Evidence Centred Approach to Measuring Learning outcomes amongst Management Students using Epistemic Games

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***Abstract*—*Current teaching methods in business schools such as case studies, instructor-led teaching, and corporate internships have come under increasing scrutiny and questioning in the recent years. In response to the sense that these pedagogical approaches may no longer be working, newer student-centric approaches such as using serious games as a pedagogical tool have been gaining prominence. However, there is no clear definition as yet on what construes an effective game-based learning pedagogical methodology and no definitive method to capture learning outcomes.This paper contributes a learning framework that uses evidence-centered design in epistemic games to model learning outcomes for management students and practitioners. The authors also report on a pilot study involving a new simulation game – STRAT UP – based on the above framework, to explore how such games can help in capturing evidence to measure learning outcomes for the Human Resource function.*

Index Terms—Learning Outcomes, Evidence Centred Design, Epistemic Games, Management Education, Non Intrusive Assessments, SKIVE

"Training the workforce of tomorrow with the high schools of today is like trying to teach kids about today's computers on a 50 year old mainframe. It's the wrong tool for the times." Bill Gates

I. Changing Face of Management Education

As per recent reports from The Associated Chambers of Commerce & Industry of India the number of B Schools have tripled in the last five years with a total of 5,20,000 seats in 2015-2016 as compared to 3,60,000 in 2011-1012. India has at least 5500 B-Schools imparting Management Education, however the ASSOCHAM Education Committee (AEC) noted that only 7% of the students who are graduating are employable excepting graduates from premier institutes such as IIMs.

The challenges imposed by the rapid rate of change in society are significant. The skills and knowledge imparted by traditional methods no longer seem to be adequate to prepare students for success in life. Jobs that are relevant today will no longer be relevant tomorrow. The next generation of jobs will be characterised by increased technology use, problem solving and complex communication**[1]**.

Current pedagogical methods of imparting knowledge in most management institutes are predominantly through instructor-led training and case study methods. These methods inherently offer possibility of assessing only after the learning has taken place. The process of learning is disconnected from the process of assessment. A move towards digital learning environments in education ensures that assessments and learning are not separated and is a part of the same continuum [2].

Introducing games as a pedagogical tool is gaining importance and adoption of Game-Based Learning in main stream academic learning is gaining prominence. Games and traditional assessment methods provide means for quantifying knowledge and learner's abilities. Games by definition are inherently assessments.

This work draws insights from literature on Evidence-Centered Design and Epistemic Network Analysis. A framework for measuring learning outcomes amongst management students is proposed using a proprietary epistemic game designed and developed by the authors to measure skills, knowledge and abilities.

II. Measuring Learning Outcomes - Literature Review

The environment of business schools has changed radically in recent years with an increasing demand on faculty and institutions to offer new and innovative methods of teaching. There has been increasing pressure from the business community to lend their support to institutionalise innovation and enhance competitiveness [3]. The current form of imparting management education is narrow, and does not provide students with an ability to relate to realistic problem solving situations [4]

The problem with current management education is multifold, with questions being asked about the relevance of a curriculum in the changing business context, the effectiveness of the pedagogical tool used, the cognitive ability and engagement levels of students, measurement of learning outcomes and more importantly what is being measured.

Management thinker Peter Drucker is often quoted as saying, "If you can't measure it, you can't improve it". All educational assessments aim to measure what students say, do, or act and make broader inferences about their knowledge. Numerous assessment methods have evolved over the centuries for addressing this problem in a systematic manner. The measurement models proposed by classical test theory, item response theory and latent class analysis are effective for large scale assessments [5]. They, however, are found wanting when it comes to testing students learning and progress.

If management education needs to be relevant in changing times, it needs to understand the requirements of its customer well. On one hand, it needs to cater to the needs of the students and on the other hand, impart skills and knowledge that are required by the industry. There is also a need to measure skills and knowledge pertaining to a profession the way in which people in the profession are measured.

Any community of practice has a culture characterised by skills, values, knowledge, identity and epistemology. The culture and grammar that defines a profession is called an epistemic frame. These parameters have a grammar and a structure

defining the profession. Traditional methods of direct assessments only measure what a student has learnt or not learnt and typically tap students recall or utmost basic demonstration of skills. They fail to capture the students learning progress along the epistemic frame of a profession.

The key step of developing an epistemic frame of most communities of innovation is some form of a professional practicum[7]. Professional practica are environments in which learner takes professional action under supervised control, thereby learning the skills, knowledge, identity, values and epistemology of the profession [8].

Epistemic Games are the second best alternative to professional practica. They simulate the professional environment and recreate the form of actions and interaction of a practicum. This provides a risk-free environment to learners to experience and provide a systematic opportunity for participating in practise.

The assessments in epistemic games are made possible by designing games using an evidence-centered design (ECD). ECD creates a framework by combining competency, evidence and task models. These models observe what students say, do or make out of a circumstance, to draw inferences about what they know, can do or accomplished. This connection between learning & behaviour provides the validity for the assessment model [9].

The elements of ECD are further transferred into a network map using Epistemic Network Analysis. Each player's evidence is captured at various intervals of time and translated into a network map which provides a learner's learning trajectory at various intervals of the game [11].

This paper explores a framework of constructing an epistemic frame for one of the functions in a management game - Human Resources. The authors explain the framework based on a proprietary game designed by them and discuss how evidence can be captured at various instances of the game to measure learning outcomes of players

III. CONSTRUCTING AN EPISTEMIC FRAME

Developing an authentic learning experience for a learner is possible when the learner is made to experience the community of practise whether virtual or local [10]. Participating in a community of practice involves developing the community's ways of doing, being, caring, knowing. This is bound together by an epistemic frame [11].

In epistemic games a learner in the context of an activity is trying to accomplish a meaningful goal by overcoming obstacles and makes the link between knowing and doing through reflective practise. Just as professionals develop the ability to reflect in action in the professional practicum, in such environments the learner acts like a professional in supervised environment and reflect on the outcome of actions with peers and mentors [12].

In-order to construct a professional practicum of a Human Resource (HR) professional as a case in point and simulate the same in the context of an epistemic game, the activities of the domain needs to be captured and modelled (Domain Analysis and Modelling). A HR professional in most organisations would perform the following *activities*: Organisation design, Organisation development, Service delivery and information, Resourcing and talent planning, Learning and development, Employee engagement and relations, Performance management and Reward systems.

To create a conceptual assessment framework, the elements from domain analysis and domain modelling need to be translated as tasks or activities in the game. In order to create the epistemic frame of the profession, we looked at what industry wants and researched various job portals and sites [13]

A HR professional would require the following *skills* to excel in their domain: judgement and decision making, complex problem solving, negotiation skills, effective communication, ability to manage conflicts, understand and manage financial resources, critical thinking, time management and service orientation. They would also require knowledge of recruitment and training practises, strategic planning and resource allocation procedures, understanding economics, accounting laws, legal codes and procedures, curriculum development, training design, understand group behaviour and appreciate information technology.

As professionals working in the HR function, they would like to identify themselves as people with integrity, having concern for others and as one who is dependable, proactive and flexible. They also would like to view themselves as professionals who have high level of stress tolerance and as one who pays attention to details.

IV. EPISTEMIC GAME - STRAT UP AN OVERVIEW

STRAT UP is a proprietary multiplayer online role playing business simulation game developed by one of the authors. In the game, students individually are required to don the role of various functional heads of an organisation such as Marketing, Finance, Human Resource, Operations, Strategy and Information Technology. They compete against another team whose members don similar functional roles. Every individual player selects their role who is represented by an avatar in the game. The game area represents that of a chess board with 64 squares, and these squares represent an overall market where the companies are competing against each to sell their products by acquiring territories.

The game simulates events and processes in an organisation to provide closer to a professional experience to a player. Each player has an individual goal that is tracked to measure their performance. All goals of an individual are tracked against the target, planned and actual values.

The movement by the players on the game board simulates the concept of time. In order to model a closer to real life situa-

tion, the impact of decisions taken are felt only after certain time frame in the game.

The player who dons the role of a HR in the game, as identified in the domain modelling layer would have the options to recruit people by deciding the number of people at various designation, salary to be offered and the channel from which they would be recruited from. The player also has the option to choose various training and welfare programs, offer promotion, manage attrition and have the power to retrench people.

Figure 1. Decision Form - HR

V NON INTRUSIVE ASSESSMENT FRAMEWORK

In the domain modelling layer, the game design captures all the elements that are required to measure the learner's proficiency in a specific domain. Each element of a specific domain is further categorised as tasks where the player makes decisions to solve a problem or to meet an objective. The outcome of the decisions taken during the game play are further used as evidence to measure various elements of the epistemic frame.

To illustrate the assessment framework and the method of capturing and measuring the evidence pertaining to an epistemic frame, let us take an example of a recruitment decision (task) made by the player in the game.

The player who dons the HR role decides the number of people to recruit based on the decision made by the marketing, operations and other roles. Based on the number of products that is being targeted for sales and production during the planning session of the game the HR role seeks a certain budget, which is approved by the finance role.

Based on the overall team strategy the HR role would need to take cognizance of the number of people to be recruited, time of on-boarding, recruitment efficiency and managing financial resources effectively.

Having secured adequate budget and understood the overall team strategy to recruit people, the player would then take decision at the appropriate time The dynamic environment of the game, requires players to revisit their planned strategy and to take decisions dynamically as the game progresses. For instance the team would be planning to achieve a territory in the current quarter of the game, and the HR would submit the request a few moves in advance calculating the on-boarding time.

At this instance of the game, the team could have either achieved their territory or not achieved it. Also they may or may not have on-boarded the resource on time.

As described in Figure 2, The impact of the decision taken by the HR affects the organisation in terms of reduced sales or production. Each player's decision is thus measured against pedagogically and professionally validated constructs to measure skills, knowledge, identity and values of players in the game.

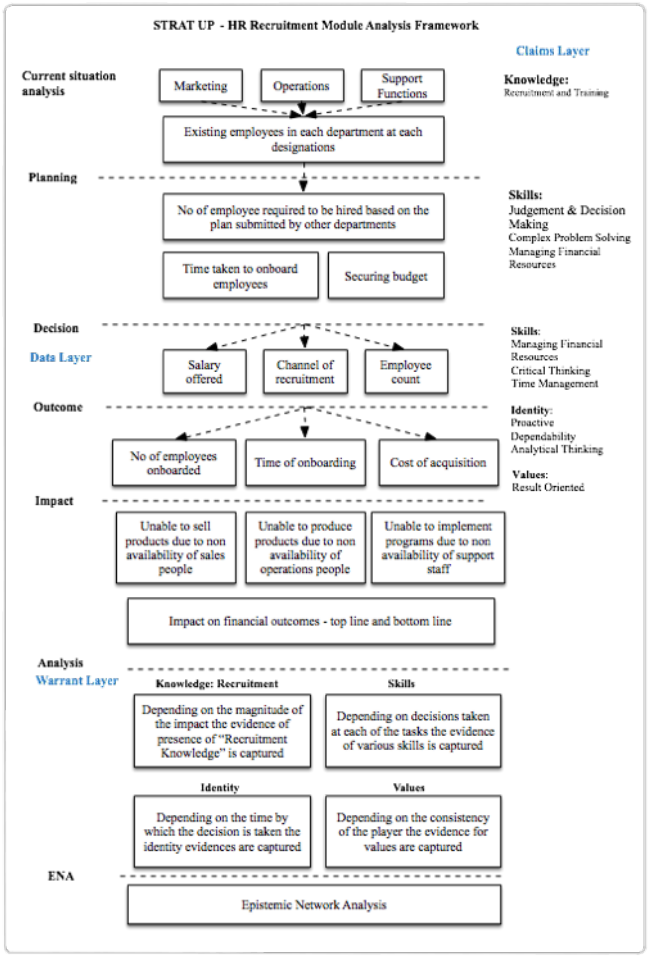
Based on the above as an example, the game engine records the player's decisions and captures the evidence to measure the components in the epistemic frame. The presence of evidence is marked as 1 and the absence as 0 in an adjacency matrix to be analysed further using an epistemic network analysis.

VI PILOT STUDY

The game was piloted at a B-School with 12 students from the second year MBA batch participating. The students were given an elaborate briefing on the rules of the game. They were asked to plan their strategy for a gaming year and execute the same. Post the game, an in-depth discussion was held seeking their feedback and learning outcomes. The following were the feedback and responses from the student.

Learnings from pilot	
Module	**Learnings and Feedback**
Overall Concept	90% of students felt that the game was immersive and engaging and it transported them to a virtual world of running a business.
Game Play	The students felt that the game play was addictive, as the game incorporated appropriate game dynamics and mechanics.
Learning Experience	All students who participated in the study felt that STRAT UP Business Simulation game would help them understand complex business interdependency between departments in an engaging way
Complexity	Students felt that the game was complex and the there should be a practise round before actual game play and the rules should be given to them prior to start of game
Intrusive Assessment	Majority of students stated that the answers to business scenarios are predictable and hence needs modification.
Non Intrusive Assessment	Operational definition of certain parameters that were being measured and the business logic needed refinement
Analysis	Not enough data and hence the analysis was inconclusive

Figure 2. STRAT UP - Non Intrusive Assessment Model



VII DISCUSSION

The millennials need a training method that they are comfortable with, they are born gamers and game based learning aligns well with their needs and expectations. However, policy makers have not been able to integrate it into main stream approaches owing to concerns over the effectiveness of the delivery method. The general belief is that games are predominantly for entertainment purposes and game mechanics and dynamics will overshadow the learning experience of a student. Advocates of epistemic games have often highlighted the benefits of including games in the mainstream curriculum, because games are an integral part of human development and they offer a risk free environment to explore and experiment and reason and reflect the outcomes of their decisions. Games provide immediate feedback and opportunity to fail which is found as an integral part of a learning experience.

The authors with the help of a proprietary business simulation game, designed using evidence-centered design principles illustrate a framework to measure Skills, Knowledge, Identity, Values and Ethics of management students (SKIVE). During the game design, a detailed domain analysis and modelling was performed to capture professional practica and simulate real life environment. Understanding the domain, led to creation of tasks or activities in the game to measure the SKIVE parameters which constituted the epistemic frame of the profession. The data was captured based on the business logic written and the presence of evidence was coded as 1 and absence as 0. The data was further analysed using epistemic network analysis. A pilot with 12 students at a B-School helped us understand the validity of the model and difficulty faced during execution.

VIII LIMITATIONS & FUTURE RESEARCH

The game is currently in its beta version and it needs to be executed to larger audience to check the validation of the non intrusive analytics model. The findings are based on a limited pilot study and hence needs to be validated over large audience.

The limitations of this method purely stems from performing a comprehensive domain analysis and modelling the domain into various tasks in the game to adequately simulate professional practica. Having captured the data, establishing the warrant to justify the logic behind why the data supports the evidence needs to be carefully defined.

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