworks already known to be valuable and in the exact form that has proven most useful. Command of the details of a framework, and ability to apply the framework correctly can be verified through testing. With verification complete, an instructor can say with some certainty that students "know" the material. Frameworks can be robust, well organized, and well integrated with other frameworks into coherent systems. These frameworks and systems can be extended in an orderly manner, through cumulative development.

But the approach also has weaknesses. It works best for subjects in which the "answers" are not in dispute and the current state of knowledge is reasonably comprehensive. In IT management, practitioners confront problems that research does not yet address or resolve; the explanation-based approach provides little guidance when this happens. Another concern with the approach: It places the student in a passive role, recipient of already formed knowledge, rather than participant in knowledge creation. Further, such already formed knowledge is often conveyed without the contextual details that motivated the creation of the theoretical knowledge in the first place; the student may understand the inner workings of a framework without seeing how it fits into practice. The resulting education may then be abstract, more "ivory tower" than practically useful.

Experience-based approaches excel in conveying context and motivation for theoretical materials; the "case system" of education aims to "bring business reality into the classroom" (Harvard Business School, 2008). When students encounter and understand the context that motivated creation of general knowledge, they may be better able to discern where and how to apply it. Student's role is active; they discuss the meaning of events, and to derive personal frameworks composed of general knowledge that can be applied elsewhere. This active role may lead to greater engagement (Li, Greenberg, and Nicholls, 2007).

The most obvious drawbacks in experience-based learning arise from the indirect way in which the method creates theoretical knowledge. When students develop their own personal frameworks, it is more difficult to assure their quality. Different students derive different frameworks from the same case circumstances, and some of these will be superior to others in application to new circumstances. Since the approach inevitably generates diverse theories, verification of command of the "content"—testing—becomes a more complicated matter; students must be evaluated on the quality of their analyses as supported by their explication of their own personal frameworks. The burden on teachers is arguably greater; they must select and order cases, and guide discussion, in a way that maximizes students' prospects for arriving at useful frameworks. Because cases are often drawn from diverse companies and industries, developing frameworks cumulatively, in a way that leads to a well-integrated system, presents major challenges. Frameworks students derive from a pure case-based approach are probably more disorganized and less refined than those developed by experts and conveyed through textbook methods.

An ideal approach would combine the best features of these two approaches, at least to the extent possible. It was this ambition that guided us in developing the IVK case series.

The IVK Case Series

The IVK series of 18 cases constitutes a book-length (approximately 80,000 words or 320 double-spaced manuscript pages) story that invites students to "walk in the shoes" of a newly appointed Chief Information Officer (CIO) during his first year on the job. The main character, Jim Barton, has led one of the fast-growing company's business units, and has been an outspoken critic of the IT department. When the company's growth trajectory levels off, the CEO gets replaced and the senior management team reshuffled. Barton (to his horror) is appointed to lead IT, where he will need to act on his own past advice. He has no technical background, thus confronts IT as an arena in which to apply *management* principles. Barton's CIO predecessor, fired in the company's reshuffle, offers Barton a parting prediction: "You won't last a year." The series describes events during that year, during which time Barton faces decisions and difficulties. Students critique Barton's actions, make recommendations, and develop a cumulative framework for IT management as the story unfolds. Table 1 summarizes the story and topic coverage.

Chapter	Topic	Summary of Action
1	Analysis of Business Context	Barton offered CIO job; looks into the history/ role of IT in business; IVK business context revealed (history, financials)
2	The CIO Role and Challenges	Barton consults personal advisors (consultant love interest, mysterious "kid" in local bar); Barton's predecessor predicts: "You won't last a year!"
3	IT Leadership and Strategy	Barton begins job as CIO, learns IT org chart; struggles with direct reports and strategy; begins to develop his IT management framework
4	The Cost of IT	Barton tries to answer CEO's question: How much does IVK spend on IT?
5	The Value of IT	Work on another CEO question: How much value does IVK get from IT?
6	Project Management	IVK IT debates approaches to managing projects; Barton is perplexed
7	Large Projects	Barton deals with a stalled mega-project and a non-performing vendor
8	Project Portfolios	Investment priorities; a security project that should have been funded was not, and Barton discovers he (in his former business role) caused the problem
9	Governance	Barton presents to the Board on control, risk, governance and strategic partnership; he deals with an overzealous Board member and CEO insecurities
10	Crisis Management	IVK attacked by hackers as Barton heads into a Wall Street analyst meeting
11	Business Continuity	What to do and say in the aftermath of attack; the CEO rejects Barton's advice; a firestorm ensues, but Barton survives
12	Communications	How to rebuild IT's credibility in the aftermath of a security incident; Barton in the senior management wilderness
13	Emerging Technology	IVK blindsided by unsettling employee involvement in Web 2.0 activities

14	Vendor Management	IVK chooses a vendor, service model, and contract design for a major project
15	Managing Talent	Difficulties with a key IVK technical employee prompt review of talent
16	Infrastructure Mgmt.	IVK struggles to set infrastructure standards, reduce complexity, cost, and risk
17	Managing Risk	Barton engages CEO in decisions about cost and risk tradeoffs
18	Career Decisions	Barton's one year anniversary: He receives two surprising job offers and must decide whether to continue as a CIO or go back to being a business guy

Table 1. IVK Plot and Topics Summary

We designed the curriculum with a number of specific objectives in mind:

Engaging Story -- A major target audience for this curriculum is the generation of "digital natives," people who have grown up in a society in which IT is omnipresent, and in which information-based media engage them in highly interactive and entertaining ways (Prensky, 2005). With this audience in mind, we aimed for a high quality, engaging story. To guide us, we used Campbell's (1949) idea of the monomyth (also known as "the hero's journey"), a basic pattern found in stories around the world, often used by screenwriters (Vogler, 1998). The monomyth begins when a central character is "called to adventure," continues on a "road of trials," and arrives at important self-knowledge. We made use of many elements within the pattern, such as the "supernatural aid," a protective figure who provides advice (in IVK, a twenty-something "kid" whom Barton repeatedly encounters at his neighborhood bar, who turns out to have a surprising true identity) and "atonement with the father" (in IVK, evolution of Barton's relationship with the new CEO). One series author has background in a major U.S. theatre company and was able to draw on this experience to help with issues of plot and character development. One peer reviewer said the "plot" of the story caused him to "stay up late reading, one night, to see what would happen."

Realistic Treatment of Situations, Relationships, and Political Factors – Although the IVK story is fictional, everything that happens in it has a basis in actual events. The authors collectively possess decades of experience working as IT managers, consulting to companies on IT issues, serving on Advisory Boards and Boards of Directors, and writing books and cases on IT issues. All these sources served as inspiration for IVK story events. We made special efforts to portray difficulties of communication, relationships, and corporate politics as realistically as possible, and gathered feedback from practicing IT leaders. After reading an early draft of the case series, one CIO said: "This is my life. This is what I deal with every day."

Basis in Business Issues, Factors, and Situations – Beginning with the first case in the series, we provided pedagogical opportunities to examine IT issues within a wider business context. IVK is a company in turnaround mode. Before the current difficulties, it was growing rapidly and IT was struggling to keep up. Now that company growth has slowed, IT spending already in motion has become a conspicuously larger percentage of revenue. Analysis of the company's market position reveals no external reason why growth has slowed, which suggests that problems with growth are at least somewhat internal in origin—some of them in IT.

Coverage of Key Core Topics – We developed the IVK plot around a list of topics that in our best estimate represented a reasonable set of core sub-topics within IT management. This list does not exhaust the topics relevant to IT management, but provides a starting point that can be elaborated upon by adding cases to the series.

Discussion Based Classroom Approach – We constructed each chapter around decisions facing Jim Barton in order to promote a classroom approach akin to case discussion. This structure is meant to set the stage for active participation by students as they develop a theoretical framework for wider use.

Cumulative framework, Whiteboard, Reflection Boxes — We attempted to overcome the tendency of the experience-based approach to generate more fragmented frameworks by using a number of devices to direct and establish continuity of evolving theoretical discussion. Foremost, of course, was the fact that the story follows a single company and set of characters from case to case; as students accumulate deeper familiarity with the IVK staff and circumstances, frameworks can be revisited and revised. We also, however, inserted a "whiteboard" device to encourage accumulation and integration of evolving student frameworks; as Barton learns the job, he fills his

whiteboard with signposts that form the outlines of his own framework for IT management. His whiteboard is not detailed enough to present theoretical material prescriptively, but it prompts students to engage in a parallel (and more detailed) exercise in framework creation. The book version of the series includes "Reflection Boxes" that contain questions to direct students as they think theoretically.

Exercises, Presentations, Framework Assembly Guidance – This pedagogical approach supports mixing in exercises, student presentations, and activities to assist students as they derive theoretical frameworks. In pilot uses of the case series, students prepared presentations on emerging technologies, designed guidelines for Barton to use in the analyst meeting described in IVK-10, and developed "checklists" to go along with their evolving frameworks. Role-play—asking students to take on assigned character roles and carry out live debate—gains particular traction when students experience more cases and become more deeply familiar with the characters in the story.

On-line Tutorial for Technology Level Setting – In view of the fact that the IVK series does not emphasize technical content, we sometimes used an online tutorial (offered by the Harvard Business School, "IT Concepts") for level-setting of student understanding of technologies. The point of the tutorial (which needed to be explained, to set expectations appropriately): To keep technical explanations in the background of the IVK series discussions, and business issues in the foreground.

Design for Integration with other Cases and Content Sources – The series is designed for use with other materials, such as lectures, other cases, textbooks, and journal articles. Materials provided with the series and footnotes throughout the text suggest supplementary reading. Instructors can add to the course as much deductive guidance as they wish, while maintaining an inductive pedagogical model that keeps students active and engaged. By integrating and emphasizing supplementary materials, the instructor can exert greater control over student development of cumulative frameworks.

Design for Use as a Whole or in Subsets – The series has been written in a way that will allow instructors to pick and choose among cases. Cases can be distributed individually, or all together. Teaching materials provided with the case series offer maps and advice for instructors who wish to use only subsets.

Online "Course Platform" – The series benefits from use of an online platform to distribute materials, capture notes from classroom discussion, and facilitate student interaction outside class. Ideal is a platform designed to include advanced features, such as RSS and video related to class discussions.

Ongoing "Open Source" Collaborative Approach – We conceived this project to involve a community of collaborators. As instructors use the case series and develop supporting materials (e.g., slides, course outlines, teaching notes), we hope they will contribute these to a web-mediated community of interest. Others will, we hope, develop new cases in the series, on topics we have missed; a community stands a better chance of keeping up with fast moving events in the IT industry than any small set of individuals. Although the original 18 IVK cases are now under contract with a major publisher and will appear in book form in 2009, we have obtained specific contractual concessions that stipulate that the publisher will support this community. They will not exert intellectual property claims over supporting materials; new materials will be freely available, unless the publisher arranges for publication of these supplemental materials (possibly with authors other than the authors of the original series). We have also obtained assurances from the publisher that the pricing of IVK materials will remain in a reasonable (nontextbook priced) range (book: US \$25 to \$35; individual cases: \$4 or less). Until published materials reach the market, materials will be available (with Teaching Notes) in free PDF files.

Experiences Using the IVK Series

We have used the IVK series in four different settings: 1) With undergraduates in a required IT course at a major US university; 2) With masters level students in an elective course at a major business school in northern Europe; 3) With experienced executives in a senior management development program at one of the world's largest industrial corporations; and 4) With IT executives in an open enrollment executive education course at a major business school in the U.S. Each of these experiences has revealed challenges and lessons, but also considerable promise in this "novel" approach to IT management education.

Experiences with Undergraduates

Undergraduates, as might be expected, need more emphasis on the business fundamentals that underlie the IVK story. In teaching undergraduates, we needed to slow the pace at which we covered the material. Undergraduates are less prepared to assess the meaning of financial information provided in IVK-1, and they are less sensitive to political nuances in relationships. Many such students do not understand the legal responsibilities of a Board of Directors, or the implications for the CEO of a rapid decline in company stock price. To address these difficulties, we supplemented experience-based case discussion with explanation-based mini-lectures on business basics.

Based on feedback from the 40 students who took the course, we believe that many of our objectives were met, especially development of cumulative theoretical frameworks, active student participation, ability to apply concepts, and degree of student engagement. The course was an unquestioned success; based on student feedback, the instructor received a best teacher award. Table 2 summarizes selected student feedback in key objective areas.

Area of Feedback	Student Comments
Cumulative	IVK case series was helpful in building on each other.
Framework and Basis in Business	The materials were presented simply and built in a way that felt easy.
Issues	It was very effective in outlining the goals and challenges of IT management. It gave insight into the day-to-day operations of an IT department.
Active Student	I really liked the case based learning. It pushes your thinking rather than memorizing facts.
Role in Theory Development	Actually had to think about real life examples; not just given theories to memorize.
Дечеюртені	Case discussion forced me to introspectively think about real life IT management situations.
	By far the most effective class I have takenIt didn't focus on learning some equation or memorizing, but rather applied real world situations and simulated situations to help develop a thought process.
Ability to Apply	Very accessible and applicable to situations in the future.
Concepts	Made us see [the IT world] from a very different, yet more applicable angle.
	I knew <u>nothing</u> about IT before this class, but now I feel like I have a grasp of it.
	Case studies facilitate the learning process <u>much</u> better than dry textbook readings. They give the subject matter context and a framework. It's much easier to relate to the information.
Degree of	IVK cases made a potentially boring subject interesting.
Engagement	I would have never taken an interest in IT before, but the course made me realize how truly important IT is to business.
	Great discussions in class forced you to care about IT.
	This was the most intellectually stimulating class I have takenI found it very effective to be able to step into the shoes of an IT manager.
	Probably the best course I have ever taken.
	Much more pleasant read than a textbook because it was interesting and educational.
	I liked reading these cases in advance because they were fun and interesting, and I wanted to know what happened!

Table 2. Representative Undergraduate Student Reactions to the IVK Curriculum

Experiences with Graduate Students

This course went well, but its context presented additional challenges. Discussion was more difficult to get going in a course offered in English, which for students was not their first language. Rules for grading students in this school make it impossible to provide strong incentives for thorough preparation, so we relied primarily on student interest to motivate preparation. It took time, also, to overcome students' expectations of a more passive, lecture-based

experience more common in this university. To address this difficulty, it proved helpful to allow students time at the beginning of each class to talk about assignment questions in small groups, to "warm up" for class discussion.

Despite these difficulties, feedback from this group of about 50 students indicates that the course was successful. Overall, students rated the case series itself a 4.64 average on a 5-point scale ("5" being a favorable rating). Informal feedback was favorable too; one student called the course "very exciting and relevant" in an unsolicited email; several students told us that they were unable to resist reading ahead, to "find out what would happen."

Experiences with Executives

Our initial senior management development program was at one of the world's largest industrial corporations. There, managers readily seized on IVK issues and related them to their own situations. The simpler IVK context allowed them to cut through the complexity in their own situations and address the essence of important issues in discussion. It appeared easier for these managers to talk about sensitive issues relevant to their own company in the context of IVK. With perspectives thus clarified and sensitivities diffused, they were better able to discuss alternative actions to address their own IT issues. Confidentiality concerns of the company in question prevent us from providing excerpts from participant feedback, but the course was well received overall.

Our second experience with executives was at a major business school and involved using the IVK series as the backbone of an intensive, week-long course designed specifically for CIOs, their bosses, and their direct reports. In formal feedback, the 65 participants rated the "Value of Topic and Materials" for the five IVK sessions between 4.44 and 4.61 on a 5-point scale. Comments from this group included: "IVK was a riveting story. Kept us all engaged. Became a 'treat' to read after more difficult cases" and "Loved the whole IVK approach."

Special Challenges of this Approach

Our experiences have revealed challenges not present in most explanation- and experience-based approaches. One issue is where and how to integrate supplementary readings; we have achieved this integration in different ways, partly because of different norms in when and how long classes meet. The graduate pilot delivered materials in larger "chunks," for example, often addressing more than one IVK case in a class.

We also discovered an important difference between IVK class discussions and more traditional case discussions. In the usual case approach, closure is reached within a short interval, often a single class session. The cumulative nature of the IVK experience means that there is less closure in early discussions, because some of the early discussions set up issues that will continue to be followed throughout the course. For instructors accustomed to traditional case discussion, this was uncomfortable; early discussions seemed too open-ended and it took time for momentum to build. However, "plot reversals" also unfolded over a longer period than in traditional case teaching, and this ultimately contributed to the power of the pedagogical experience and was very satisfying for students. Unfolding the series over time allowed students to see consequences of earlier case decisions and framework applications play out in successive cases to sometimes surprising and framework-revising effect.

Another possible concern arises from the "fictional" nature of the case series. One person commenting on our project expressed a concern, for example, that students might not take fictional cases, or learning derived from them, seriously. We acknowledge this as an issue that must be addressed in some contexts; we have found, however, that the "based on real events" nature of these officially fictional cases tends to overcome doubts. Seasond executives have been quick to vouch for the realism of the series, with comments such as "This is my life." We note also, as experienced case writers, that teaching cases almost always contain fiction. Financial figures are routinely adjusted and company identities frequently concealed. Many popular cases contain overtly simplified or entirely fictional elements constructed in the service of pedagogical objectives.

Conclusion

Overall, the early returns from offering the IVK series have been favorable. They suggest to us that there is wisdom in continuing and expanding this experiment conceived to confront the difficulties of IT management education. We find that a synthetic approach that attempts to combine the best features of explanation- and experience-based approaches—specifically, this "novel" approach—holds considerable promise.

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