Preventing Indigestion: Using Organizational Design when Adopting Modern Educational Technology

ETEC 511: Scholarly Essay

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Introduction

"In short, software is eating the world." (Andreesen, 2011, p.1)

This exploratory paper begins with a broad and brief survey of Modern Educational Technology (**MET**) which includes big data, machine learning, cloud computing and the Internet of Things (**IoT**). These technologies have delivered interesting and valuable results in many domains and organizations; similar results could be expected in the field of education. Personalized learning solutions, built using MET, have the potential to radically improve the efficiency and effectiveness of education. However, successfully adopting MET, and in turn personalized learning, is not straight-forward and will be difficult.

Technology design, implementation and configuration are not the main barriers for successful MET-based personalized learning solutions. Implementing 'cultural change' is touted as an approach and path to success (Jacobs, 2016). However, culture is an abstract target that is hard to define and impact directly. Organizational Design (**OD**) models, such as Galbraith's Star Model (Galbraith, 2014), provide a way to analyze, plan and execute the changes necessary to create compatibility between the organization and MET. Through the application of OD, an organization can establish an aligned and balanced system leading to desired behaviors, outcomes and ultimately culture.

Modern Educational Technology

Overview of Technologies

Big data, machine learning, cloud computing and the Internet of Things (**IoT**) are having a major impact in many fields and organizations. Organizations successfully adopting these technologies have impacted our daily lives in a range of ways from the trivial to the bold and life-saving (Dede, 2015). Examples of use include fraud detection and prevention, weather models and forecasting, traffic management, entertainment recommendations, and shopping suggestions (Drigas & Leliopoulos, 2014; Simon, 2014). In each case, the solution incorporates vast volumes of data, consumes many forms of

content (structured and unstructured data), uses elasticity to provide scalability and cost efficiency, and does so in both a timely and targeted manner.

- MET starts and ends with big data. MET solutions that lack the right data, that do not ask the right questions, and that are unable to translate data into useful information are going to fail. Big data solutions are defined by characteristics including: volume, velocity, variety, veracity, variability and value; known as the "six Vs" (Demirkan & Dal, 2014).
- The IoT connects anything and anyone to the internet, and serves as a key source of information for big data.
- With cloud computing, large data centers use virtualization and a service-based approach to provide a multi-tenancy solution environment that has scalability, elasticity and high availability.
- Machine learning solutions make recommendations and predictions based on models, rules and data streams.

These technologies are being used in combination across many industries and fields. An interesting aspect of these solutions is that while they represent the forefront of technology and advanced capabilities, they generally appear to end users as simpler solutions than those of the past – as the complexity is hidden in the "cloud". "The digital devices we use, connect and interact with have become seamless parts of our day. Many of the processes and tasks they complete are invisible to us" (Mikton, 2015, para. 2).

Potential in Education

In personalized educational, built using MET as imagined in Figure 1, each student is treated as an individual – they receive lessons that are tailored to their needs, feedback loops of varying sizes are provided, and the teaching staff is fully aware of each student's progress, challenges and learning paths. MET is required to support personalized learning: to collect and support large volumes of data, analyze that data, make recommendations and communicate both the plan and the progress. Each day students

generate large volumes of data – the more fine-grained the captured data, the more insightful the analysis, the better the ability to gauge, guide and predict progress.

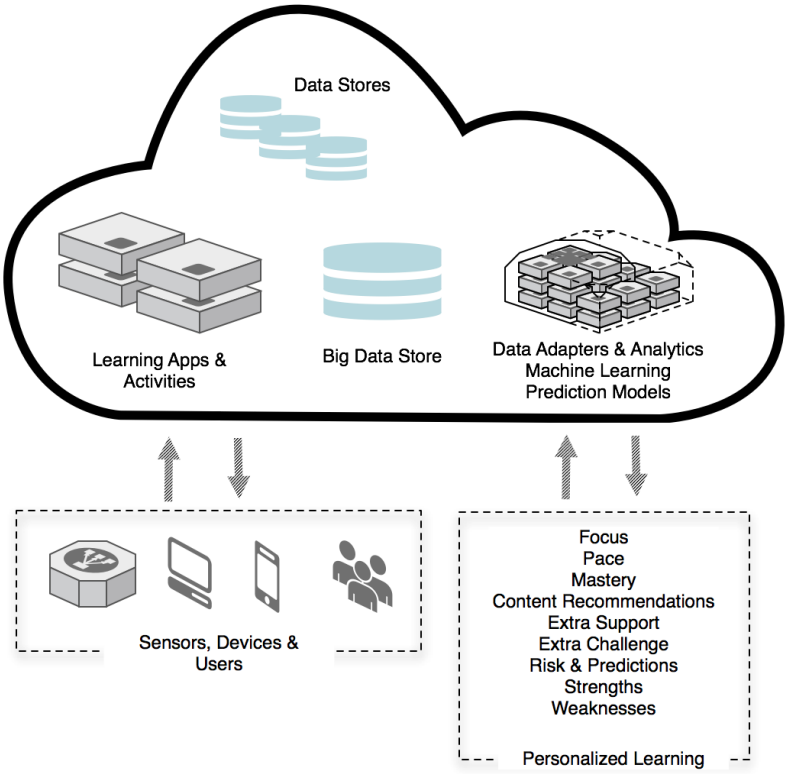

Figure 1 Overview of MET Solution Architecture

Legacy Educational Technology (**LET**), such as SMART Boards, Desire to Learn, or isolated learning "apps", offers minimal support for personalized learning. Instead, LET puts the burden of personalization on individual teachers and students. The patchwork of disconnected solutions requires significant effort to learn, support and use effectively – thereby limiting the teacher's ability to give students attention, support and guidance. In a LET-based environment, the student is still generating large volumes of data, but there is limited capacity to collect and process that data; never mind analyzing the collective set of data or comparing data against peers - including both geographical and temporal comparisons.

Challenges in Adoption and Application

Launching a new initiative is typically going to fail (Blank, 2015). Even replicating one organization's success elsewhere is a challenge. This is surprising as one might think that after a precedent has been set, it is a simple matter of repeating the deployment of the technology and associated practices. Yet, failures are common and caused by one or more of: the technology itself, how it is developed and deployed, or how it is utilized. Many attribute the root cause of failure to culture: "If you don't have the right culture in place and teachers haven't bought in, it can go horribly wrong" (Jacobs, 2016, p. 46). But such a diagnosis provides little guidance and substance for avoiding failures.

Off the shelf, preconfigured MET solutions are not widely available and are unlikely to appear soon as generic solutions do not lead to personalized insights. "Also, education as a sector lacks much of the computational infrastructure tools, and human capacity requisite for effective collection, cleaning, analysis, and distribution of big data that involves issues of volume, velocity, variety, and veracity" (Dede, 2015, p.8). In recognizing this need and the potential of MET and personalized learning, educational organizations will find themselves becoming software organizations (Galbraith, 2014). And simply put, software is hard. How can educational institutions prepare for MET, design solutions, build and operationalize solutions, and extract value from solutions? And, how well can the organization adopt and adapt to a software mindset and associated set of practices? For instance, today's software teams leverage Agile, Lean, DevOps and have oddly named rituals such as Sprints, Retrospectives, Standups, and Hack-a-thons. In addition, software organizations now aim to release software daily while incorporating user feedback with a fail-forward mentality (Mead, 2016).

Experiences, surveys and predictions foreshadow the rocky path ahead:

- Some predict "that half of all big data projects will fail to deliver against their expectations" (Marr, 2016, para.1).
- Other research finds:

> "…that most organizations lack the required skills, technical capabilities and culture to truly gain the greatest advantage from their information. In fact, three in four businesses extract little or no advantage whatsoever. We uncovered a consistent lack of focus when it comes to organizational investment in the right analytical talent, tools, innovative information-led solutions and value-driven information strategies" (Reid, McClean, Jones, & Ruck 2015, p.4).

- inBloom, an open source, non-profit, solution with $100MUSD in funding failed in less than two years. The solution was initiated by a group of educational institutions to manage their data and use it to improve education. Initially welcomed by schools, they lost support as parents and advocacy groups raised concerns about student privacy – concerns that were exaggerated and fixable (Cukier, 2014).
- Common causes cited for big data failures (Asay, 2014) (Sicular, 2014) include:
    - Poor leadership and strategy;
    - Wrong usage scenarios;
    - Not asking the right questions;
    - Skill gaps;
    - Thinking and executing too narrowly;
    - Incorrect prioritization of big data;
    - Data and organizational silos;
    - Avoidance of challenging the status quo.
- Additional examples come from personal experiences working with large organizations across North America. Such organizations have underestimated complexity, overestimated their capacity to change, and failed to take a holistic approach when introducing new IT solutions and approaches to building such solutions. In one case, the CIO of a large insurance company decided to change their technology approach from Microsoft .NET to a Java-based, SOA solution. This

required a significant change; impacting run-time technology, skills, processes, mindset and design approaches. The organization exhausted their annual budget before the end of the second quarter, the CIO was replaced and the organization paused all investment and went into recovery mode. Project retrospectives revealed that too little effort went into aligning IT strategy with organizational strategy and considering the capabilities of the organization.

Organizational Design

Focusing on organizational 'culture' is often proposed as the solution to overcoming challenges in adoption and application (Jackson, 2011). However, while trying to 'fix' or 'improve' culture sounds like a good idea, it is an abstract target that is hard to define and impact directly (Melitski, J., Gavin, D., & Gavin, J., 2010).

> "Culture follows Structure…. As long as the structural elements—groups, roles, hierarchy, and policies, or more broadly the organizational system/design—aren't changed, the behavior and mindset isn't going to change" (Larman, 2014).

Organizational design takes a holistic approach to the definition of the organization, thinking of it as a multi-faceted system considering aspects such as structure, processes, skills and so on. By designing the organization in a thoughtful manner, we change the behavior of the organization impacting performance and, in turn, its culture.

Introduction to the Star Model

The Star Model, as shown in Fig 2, is an approach to Organizational Design pioneered by Jay Galbraith (2014). The model is simple, logical and powerful in its capabilities. The model focuses on an organization's Strategy, Structure, Processes, People, and Rewards; requiring consideration of the interconnectedness, balance, harmony, congruence and alignment of the model elements to avoid localized and isolated optimizations.

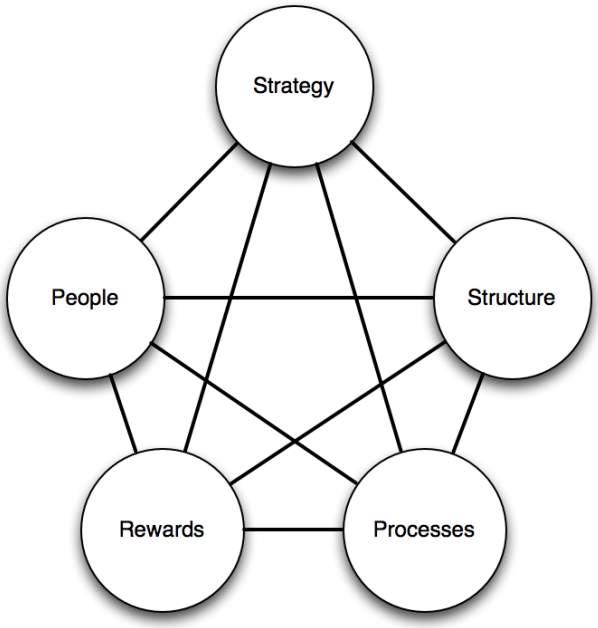

Figure 2 Overview of Galbraith's Star Model

There are three critically important aspects of the Star Model:

1. The Star Model is simple to represent graphically and explain to others.
2. While the Star Model starts with a simple representation, we can dive deeply into the details of an organization's current state and plan a transition to an improved future state.
3. The effort to balance and align is an ongoing process. This guides organizations to continuously learn and adapt.

Using the Star Model to Adopt and Apply MET

In this section, the Star Model is used to introduce considerations related to successfully adopting MET. Such questions and concerns must be considered within the context of a specific educational organization.

Strategy: A focus on vision, mission, values, goals, and objectives - comes first. Decisions on trade-offs and alternatives are driven by the strategy (Galbraith, 2014; Kates & Galbraith, 2007).

An organization should never adopt MET, or any technology, just for the sake of having new technology. “Technology, as a support or accelerator, can ensure more effective collection and use of data to improve instruction. Technology can also facilitate communication, provide much more diversity in content for students, and help schools better meet the varied needs and preferences of students. What is crucial, however, is that technology must serve the core purpose of schools” (Fullan, 2009, para.51).

A key driver for using MET is the adoption of personalized learning. And to provide personalized learning, organizations will need data. “The true profit of such data lies in the users’ capability to select helpful reports, spot attractive events and trends, support decisions and policy based on statistical analysis and reasoning, and exploit the data to achieve business, practice, or scientific goals. When the scale of data manipulation, exploration, and inference grows beyond human skills, people look to computer technology to make things easier” (Drigas & Leliopoulos, 2014, p.59).

All organizations have limited resources; they cannot do everything at once. Educational organizations can use this view as a starting point in developing a strategy and plan. In doing so, they strive to answer the question: “What are the best opportunities for investment in delivering personalized learning via MET?”

Structure: The organization’s structure focuses on the definition of roles, groups, and departments. Structure also considers placement of power and authority (Galbraith, 2014; Kates & Galbraith, 2007).

Educational institutions, as they take on characteristics of a software organization, will need to restructure. Software organizations are striving to adopt flatter structures that include self-organizing and self-managing teams. The days of command-and-control along with rigid, hierarchical structures are long past. Software organizations are moving away from the Traditional, Functional Silo model to the Matrix model, Product and Platform model, or the Adaptive model (Schwartz et al., 2016).

Consideration must also be given to authority and decision making. In using MET to drive personalized learning, organizations move toward the ability to make real-time decisions. “Before an organization can make real-time decisions, it must get data scientists and analytics experts embedded into

decision processes. This will require a shift in power from experienced and judgmental decision makers to digital decision makers" (Galbraith, 2014, p.3). Will teachers accept content and learning path recommendations from the "digital decision makers?" Will parents accept such recommendations?

"Smart data consumers must learn to keep an open mind to what the data say. Data mining and analytics techniques can confirm or disconfirm teachers' and students' beliefs about student knowledge, abilities, and effort. Sometimes, these beliefs are not consistent with the data…" (Bienkowski, Feng, & Means 2012, p.41). Who judges, reconciles and finalizes decisions where there is a disagreement between the teacher and the system?

Processes: Processes define how information flows through the organization, how decisions are made, and how work gets done. Processes also align and support the strategy to ensure optimal allocation of scarce resources (Galbraith, 2014; Kates & Galbraith, 2007).

For instance, consider that "AltSchools' personalization still requires considerable human intervention. Software is updated every day.…'We encourage staff members to express their pain points, step up with their ideas, take a risk, fail forward, and fail fast, because we know we are going to iterate quickly. Other schools tend to move in geologic time'" (Mead, 2016, p.5). If software is updated every day, how are changes communicated to the user community? Will such a pace be appreciated? Or will it put stress on the students and teachers?

Processes also need to consider ethical and privacy concerns. Will parents and administrators accept institutionalizing changes driven by metaphors such as "You've got to build the plane while you're flying" (Mead, 2016, p.6). Is it ethical to introduce new capabilities and seek out answers via small experiments in the classroom? What protocols and policies need to be put in place to support such an approach and mindset? Also, big data solutions can incorporate all kinds of data. Does that mean that all data is acceptable? What processes and policies need to be established to collect, protect and use student data? Data could be collected from surveys, social networks (Cen & Ng, 2015), or wearable technology – should it be? The failure of inBloom serves as a cautionary tale influencing the definition of processes.

People: Focus on the policies around people, their skills, recruitment, training and development. The "right" talent and capabilities must exist in the organization to realize the strategy (Galbraith, 2014; Kates & Galbraith, 2007).

Some schools, such as AltSchool, have already started down the path of becoming a "software" organization. For instance, "Today the company employs more than a hundred and fifty people, split evenly among educators, technologists, and operations managers" (Mead, 2016, p.4). This allocation of resources is just the tip of the iceberg in terms of how an organization that heavily focuses on technology will be different from a traditional educational institution. On a smaller scale, such as that seen at AltSchool, it is possible to bring together such a mix of resources. However, in the mainstreaming of MET across larger educational institutions, can organizations find, grow and retain the right staff?

Skills supporting big data (data capture, preparation, processing, analysis), software development (mobile, services, integrations) and operations (cloud, big data, devices) represent significant challenges for human resources as "…many people in the U.S. and around the world lack the education and skills required to participate in the great new companies coming out of the software revolution. This is a tragedy since every company I work with is absolutely starved for talent" (Andreesen, 2011, p.8). Can schools compete with other industries in attracting sufficient numbers of technical talent? Can schools afford the salaries demanded by such talent?

Rewards: Ideally the organization's reward systems align the goals of the employees with the goals of the organization (Galbraith, 2014; Kates & Galbraith, 2007).

Applying MET to implement personalized learning will allow educational institutions to discover new facts and indicators for educational success (Dede, 2015), replace standardized examinations (Cen & Ng, 2015), and provide many new feedback loops (Bienkowski, Feng, & Means, 2012). However, how does the organization's strategy align with measurement of employees' performance, recognition of accomplishments and provide career and personal fulfillment?

Recognizing that a "…lot of value comes from combining data from different sources both inside and outside the company. Resistance to sharing and combining data often arises depending on the strength

of the organizational silos. Corporate leaders must create norms and values concerning information sharing, transparency, and trust" (Galbraith, 2014, p.5). Will current educators want to take on a new approach to teaching as a "data-enabled detective" (Mead, 2015)? Some educators will value transitioning away from being "artisanal lesson planner on one hand and a disciplinary babysitter on the other hand" (Mead, 2015, p.5). But, what will happen to educators that do not want to adapt?

Conclusion

While it is fair to identify culture as an issue, it should not be counted on as a key solution component.

> "It is axiomatic that the system will govern behaviour, but something not understood by managers. Culture-change is appealing: 'what if all my people were positive, contributing, going the extra mile?' But it is fool's gold. Models promoting 'people-process-systems' and the like maintain this deception that keeps us from seeing their inter-dependence. It is ironic; when you change the system your people become your asset, but do nothing to the people, for culture change is free" (Seddon, 2009, p.3).

Organizational design, as provided by the Star Model, is a holistic approach to the definition of the organization, the systems within, and in turn an improved and aligned culture. Use of the Star Model, provides a starting point for a holistic, deep, insightful and valuable analysis and plan for adopting MET, and in turn, personalized learning. The Star Model does not presume that there is a one-size-fits-all approach; context is a key ingredient in the application of the model. The considerations and questions introduced in this paper serve as a starting point for planning and executing personalized learning.

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