Enterprise Integration: An Experiential Learning Model

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Abstract

With the ceaseless development of new and more advanced technologies, along with their growing influence and control over business and commerce, it is no surprise that the educational community is struggling to come up with programs to educate students to adequately handle these developments. Textbooks are becoming a thing of the past, for information and standards are changing faster than any publisher is willing to re-publish. Instead, a student of advancing business technologies must be able to adapt and learn from the 'here and now' while efficiently filtering out any antiquated information. These students must also be able to handle the myriad technologies currently in use and solve complex problems. This paper investigates innovations in experiential learning and their application to enterprise systems integration education.

Keywords: enterprise integration, enterprise systems education, experiential learning, problem-based learning.

1. INTRODUCTION

Beginning with team learning, the first wave of 'new learning', case studies have developed as an important method of educating technology students that incorporates the principles of Experiential Learning as well as its precursor, "Problem-Based Learning". This paper will discuss case studies as a viable and innovative means for educating technology students. To discuss Experiential Learning in detail as well as see its effects in action, we evaluate the merits of the Experiential Learning programs currently in place at the Pennsylvania State University's College of Information Sciences and Technology.

Among the most difficult technological challenges facing organizations as well as IT students today is enterprise integration, the coordination of activities, information and technology resources in an organization.

As more and more organizations make the decision to employ Information Technology solutions in their daily operations, the focus in selecting these technologies becomes less about what the technology does for the organization, and more about how the technology may (or more commonly, may not) interface with other technologies currently operating within the organization. A statement made by United States Senators Frist and Clinton exemplifies both the pitfalls of disparate Information Technology systems as well as the potential

benefits that exist should they be properly integrated:

> We (the United States) have the most advanced medical system in the world, yet patient safety is compromised every day due to medical errors, duplication and other inefficiencies. Harnessing the potential of information technology will help reduce errors and improve quality by making it more effective and efficient. (HIMSS, 2008).

This is where Enterprise Integration comes in to play. As an organization (such as the healthcare industry in the above example) becomes ever more reliant on various Information Technologies to improve their productivity or workflow, the major barrier in the way of future improvement is not the technology itself, but rather its innate inability to communicate with other technologies without significant human intervention. Until we are better able to develop technologies that interface completely with one another, we must develop a program of human education that will train employees in the art and science of manipulating technology to fit the needs of businesses--and to do so in a unique, case-by-case environment. Experiential Learning is that program.

2. UNIQUE CHARACTERISTICS OF ENTERPRISE INTEGRATION

Much like diagnosing an illness in a patient, the first step in addressing application integration issues within an organization is identifying the problem areas and scoping out the extent to which integration is warranted. Organizations are often reluctant to start enterprise-wide strategic integration initiatives. Instead, they attempt to solve limited and tactical problems (Toulemonde, 2004). This is often dangerous, in that simply throwing more technology at an integration situation may have little to no effect, and in many cases can exacerbate the problem.

> It is generally acknowledged that careful attention to organizational issues is crucial to the success of enterprise information systems. The most sophisticated technology becomes irrelevant or even harmful if it does not meet human needs. Work context and organizational concerns are increasingly important as information technology is no longer used only to automate highly structured, repetitive tasks, but offers support to practically all facets of work activities in enterprises today (Yu and Mylopoulos, 1997).

Yu and Mylopoulos (among others) state that the first step in identifying and properly scoping out an Enterprise Integration situation is to look past the technology to the human, organizational operations taking place on a day-to-day basis. Ultimately, if the technology is not working toward the benefit of the organization, then it offers no advantage in being there.

> Key 1: An Enterprise Integration situation does not so much involve the technology itself, but rather its interaction with the human operations in the organization.

As with designing complex technical systems, appropriate modeling techniques can be invaluable to the analysis and design tasks of mapping the relationships among technologies and the organization. Such modeling techniques must be able to express the richness of human, social, and organizational relationships (Yu and Mylopoulos, 1997).

> Key 2: By utilizing comprehensive organizational models, we can more easily see the interaction of Information Technology with human operations and subsequently identify problem areas that could be addressed by an Enterprise Integration project.

Another unique characteristic of an Enterprise Integration situation is that the technology may not be the only system at fault. Business applications generally focus on a specific functional area, such as Customer Relationship Management (CRM), Billing, Finance, etc. In most instances, the business and IT groups are organized along the same functional areas. Successful enterprise integration, however, requires communication and the sharing of responsibilities across units. Functional groups may no longer control a specific application because typically it becomes part

of an overall flow of integrated applications and services (Fowler and Hohpe, 2003).

> Key 3: An Enterprise Integration project can (and will) involve changes not only to the IT infrastructure, but also the operational structure of the organization itself.

Even after modeling the organizational structure and addressing the potential for sweeping organizational changes to accommodate Enterprise Integration, there still exists the understated (yet silently accepted) fact that an organization's Information Technology infrastructure and library may be as unique as a fingerprint. Even with the extensive number of Commercial Off-The-Shelf (COTS) software suites available today, an organization may still find itself making custom modifications to better fit the software to its operational structure. While such customizations may make the technology more efficient at the time, they often conflict with future upgrades and can seriously hinder any Enterprise Integration project.

> Key 4: Any Enterprise Integration project will ultimately have to deal with the technology. The number of concurrent technologies and the degree of after-market customization that exists within a system is almost always inversely proportional to the ease of Enterprise Integration efforts.

It is apparent from these characteristics that anyone interested in pursuing a career as a manager of Enterprise Integration projects will need to know more than how to code in Java or how to repair circuit boards. While Computer Science can play a valuable role in Enterprise Integration, a manager of these projects must also be fluent in organizational operations, business etiquette, chains of command, and so forth. What an Enterprise Integration manager needs to understand is almost entirely dependent on the project at hand, which in turn lends itself to a fairly new educational practice designed to prepare future managers for a world of uncertainty.

3. EXPERIENTIAL LEARNING

Based on the above descriptions of Enterprise Integration projects and what is required for them to succeed, it would seem almost impossible to create a curriculum of study that would give a student all the requisite knowledge to handle each and every Enterprise Integration project. And for the most part, it is impossible. Rather than attempt to compile a never-ending library of texts on Enterprise Integration, the Pennsylvania State University's College of Information Sciences and Technology along with several other colleges and universities have instead worked to develop and perfect an entirely new system based on Experiential Learning for educating future Enterprise Integration managers.

Experiential Learning theory defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p. 41; Kolb et al, 1999). David A. Kolb is one of the leading authorities on Experiential Learning and its applications in education. Below are Kolb's six basic tenets of Experiential Learning as employed in higher education:

1. Learning is best conceived as a process, not in terms of outcomes. To improve learning in higher education, the primary focus should be on engaging students in a process that best enhances their learning—a process that includes feedback on the effectiveness of their learning efforts.

2. All learning is relearning. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested, and integrated with new, more refined ideas.

3. Learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflict, differences, and disagreement are what drive the learning process. In the process of learning one is called upon to move back and forth between opposing modes of reflection and action and feeling and thinking.

4. Learning is a holistic process of adaptation to the world. Not just the result of cognition, learning involves the integrated functioning of the total person— thinking, feeling, perceiving, and behaving.

5. Learning results from synergetic transactions between the person and the environment. In Piaget's terms, learning occurs through equilibration of the dialectic processes of assimilating new experiences into existing concepts and accommodating existing concepts to new experience.

6. Learning is the process of creating knowledge. ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. This stands in contrast to the "transmission" model on which much current educational practice is based, where preexisting fixed ideas are transmitted to the learner. (Kolb, 2005).

In essence, Experiential Learning as a concept looks to break away from the long-standing traditions of book-learning and lecture-driven courses, and instead seeks to place the student directly into the type of situations he/she will experience in their future workplace. Below is a brief definition of Experiential Learning as it is seen by The University of Colorado – Denver's Experiential Learning Center (adapted from the National Society for Experiential Education):

> Experiential learning is a process through which a student develops knowledge, skills, and values from direct experiences. Direct experiences go beyond the conventional activities of college courses, such as reading texts, doing homework problems, writing papers or taking exams. Academic experiential learning includes service-learning, internships and co-ops, undergraduate research and other activities including performances, lab work, and creative and studio work. Co-curricular activities include volunteering and community service as well as leadership through participation in student clubs and organizations. Learning that is considered "experiential" contains all the following elements:
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> 1. reflection, critical analysis and synthesis;
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> 2. opportunities for the student to take initiative, make decisions, and be accountable for the results;
>
> 3. opportunities for the students to engage intellectually, creatively, emotionally, socially, or physically; and
>
> 4. the design of the learning experience includes the possibility to learn from natural consequences, mistakes, and successes (University of Colorado – Denver, 2008).

So, while students who are involved in an experiential learning project may still take tests, write papers, or prepare presentations, all of these assignments are more specifically designed to mimic what the student will experience in his/her future career.

4. EXPERIENTIAL LEARNING IN ENTERPRISE INTEGRATION EDUCATION

If there is one common theme that runs through the entire definition of Enterprise Integration situations and projects, it is that no two Enterprise Integration projects will be exactly the same. Their variety and complexity demands that those tasked with managing such projects must be able to adapt and meet every challenge, because if each and every aspect of Enterprise Integration is not addressed during the lifetime of the project, items left unchecked can mean the complete failure of an Enterprise Integration initiative.

Experiential Learning can work to prepare future project managers for situations like these by placing students directly into Enterprise Integration situations with real-world issues, and then allowing them to use their own experience (with reasonable guidance from instructors) to shape the outcome of the project. Below is a brief example of an Experiential Learning exercise employed in an Information Management course at Boston College:

> …The project was developed jointly by Boston College faculty and consultants from the Boston office of a major consulting firm. The project involves student teams playing the roles of IT consultants who must compete against one another to win a consulting engagement at an imaginary company.
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> The company's business situation is communicated to students through a case study written in the format of a Request For Proposal (RFP) informing information technology (IT) vendors that the company is interested in procuring a Customer Relationship Management (CRM) system. Each student team develops a consulting proposal responding to the RFP and presents the proposal to company managers.
>
> The activities involved in identifying the company's business needs, developing a proposal, and determining which team "wins" the contract are simulated through phone calls and live meetings with company managers, who are role-played by consulting firm employees. These real-life business interactions expose students to the ever changing nature of IT, motivate them to improve their technical understanding, and challenge them to improve their communication skills through written deliverables and live business presentations. Student buy-in and response to the project is strong and immediate since they find themselves challenged by complex, relevant business issues (Heim, 2005).

This scenario is an excellent example of how experiential learning can be applied to Information Technology Management. The information, documentation, contacts, meetings, and deliverables were all close to --if not identical to--what these students might expect from working in a major consulting firm. In this case, the only difference between this scenario and a real-world project is that rather than being used as part of a project, the students' deliverables are reviewed and then given a classroom grade.

5. PENN STATE COLLEGE OF INFORMATION SCIENCES AND TECHNOLOGY

Much like the example of Experiential Learning at Boston College, Penn State's College of Information Sciences and Technology has worked (and continues to work) on implementing Experiential Learning practices in its Enterprise Integration curricula.

The College of Information Sciences and Technology (IST) practices an applied approach to learning. This approach entails hands-on activities supported by a solid practitioner knowledge base. In addition, the curriculum presents a strong business orientation to the practice of Information Technology. Approximately two-thirds of the graduates from the College of IST are enrolled in the Enterprise Integration option within the IST major.

The need for enterprise systems integration education at the undergraduate level became increasingly apparent to Penn State's IST faculty after numerous discussions with many corporate partners. The feedback received from corporate partners indicated that most IT curriculums do a good job with technology and business topics but often do an inadequate job in the area of Enterprise Integration.

The ACM, IEEE, and AITP have continuously addressed the educational needs of future IT professionals by curricula development and standardization. Each organization, in their latest curriculum guidelines, emphasizes the importance of developing and mastering problem-solving skills in concert with real-world projects and group activities.

In response to this information and feedback from industry, an experienced-based model was incorporated into the senior-level Advanced Enterprise Integration Course (IST 421) within the College of Information Sciences and Technology. At the heart of the course is a real-world integration engagement with corporate clients from all areas of the country. The students work in teams of four or five on in-depth corporate integration projects, many of which span traditional semesters. In order to provide the students with an experience that is in-

depth and as close to the real world as possible, we recognized that projects should not be forced into the fifteen week constraint of the traditional semester. Rather, utilizing a flexible project scheduling model allowed us to consider projects that are much more robust than typically undertaken in traditional courses.

Many projects are broken into implementation phases. The semester-long Phase I typically consists of requirements gathering, solution design, and prototyping, and is completed in IST 441. Phase II of the project can be accommodated in a variety of manners, depending on the interests of the client corporation. The second phase of the project can be conducted in a subsequent course, either as members of the team work for the client as full-time hires, or as part of a relationship where the client corporation provides funding for the development of the project at Penn State.

The success of this model can be attributed, in part, to a unique, synergistic relationship between the faculty that teach the courses in the track, the career services unit within the College, and the university development office. This track has proven to be a great mechanism for engaging corporations with the IST students and curriculum. Furthermore, almost all of the participating corporations extend internships and/or full-time placement offers to one or more team members, demonstrating how such experiential learning projects can become an innovative placement tool for the career services unit within the College. The development office of the university views this track and its associated projects as unique mechanisms for engaging corporations and alumni with students. The positive experiences produced by these projects have generated substantial donations to the College and have helped to foster stronger long-term relationships with a variety of organizations and individuals.

6. RATIONALE FOR IN-DEPTH PROJECT EXPERIENCE

One learning objective that is persistent throughout the Enterprise Integration track is to develop in-depth problem-solving skills, particularly in order to develop students' skills to address open-ended, high-risk problems that may have multiple potential solutions. Another learning objective includes the ability to work well with all of the various stakeholders associated with corporate engagement, including the members of the integration team. The projects chosen for the course are carefully selected and scoped by faculty with substantial industry experience. Projects are sought that provide students opportunities for learning experiences on multiple levels and that provide substantial value to the client organization.

The selection and scoping of the project is one of the most crucial elements of the learning experience. Projects should be challenging and force students to step out of their comfort zones to learn (or re-learn) new skills and technologies in a real-world, on-demand mode. At the same time, projects must be scoped to determine achievability.

In-class lectures and discussions focus on a variety of enterprise integration issues, methodologies, and tools. A wide assortment of industry speakers are also utilized in the course. The use of structured methods that require careful planning such as traditional linear processes to define requirements, evaluate design options, build on schedule, and the setup of testing and evaluation tools, do not hold much relevance to today's IT professional.

Real-world projects change this perspective. Students gain a meaningful understanding of why and how structured methodologies affect success in a team-based environment. The implementation and relevance of textbook methodology comes to life in real-world examples of changing requirements, constraints, cultures, and competing objectives. Students gain experience with the less tangible 'people skills'--qualities that get overlooked by prescriptive text book descriptions. Grades are determined by the use of individual, group, and instructor measures. In this manner, it is possible (and is usually the case) that members of the same team receive differing grades. This design helps to prevent the "free rider" from receiving the same or similar grade as

the team member who contributed more to the project.

The traps and obstacles to taking a project approach to traditional classroom instruction can be daunting. They include the ability to manage and direct open-ended assignments, managing student and customer expectations, engaging real-world customers, defining project scope, producing a real world deliverable, intellectual property issues, and customer commitment. Students and instructors must be guided in making this transition to Experiential Learning to help overcome a bias for the traditional approach. The use of corporate projects often results in greater time demands, and the collaborative skills they require do not occur spontaneously.

7. BRIEF HISTORY OF EXPERIENTIAL LEARNING

In order to more fully understand the past, present, and future of Experiential Learning as a means for educating future generations, one must first understand how the concept of Experiential Learning was developed and refined. This requires an in-depth analysis of the growing paradigm shift occurring in higher education that is quickly replacing desks and chalkboards with workspaces and collaborative presentations. For the first time in several generations, the instructor is stepping out of the spotlight as the sole source for learning, and that position is now filled with limitless possibilities for learning and discovery, left open for the student to explore and comprehend.

Problem-Based Learning

Perhaps one of the first recognizable shifts away from the teacher-student dichotomy was the introduction and subsequent spread of a concept known as 'Problem Based Learning' or 'PBL'. "Problem Based Learning originated at Case Western Reserve University Medical School. However, McMaster University Medical School in Canada usually gets the credit and indeed was the first to widely adopt PBL in the 1960s" (Pennsylvania State University, 2006).

> Problem based learning is the simple but revolutionary idea that problems should come before answers. Instead of instructors giving you answers and then testing to see if you have memorized them, you will encounter problems or "messes" to tackle before teaching begins. Beginning with a problem puts you in the driver's seat. You can use and explore what you already know, your hunches, and your wildest ideas to try for a solution. In the process you can develop an inventory of what you know and what you need to know. Once you get a sense of what you need to know you can start questioning your instructor or your classmates, plundering the library, surfing the net, or bugging the many excellent Penn State experts to fill your needs (Pennsylvania State University, 2006).

As evidenced by this except from the College of IST's own website, the primary goal of Problem-Based Learning as implemented in higher education is to shift the focus of learning from factual memorization and recall to a more free-form and creative undertaking.

> "Problem-based learning involves the use of authentic problems and materials for learning; students in a PBL environment are tasked with applying their knowledge toward developing solutions.
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> Problem solving activities give students the opportunity to learn from authentic scenarios and actively engage in the use of higher order thinking skills… In other words, a PBL scenario assesses student performance on tasks that go beyond requiring just knowledge, comprehension, and application, and that involve demonstration of analysis, synthesis, and evaluation, all of which are more complex abilities" (Dennen, 2000).

This method of learning allows students to take a problem and create solutions that reflect not only their level of understanding of the material, but also the student's personality and unique method of getting to an answer, instead of simply regurgitating a prefabricated answer to a prefabricated question. "Instructional approaches derived from these perspectives use student-centered discourse as an instructional

strategy. The role of the teacher becomes to guide the learning process rather than provide information" (Hmelo-Silver, 2006).

Students who enroll in PBL courses often find the course substantially more difficult than a standard "lecture-learn" course (primarily because they are accustomed to "lecture-learn"), but ultimately discover that the concepts and materials learned in a PBL course hold significant future value and are retained. This is opposed to a standard-format class, where the information that is memorized in preparation for an exam is immediately regurgitated and often forgotten upon completion of the corresponding exam.

Group-based (or Team-based) Learning

> During the last two decades, there has been a rapid growth in the use of small groups in college-level teaching. When I talk to professors these days, the majority say that they use small groups in one way or another in at least one of their classes. The majority of students say that they have had a small group learning experience in at least one of their classes. What has lead to this rise of interest in teaching with small groups? (Fink, 2002).

Another predecessor to Experiential Learning is "Group-based Learning". As the name implies, this is the concept of providing a significantly more difficult assignment to a group of students to complete as a unit, rather than producing smaller (and perhaps less meaningful) assignments for each individual student to complete on their own.

The major impetus for the development of Group-based Learning was the natural progression and evolution of team-based production and projects occurring in the Information Technology workforce. Very rarely will there be an IT project started in a company or organization that is not assigned to a diverse team of people, each bringing their own unique set of skills to the overall operation. The natural progression of group-based projects and assignments in the workforce brought the concept of team-based assignments to the classroom. With this approach, courses are not structured around quizzes, tests, or homework assignments, but rather around one (or several) major projects that cover the entire range of topics and content for the course. Students are broken down into teams to handle these projects, and the teams themselves are responsible for assigning roles to the members based on their individual strengths and weaknesses.

> The primary learning objective in TBL [Team-Based Learning] is to go beyond simply covering content and focus on ensuring that students have the opportunity to practice using course concepts to solve problems.
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> Thus, TBL is designed to provide students with both conceptual and procedural knowledge. Although some time in the TBL classroom is spent ensuring that students master the course content, the vast majority of class time is used for team assignments that focus on using course content to solve the kinds of problems that students are likely to face in the future (Michaelsen, 2008).

Team-Based Learning is both an adaptation to and an evolution of Problem-Based Learning, in that oftentimes the assignments given to the teams are in the form of a problem that must be solved. The key here (just as it was for Problem-Based Learning) is that students are given the freedom to develop a solution that is unique to the inherent characteristics of the group and its members, and that is free from the potential scrutiny of being compared to 'The Right Answer.'

Often there is no predefined answer, and it is instead the group's responsibility as part of completing the assignment to include a logical and reasonable justification as to why their solution accurately and completely solves the problem. This self-justification can be just as important to the learning process as the solution itself, because in the business world, very often a project will never see the light of day if its sponsors cannot legitimately justify the time or money that will be spent developing or implementing a solution.

Case Studies
The next logical step in changing university learning to better prepare students to adapt and understand real-world problems and solutions is to present students with real-world problems. Case studies can be performed using varying levels of fabrication, ranging from a case that is completely created by the instructor(s) to a case taken directly from publications or journals (often names and numbers are changed to protect those involved). Cases can then be presented to student groups in the context of current course content in one of two ways:

1. Solving the Problem: In these cases, the students are presented only with the problem and are assigned to create and justify a solution. If the case study in question has already reached a real-world solution, that solution is kept from the student until the end of the course (or may not be revealed at all). This method is also well-suited for more current cases that may not have been solved yet.

2. A Better Solution: Done more with older or more complex cases, this method involves presenting the students with the complete case--both problem and solution. They are then asked to use what they have learned (along with any additional research) to make and justify changes and/or improvements to the given solution. While these projects are not necessarily as difficult as generating a solution from scratch, they are nonetheless effective in demonstrating students' understanding of the content.

The real key behind the introduction and adoption of Case Studies as effective learning tools is the existence of a tie between the students assigned to the project for a grade, and the actual project team that most likely worked to solve the same problem as part of their job. Case studies are able to get students closer to real career-making (or career-breaking) decisions than any previous assignment or project from a textbook or manual. The implementation of case studies in education laid the groundwork for what has become the newest evolution of career-oriented education tools: tools that bring real companies in direct contact with real students to develop, test, and perfect real solutions--all in real time.

Beginnings of Experiential Learning
The core concepts of Experiential Learning are far from new, and they have in fact been employed in the various trade skills for several centuries. Some have made the case that the earliest experiential learners were those who were inducted into guilds of craftsmen, or taken on as apprentices or squires by the masters. These apprentices would work directly with a seasoned professional to acquire an understanding of their trade that could not be written down--an understanding that (once mastered) would be passed on again to future apprentices.

Only recently has this concept of 'non-recordable' learning begun to surface in the world of business and information technology. As technology continues to permeate our society, and as business becomes more complex and nuanced, it becomes harder and harder to put into print exactly what students in these fields must know to succeed, leading education to come full-circle. By providing students the opportunity to reach out and work with veterans in the field, experiential learning is allowing students to ask questions and get answers to questions that might never have been answered by memorization and regurgitation of written materials.

Today, experiential learning has become a hot topic in schools, universities, and businesses around the world. As more and more colleges develop educational programs around the idea of real-world problems from real-world people, there are more and more companies eager and willing to embrace this nearly limitless source of knowledge and thought.

8. CONCLUSION

Every day, a myriad of new technology problems develop in organizations and businesses across the globe. These problems may be large or small, cover a single operating unit or the entire business, involve one operating system or many, and require the talents of anywhere from a single subject expert to an entire division of

technicians, business experts, and solution developers.

To capture this information and experience in the form of a single textbook is not feasible, yet the education of future enterprise solution providers falls to colleges and universities. Rather than learning about all of the different technologies involved in (for example) Storage Area Networking from a series of textbooks, students must learn about Storage Area Networking from those professionals who are currently mastering the art and science of such quickly evolving technologies and solutions. Just as the apprentices of old learned their craft or service trades from master carpenters and plumbers, so too must a student of technology learn the ins and outs of their trade from the hundreds of thousands of their colleagues who are out in the world mastering those technologies anew every day. Experiential Learning models can provide the foundation to teach today's students how to learn in a constantly changing environment and better prepare them for the world that awaits them

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