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The development of expertise in project management using an advanced cognitive learning model; Results of Research with Project Management Institute (PMI) Members using an "Alpha" version of an online learning product.

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ABSTRACT

This research examines the development of increased expertise among volunteers using a single player version of PAL, or "Project Management Accelerated Learning" model. The purpose of this study was to see if a learning approach normally reserved for smaller groups, specially selected or elite performers being trained in constrained settings, could be effective if built into a widely available PAL prototype residing in a virtual world. The participants were all volunteers residing in various parts of the world, accessing the prototype via the internet, and voluntarily completing it in their own time over a period of weeks. This report shows results from a statistically significant sample of people who had gone through the complete session.

INTRODUCTION

In general, the PAL model and prototype produced learning benefits much better than anticipated, and much better for something that was completely voluntary. The participants also liked the prototype (e.g., 84% reported it was meaningful and appropriately challenging as well as a valuable learning experience).
The strong results show promise not only for this PAL model, but for the potential to deliver accelerated expertise educational methods more widely than thought possible for professional development purposes.

LITERATURE REVIEW

Research on the nature of intuitive expertise is not new, but probably began in earnest in the 1980's with important work being done by Robert Glaser, Micki Chi, Robert Hoffman and others (see references for sources used for this paper). The research focused on four areas.

1. Content: The "nature" of expert knowledge. What is the mental map of an expert?

2. Epistemological: The differences between experts and novices; how do experts and novices navigate the same problems differently and what do experts see that others do not?
3. Acquisition: how does expertise occur? Is it a learned set of content that is acquired, or does it develop as a way of knowing and thinking; if it develops, what is the nature of the development and what cognitive mechanism come into play (memory, procedural knowledge, declarative knowledge, etc.)?
4. Generality: Is expertise the outcome of a general capability or does it occur in a domain specific way?

Looking at the early research, it seemed expertise was assumed to concern complex but relatively unchanging areas of knowledge, such as mathematics, physics, computer science and astrophysics. This led to a lot of work on the mapping of expert knowledge and the development of AI systems that replicate experts. Other researchers – such as Chi, Glaser and Farr – were more focused on the cognitive mechanisms and "ways of knowing" that made experts different in complex but relatively stable domains of knowledge.
In the 1980's Gary Klein conducted pioneering research on expertise in dynamic areas, or areas of knowledge that change quickly and where effective actions require understanding the dynamic underlying principals defining the domain itself. In general, these domains require that the same cognitive mechanisms to come into play as that in other kinds of expertise, but manifest in different decision-making capabilities, which are required to navigate these domains as experts. Around the same time, other researchers began to see similar capabilities in what had been assumed to be more static domains, such as chess. Very broadly speaking, these capabilities were:

1. Developing an intuitive understanding the domain that constitutes a gestalt shift, resulting in seeing things that non-experts cannot see.
2. Being able to assess and address situations not cognitively available to non-experts.
3. A way of thinking that is "first principles" based, rather than the result of memorizing a set of facts or concepts.
4. The ability to "forward simulate" eventualities in a domain that is rapidly changing and take appropriate actions proactively.

As a result, that work, Klein and others identified other key questions now critical to research on experts:

1. Can expertise lead to important events, such as innovation?
2. Are there meta-capabilities associated with expertise, such as cognitive agility or cognitive flexibility?

More recently the concept of "expert" is being applied to a broader set of domains that, 30 years ago, would not have been seen as candidates for expertise research. The emergence of "expertise" in business is driven in part by the increased complexity of business environments themselves (such as high tech and bio tech), which in turn, is driven by the influx of advanced information technology. Put simply, running a business or being an effective project manager is best done using many of the cognitive capabilities associated with "expertise" in the cognitive sense, as both of these jobs have become more complex and dynamic.

Theoretical Development of Workplace Technologies Research Inc. (WTRI)

WTRI studies and assesses business expertise of all kinds and helps companies re-align the expertise of their senior teams to keep pace with changes in the marketplace. Our research focusses on the ***development of expertise,*** seeing it as a result of stage-like development in the sense of Piaget and with specific mechanisms involved, such as functional invariants identified in Piaget's research. However, we differ from other genetic epistemologists in that our work incorporates the influence of what Vygotsky called "scientific knowledge." Scientific concepts" in today's terms are systems of knowledge that created collectively within a field and formalized (See DiBello 1997 and DiBello and Missildine 2007 for a full explanation of this approach). In other words, our works shows that expertise develops through a series of stages, but this is guided by the nature of the domain itself; as such, experts "enter" into a way of understanding the world already in place for other experts. We believe this is an important differentiator of our species; unlike other animals, we can understand physics as well as Einstein without having to replicate in our own lives the history of physics which led to the theory of relativity over several thousand years.

However, the development of expertise is more complicated than reading about Einstein, hence the famous proverb "I can explain it to you, but I can't understand it for you". Rather, becoming an intuitive expert in a domain involves cognitive reorganization. WTRI's models and systems are built on research on how to accelerate the development of expertise through experiential activities specially designed to speed up cognitive reorganization through specially designed simulations.

Expertise among Professional Project Managers

For the Project management Institute, we are developing a PAL model and prototype that will accelerate the trajectory from novice to expert with an approach we now use with our customers to accelerate expertise for complex businesses situations.

In other words, we are accelerating the development of expertise in Project Management. This became a possibility after we conducted a number of studies funded by the National Science Foundation and IBM Research on what differentiates "experts" in Project Management. In particular, we were interested in Project managers who manage "capital projects". These are projects with specific strategic purposes for the improvement of the business as a whole and which have their own considerable budgets, usually justified by the business benefits that rationalized the project. Some large companies, such as IBM Global Business Services, sell project management services and employ large numbers of these Professionals (2000+) to manage capital projects for their customers. Other companies, such as large pharma companies, high tech companies and mining companies depend on capital projects to maintain or improve their position in the marketplace. These companies each spend billions on these projects each year.

When characterizing expertise for this research, we settled on the Dreyfus five-stage model as our descriptive framework. Our research showed us that expertise in project management develops in line with the stage-like genetic epistemology described by Dreyfus, with more complex capabilities emerging at each stage. Below are the Dreyfus stages and cognitive and behavioral consequences at each stage.

Figure 1 is a tabular summary of the Dreyfus five-stage model.

Stage		Characteristics	Standard of Work	Autonomy
5	**Expert**	No longer relies on rules / guidelines / maxims Grasp of situations & decision making intuitive Vision of what is possible	Excellence achieved with relative ease	Able to take responsibility for going beyond existing standards and creating own interpretations
4	**Proficient**	Sees what is most important in a situation Perceives deviations from the normal pattern Maxims vary according to situation	Fully acceptable standard achieved routinely	Able to take full responsibility for own work, and coach others
3	**Competent**	Copes with crowdedness Sees actions partially in terms of LT goals Has standardized and routinized procedures	Fit for purpose, though may lack refinement	Able to achieve most tasks using own judgement
2	**Advanced Beginner**	Action based on attributes or aspects Situational perception still limited All aspects are given equal importance	Straightforward tasks likely to be completed to an acceptable standard	Able to achieve some steps using own judgement, but supervision needed for overall task
1	**Novice**	Adherence to rules or plans Little situational perception No discretionary judgement	Unlikely to be satisfactory unless closely supervised	Needs close supervision or instruction

Adapted from: Dreyfus, Stuart E., *Formal Models vs. Human Situational Understanding: Inherent Limitations on the Modelling of Business Expertise*, University of California, Berkeley, 1981

Of particular interest to IBM, the National Science Foundation and our other clients who participated in the research (Tri City College, Rio Tinto, Takeda, Merck, etc.) are “stage 4 and 5” project management experts. In general, capital projects have high failure rates, costing billions of dollars a year. Further, even so-called successful projects fail to deliver the hoped for business benefits about 72% of the time. Our research showed that stage four project managers are more likely to mitigate the risks that put projects at risk, but more to the point, Stage five project managers rarely if ever fail to deliver the hoped for business benefits and often find opportunities for their employers or clients in troubled projects. In other words, rather than mitigate risks alone, they find opportunities. For this reason, project managers with this kind of expertise are considered highly valuable. However, they are also relatively rare, and have developed their skills as a result of having the opportunity to learn through trial and error, usually on a very expensive scale. Most of the Level 5 Project managers we studied had developed their capabilities through experiencing spectacular failures or had worked for mentors who had learned this way.

It is relatively well accepted that education and certification programs, even at the graduate level, produce Level 3 Project managers relatively reliably, and that higher levels of expertise occur as the result of experience. This is not new; we see the same trend with other kinds of experts, such as surgeons, computer scientists, etc. Learning through experience has been a constraint for project managers, however, because of the risks involved. Most employers are unwilling to voluntarily develop their project managers by permitting huge mistakes and the lessons learned from them and are also unwilling to put non-experts in charge of very large, very complex projects with significant potential for failure. Therefore, the most talented are overused while relative novices are under-exposed.

Background of the Method and its Adaptation to Project Management Education

WTRI provides market modeling services to help companies identify achievable goals and leverage their strengths and overcome their constraints, but this does not enable them to meet the challenge. For that, we develop complex "war games" for companies to rehearse their future. These exercises are iterative; companies do not achieve their goals the first time through, but through iteration over two days, they do arrive at an approach for winning. We also rehearse actual "projects" such as major initiatives that are meant to transform the company's future.

We normally measure "transfer" of the skills by looking at the real-life performance of the team for six months after the event. Without exception, the teams achieve high performance the second time through the sim (and without exception they do not achieve this the first time through, but rather replicate a pattern of lower performance). Back at work, the same financial and marketplace benefits achieved in the simulated environment the second time through are achieved in real life, measured as gross revenues, market cap, stock price and profitability.

The challenge for us was to use what we have learned from our clients to develop an "educational" approach to help professional project managers develop higher levels of expertise. In other words, the clients are individuals trying to learn as opposed to leadership teams from a single company trying to meet a new set of challenges before the company. Cognitively, the task should not be different. As long as we design the environment properly, we should get the same effect as we do with our corporate clients.

Preliminary research funded by the National Science Foundation bore this out. In the spring and summer of 2015, 80 MBA students taking a graduate level Project management class went through a simulated project management exercise over several weeks. 100% of our 80 test participants rose a full level on the Dreyfus scale from Time One to Time Two in the simulated Project Management Scenario and 38% rose two levels. In that study, we accepted performance in the sim as a proxy for the development and transferability of skill. This assumption was based on our experience with our clients. Many of these students were not yet working as professional project managers; some were full time students. Further, these students worked in teams and managed a project as a project team.

To summarize, there are two important differences in the PAL model and prototype we are developing for PMI.

1. This is an educational prototype, with expertise as an end in itself. Even though we saw measurable change between time one and time two, we are not able to do follow-up with the participants back at work. Further, they may not have positions in which the transfer will be obvious; for example, even though they are PMP certified, their current job may not have them in a project management role.
2. Most of the participants will be in single sign-on mode. Although teams can use the prototype and engage in projects together, PMI will be selling the prototype largely as a single sign-on individual learning product people can use from home.

As a result, for this PAL model and prototype, we had had to figure out a way to measure the development of expertise a little differently than we normally do.

1. They were pre-assessed and leveled using a cognitive task instrument we use now for measuring level of expertise on a Dreyfus scale. (This instrument is an automated knowledge elicitation instrument that we developed in 2008 and has been used successfully with hundreds of people in business domains).

2. They were assigned an exercise that is a level of difficulty higher than their “level” on the Dreyfus scale. E.g. Someone who tests as a level “3” on the cognitive Task will be assigned to a project that can only be successfully completed using level “4” capabilities.
3. We compared performance between Time One and Time Two. The exercise is similar the second time but not exactly the same. If they have gone up a level on the Dreyfus scale as a result of iterative failure and feedback during time one, they should be able to complete the exercise successfully the second time around.
4. Additionally, there were “challenges” which operate as knowledge elicitation tasks; these are distributed “distractors” or small events that the participants have to address but which will have more than one viable solution. The solution chosen by the participant will be an additional way to reveal the participants’ underlying mental model and any changes in the way of assessing situations and seeing solutions. In other words, challenges are built-in cognitive assessment tasks.

Structure of the PAL Prototype

As indicated, the participants must login to a virtual world and manage a project for a client. In this case, the project is an ERP implementation for a printer manufacturer. “Success” of the project is defined by executing the project in such a way that it delivers the hoped for business benefits to the client. All the participants’ decisions and actions have an impact on the company, such as product shipments, computers working, or not working, and remote locations being connected. The whole exercise takes 5 game hours for each pass through. Participants get two tries. The project is the same the second time, but the challenges are different, and some activities can be more complex.

There is a “grammar” to the scenarios that has been shown to be important to accelerating expertise in business. These are the components:

1. The world: the virtual world is where all the companies reside and in which all the projects take place. We have created a simulated Economic Index Company and imposed on the geography of the simulated world. The companies and therefore the projects they initiate will be affected by the features of the country they are in the economic trends of that country. Below is a world map:
2. The company: each project take place in a company. The company has its own goals, website, annual report, history, financials and internal documents. All of these can be accessed via the company’s website.
3. The project: the project is designed to have an easily measurable benefit to the company and something that the company has invested in order to realize a strategic improvement. Therefore, each project has:

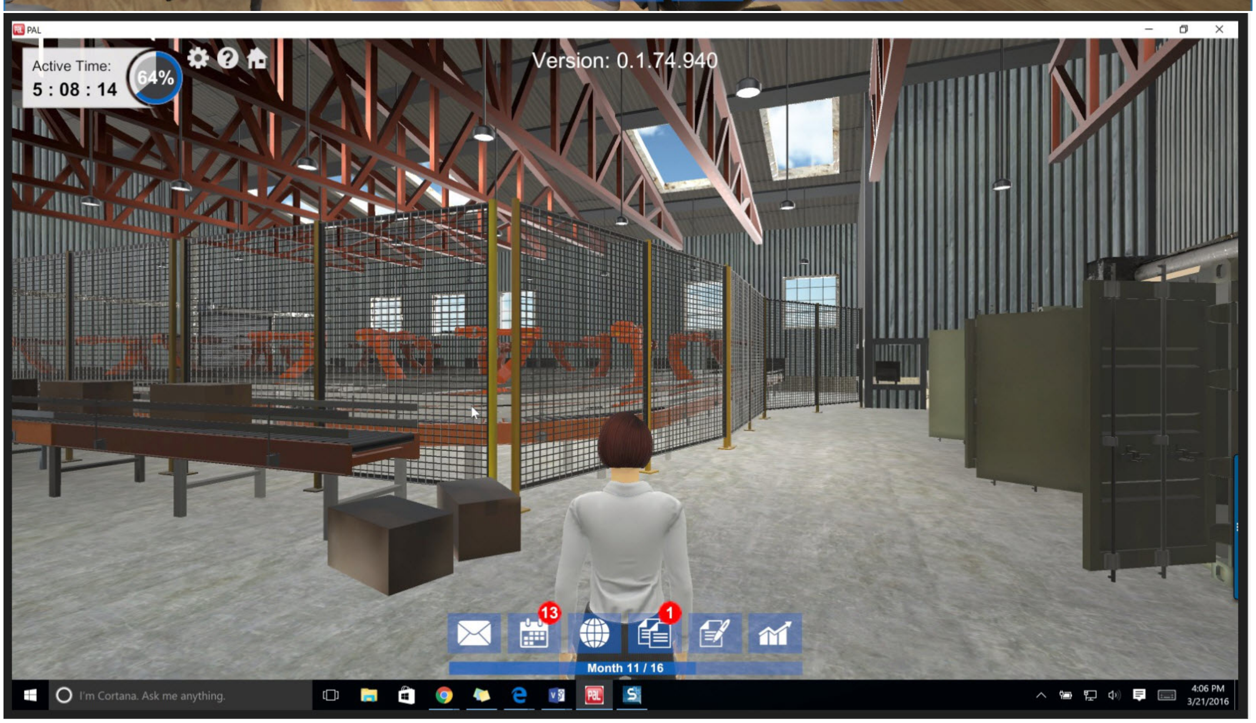
    a. A non-negotiable goal; this must be achieved in order to justify the expense and investment in the project itself. It is a clear business benefit in something like sales, shipments, profits or market reach that can be realized only with successful completion of the project.
    b. Major activities; things which must be accomplished in order to meet the goal, and which, if not met, put the whole project and reason for doing it at risk
    c. Core event: an event that is not part of the original project scope, but which must be navigated successfully for the best possible outcome for the client. Examples might include a change in market conditions that necessitate early completion. The “core event” of each project will be a challenge that can only be accomplished by a PM at specific level of expertise. Therefore, there will be level

3, level 4 and level 5 core events for participants whose pre-tests indicated they were level 2, 3 or 4 respectively.

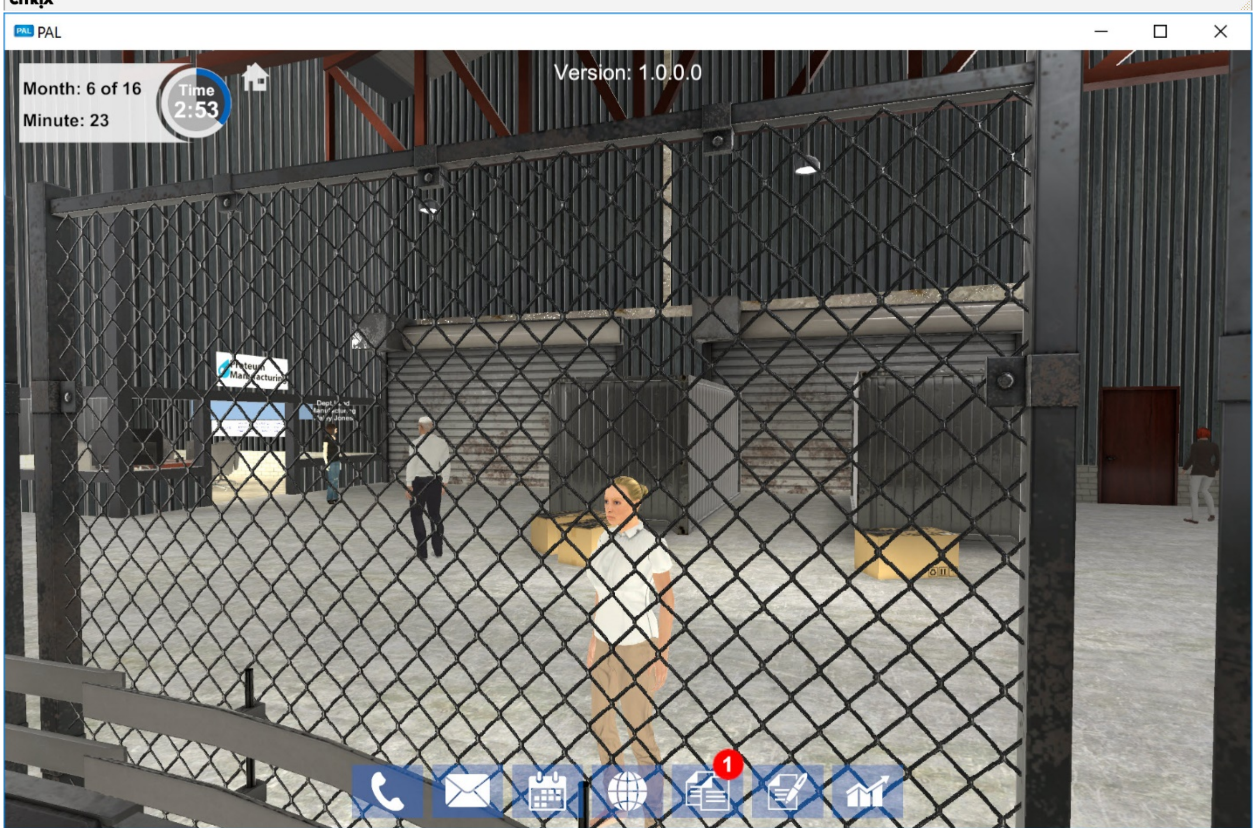
d. Challenges; events which will not bring to the project to a halt if not successfully complete, but which will test the PM's skills in various areas. These will have three scores: 0, 1, and 2, with "2" being a solution a level above the participant's current level of expertise. Indirectly, these can measure level movement. These are randomly delivered from a large library of examples, with each level of difficulty having its own library. They occur at regular intervals throughout the exercise as distractions and roadblocks. The relative randomness contributes to the immersion of the exercise and makes the experience unique for each user.
e. Cognitive probes: From the user's point of view, these look like "challenges" but are not randomly delivered. Rather, these are delivered deliberately at critical points in the exercise for the sole purpose of being an independent measure of expertise. They are similar to tasks used to reveal an expert's underlying mental model in other expertise research. There will be a number of equally viable solutions, but each will indicate a "level", much like the CAAT works now.

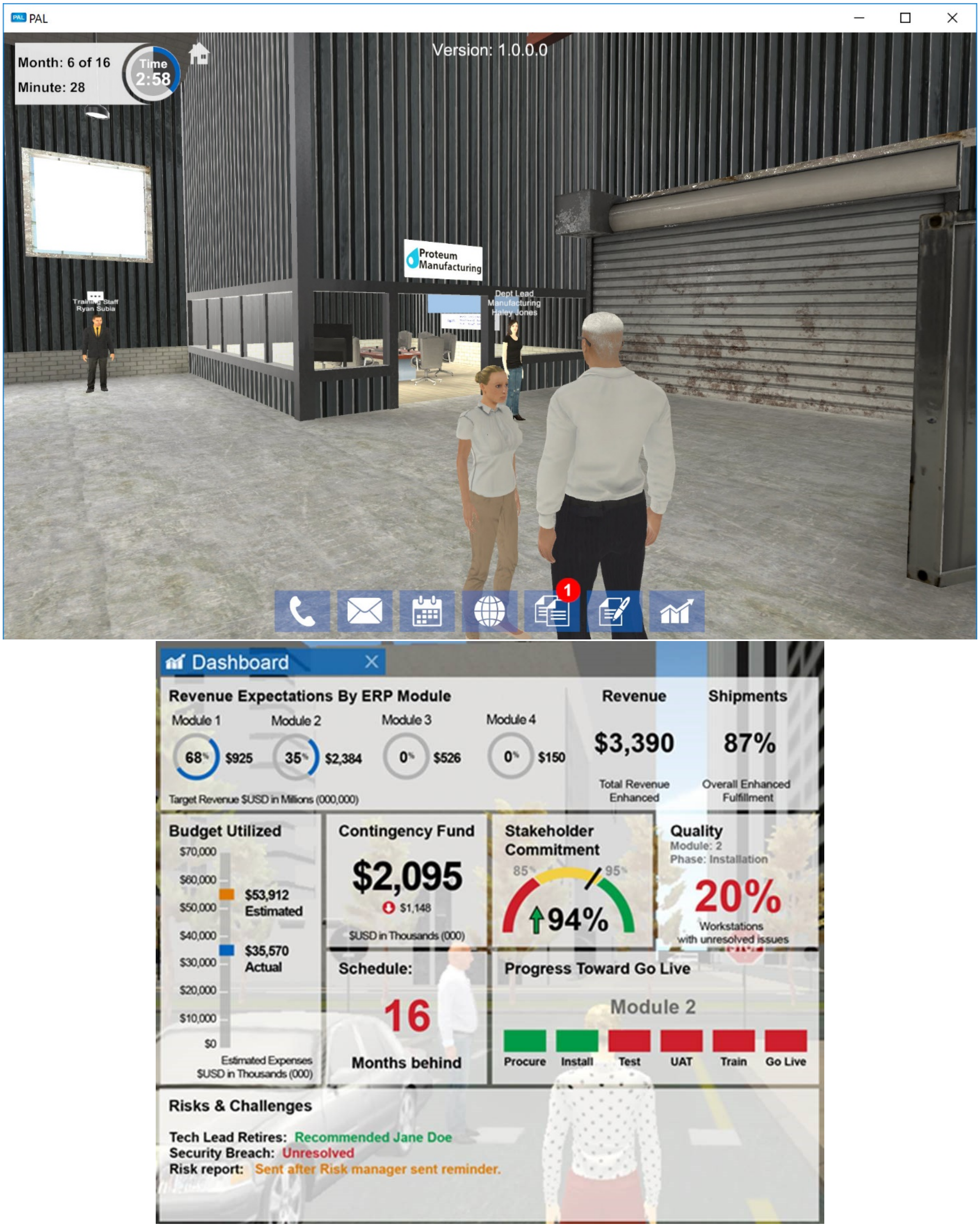
Screenshots of the prototype from a user's point of view


PAL
Month: 8 of 16
Minute: 8
Time
3:38
Version: 1.0.0.0
Stakeholder Assessment
Schedule Predictable
Costs Controlled
Scope Manageable
Risks Mitigated
Quality Assured
Stakeholder Committed
Business Benefits Realized
CEO
Jane Kent
CFO
David Hill


PAL
Active Time:
5 : 08 : 14
64%
Version: 0.1.74.940
Month 11 / 16
I'm Cortana. Ask me anything.
4:06 PM
3/21/2016


GoToMeeting Viewer
Now viewing Shelby's screen
PAL
Active Time:
3 : 28 : 17
43%
Version: 0.1.74.940
Connectivity? I hope not. I had talked to him about cybersecurity. He must have heard me wrong. Good thing you came down. We've found weaknesses in our security system that wouldn't live up to Proteum quality standards. Security threats are rare but can have a huge impact, so I wanted you all to be aware to increase priority on Security risks in case something should happen.
Legend:
Hi, I just talked to the Risk Analyst and he said there were some concerns down here about connectivity. If we can't get these machines to connect we're in big trouble. What seems to be the issue?
OK
Month 7 / 16
I'm Cortana. Ask me anything.
3:32 PM
3/21/2016
CITRIX


PAL
Month: 6 of 16
Minute: 23
Time
2:53
Version: 1.0.0.0


PAL
Month: 6 of 16
Minute: 28
Time 2:58
Version: 1.0.0.0
Proteum Manufacturing
Dept Lead Manufacturing Haley Jones
Training Staff Ryan Subia
Dashboard
Revenue Expectations By ERP Module
Module 1 68% $925
Module 2 35% $2,384
Module 3 0% $526
Module 4 0% $150
Target Revenue $USD in Millions (000,000)
Revenue $3,390 Total Revenue Enhanced
Shipments 87% Overall Enhanced Fulfillment
Budget Utilized
$70,000 $60,000 $50,000 $40,000 $30,000 $20,000 $10,000 $0
$53,912 Estimated
$35,570 Actual
Estimated Expenses $USD in Thousands (000)
Contingency Fund $2,095 $1,148 $USD in Thousands (000)
Stakeholder Commitment 85% 95% 94%
Quality Module: 2 Phase: Installation 20% Workstations with unresolved issues
Schedule: 16 Months behind
Progress Toward Go Live
Module 2
Procure Install Test UAT Train Go Live
Risks & Challenges
Tech Lead Retires: Recommended Jane Doe
Security Breach: Unresolved
Risk report: Sent after Risk manager sent reminder.

How was Accelerated Expertise Measured During the Alpha3B Phase of the Prototype Development?

In Alpha 3b, 203 volunteers from around the world used the PAL prototype. They were all project managers recruited by PMI. Of those, we needed at least 40 who have completed both sessions to looking for an elevation in expertise.
The main way of determining if a participant has moved a level up is an increase in the proportional frequency of decisions or actions that are characteristic of a "level" up from the level at which the participant was assessed before the exercise. In other words, we calculated the frequency of behaviors/actions/decisions associated with a higher level of expertise in each of the two sessions. The hypothesis being tested is that participants do significantly better the second time.
In order to execute the project in the simulation, a minimum number of 60 decisions/actions are taken through the course of each session. Not all participants address all 60, and some take on additional, optional tasks. Each of the many options for action are coded for level of expertise. I.e., every action or path of actions is associated with a level of expertise in project management using an association matrix. The "score" is automatically collected for every action for each user, date and time-stamped, and stored in an ongoing logging database. That data was used for this analysis. The coding system was first developed in May 2016 and tested over 3 Alpha releases. Codes were adjusted as we examined the data and corrections and refinements were made. By the time we embarked on Alpha 3B, the coding scheme had been tested and validated with hundreds of participants.
We validated the coding scheme by comparing behavior to measurable financial and operation impact on the virtual company. The product is designed so that greater financial benefits are directly the result of good decisions. For our analysis here, the primary interested in how decision-making and action-taking changes between time one and time two.
A secondary way to measure changes in expertise is performance on "challenges", especially those that are imbedded cognitive probes. The use of cognitive probes, although not tested before in this context, has a long history in expertise research (Cognitive Task Analysis, or CTA) and may be a way to continually test the prototype's impact long term in an elegant and non-invasive way. It seems useful to introduce this into the alphas and see what they reveal, but not count on them as primary indicators until that method is more refined for this context. All the challenges in the Alpha phase of development acted as cognitive probes and were not randomly delivered from the larger library. "Unique" challenges were used as indications of transfer; i.e., the new way of thinking can be used on unique tasks, which suggests deep learning. Neither of these uses of challenges affected the user's experience and allowed to more closely tracking learning and the value of challenges as cognitive probes.
Originally, we were hoping to use performance on "core" events as a primary way of measuring a change in expertise. With WTRI clients, who are looking for project managers who will take extra risks for the benefit of the client's company, this has been an important feature. However, there are a number of reasons not to rely on it as a primary indicator in this situation:

1. Core events are "optional" in that a project can be successfully completed without taking the extra step a core event introduces. Some PM's in our smaller pilot (the Texas students) avoided core events because they thought they were too risky and could put the client at risk. This suggests that individual users working alone could have the same concern and avoid core events that they perceive as risking the primary project
2. The instructions to users were not clear that taking major risks was encouraged and that a virtual world rehearsal is good opportunity to try things too risky for real life. Users

could worry that if might affect how their performance was assessed if they took what they perceived to be risks to the project.

3. The Level 3 core event had a feature in the programming whereby it was possible to do this activity well and not get credit for it if you failed to notify stakeholders of your plan via email. At the same time, it is not clear in the instructions that the stakeholders have to be notified. We are considering this a flaw in the way credit is assigned... For Alpha 4, this has been fixed.

Although willingness to do core events was highly variable, a significant number of people did try them, and measurable performance improvement from time one to time two was seen and was statistically significant. We think with clearer instructions on the PM's role in the rehearsal, we will get greater compliance and see greater gains across the board.

Caveats

The performance on the sim Time Two has been a reliable way to measure expertise and has been a reliable predictor of transfer in other contexts, where we have access to participants for follow-up studies. The challenges will be used as proxy measures of transfer, since they are different from time one to time two.
The challenges as cognitive probes have not been tested in this context. We are introducing them in order to test their efficacy and elegance at measuring expertise mainly as a supplemental measure. The idea is that with some road testing and refinement, they might provide a good long-term measure for new versions and new scenarios.
During Alpha 3b, we implemented the Dashboard and interim reports of the PAL model, which helps users see how they are doing against the goals. During the second session, users had access to their Time One dashboard and summary of results to be used as a reference point. The dashboard and some added incentives for completion both improved compliance of the volunteers and greatly improved the results. In Alphas 1-3a, users were "flying blind", and many had trouble knowing or remembering how they were doing between logins. A pilot with 50 MBA students from a Texas University showed that access to feedback increased performance markedly, even if the students had to get it in the form of weekly progress reports from a facilitator. Therefore, the dashboard, which was planned for Alpha 4, was moved up into Alpha 3B.

Discussion and Conclusions

Out of 203 participants who took the pre-assessment, 88 completed session one by November 1, 2016, 73 had completed two sessions, and 46 had completed two sessions with a minimum of 60 activities/decisions during the second round. The minimum number of activities and decisions needed to do the project well is 60 or more within the PAL prototype. Our analysis focused on the 46 that completed the second round with >60 actions or decisions and secondarily, the whole group of 64 who attempted to finish both round one and two, regardless of the number of the decisions/actions taken. The distribution of the 46 by starting level and level of exercise is shown below.
Figure 2 is a tabular summary of the results.

Pre-assessment level	Project level: Level required	Exercise Level assigned	Measure of learning #1 Increased frequency	Measure of learning #2 Success on project	Measure of learning #3 Cognitive probes	N

	to complete project		of Leveled-up decision or actions			
2	3	3	Statistically significant increase of proportion of "level up" scores on time two	Success = Main indicator of success and level change.	Generic; Level 3 or above = secondary indicator of level change	4
3	4	4	Statistically significant increase of proportion of "level up" scores on time two	Success = Main indicator of success and level change.	Generic; Level 4 or above = secondary indicator of level change	13
4	5	5	Statistically significant increase of proportion of "level up" scores on time two	Success = Main indicator of success and level change.	Generic; Level 4 or above = secondary indicator of level change	29

Assumptions of the analyses:

1. The activities included our analysis included every score-able action the participant could take: activities, challenges, and core events.
2. The size of the "universe" was factored in. In other words, we gave them credit only for the proportion of each score-type in the decision set they actually addressed. This removes the possibility of things looking more optimistic than they really are. E.g., if in Time One, they had only 30 score-able events, and 10 of them were level-up, we counted that as 30% Level-ups. If they did 60 score-able events the second time and 20 of them were a level-up, this is still 30%. This result would count as "no change".
3. The participants who did not have 60 decision/action events showed evidence of "letting the clock run" perhaps by failing to log out properly. The game then went on without them and important decision windows closed. It is not possible to re-set or go back when this happens. We thought we should also include the data from these participants in a separate analysis of "everyone", for evidence of increased "Level-up" scores since the participants likely inadvertently let the clock run and might have been learning.

Level of performance on all activities between Time One and Time Two

Student's T analysis of the differences between Time One and Time Two change in <u>Level-up scores on all scoreable activities*</u>

Group	N	Av Ratio time One	Av Ratio Time Two	df	Sig.
<60 events	46	.433	.591	45	p<.0001
>60 events	73	.377	.523	72	p<.0001

*includes all activities, challenges and core events

All Challenges; comparison between Time One and Time Two

Student's T analysis of the differences between Time One and Time Two change in Level-up scores on all Challenges

Group	N	Av Score Time One	Av Score Time Two	df	Sig.
Challenges	46	.761	1.054	45	p<.001

Core Events; comparison between time one and time two

Student's T analysis of the differences between Time One and Time Two change in Level-up scores on all Core Events

Group	N	Av Score Time One	Av Score Time Two	df	Sig.
Level 3	46	.435	.783	45	P<.015
Level 4	9	1.333	1.556	8	(insuff data)
Level 5	29	.52	1.17	28	P<.0007

Performance on Challenges that were unique to Time Two

Student's T analysis of the differences between Time One and Time Two change in Level-up scores on Unique Challenges that functioned as cognitive transfer indicators

Group	N	Av Score Time One	Av Score Time Two	df	Sig.
Challenges	46	.35	.44	45	p<.04

Results

Surveys were conducted to evaluate user experience and their ratings of various features of the PAL prototype. Although not the topic of this report, these results were important in a number of ways. Our goal was to develop a PAL prototype that people liked using and felt was valuable and at the same time push them to higher levels of performance. In general, it can be hard to develop accelerated expertise approaches that people would enjoy or participate in voluntarily; generally, these types of exercises are not fun. However, in the latest surveys show about 84% gave positive ratings on a Likert scale for both “All activities are meaningful and appropriately challenging” and “The Virtual World was a valuable learning experience for me”

Additional Discussions and Conclusions

This study showed that the basic principles proven to accelerate expertise, namely cognitive reorganization through iterative trial and error with embedded feedback, held up in a single-player application with volunteers working alone, relatively unguided, and remotely. In general, the PAL prototype produced learning benefits much better than anticipated, especially for a prototype still in Alpha, and much better for something that was completely voluntary.

We were also able to show that fundamental cognitive mechanisms must be involved; because this method had been heavily tested with groups prior to this study, it could be argued that individuals had not necessarily undergone a change in their ways of thinking. In this study, all participants were working on their own and showed measurable changes in expertise in universal and consistent ways.

Beyond proving the robustness of the model, there are other implications. First, it holds promise that a method confined to restricted settings and “elite teams” (mainly the military, scientists and corporate executives) can be made available to a wider set of users with benefits that may enhance their careers.

Further, we were able to collect data that showed us how to make the approach more powerful; in other words, we had the opportunity with large numbers of people to see what was working well and what could be refined. The participants also liked the prototype (e.g., 84% reported it was meaningful and appropriately challenging as well as a valuable learning experience).

The strong results show promise not only for this PAL model and prototype, but for the potential to deliver accelerated expertise educational methods more widely than thought possible for professional development purposes.

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