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nDiVE: The Story of How Logistics and Supply Chain Management Could be Taught

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Abstract: One major element of supply chain management education is helping learners to grasp the complexity, the challenges, and the efficient management of the multiple dimensions in supply chains. Each decision made can 'ripple' through supply chains and have serious repercussions that may include causing millions of dollars in damage or triggering a chain of events that degrade the quality of life for people, society, or the environment. We can teach relevant theory and train learners for some situations that do not require immediate responses. However, we remain disadvantaged by the constraints of time and space; observation of a real supply chain is often unpractical, and lengthy times for transports exceeding any class duration. In this paper, we present the nDiVE project which creates a supply chain story to immerse learners, provide an authentic experience in a realistic environment, and apply traditional and advanced gamification mechanisms to engage and motivate learners.

Keywords: Action-based Learning Assessment, virtual training environments, feedback, authentic learning

The Beginning

Supply chains can be relatively small, such as a small local manufacturer that supplies nearby markets, or they may be much more expansive and globe-spanning, consisting of long-haul transport between multiple stages of manufacture and assembly. Teaching learners about supply chain management involves evolving learner awareness regarding the complexity and multiple dimensions in supply chains. The multifaceted nature of real-world supply chains incorporates their geographically distributed facilities, long and variable lead-times between stages of production, manifold production systems and mentalities, availability of resources, constantly changing markets, unpredictable financial interdependencies, and the possibility for many unexpected events to cause disruptions or erroneous outcomes that could potentially cause millions of dollars in damage or trigger a chain of events that degrade the quality of life for the people, society, or the environment (Reiners et al., 2012). Since the turn of the millennium, scholars have worked hard to transfer this complexity into textbooks and classrooms to support education about supply chains that encompass an understanding of space, time, cost/budget, process, relationships, environmental or other risk factors, sustainability measures, or technology (inter alia; this is a small sample of relevant subjects, demonstrating the breadth of issues that must be

addressed). Textbooks embed learning materials using real-world case studies, theories are applied to real-world data, and results from optimisation algorithms for the problems in the warehouse location are visualised in map-overlays; yet, despite these advances we still fail to achieve an authentic and immersive experience for the learner.

‘Study tours’ are often touted as an authenticity-increasing alternative to classroom-bound education as they help learners to understand context and practical significance. Study tours have become an increasingly viable support of authentic education and are an important method in contemporary tertiary education (Reiners et al., 2012). However, while “the study tour helps to bridge the gap between business theory and practice” (Porth, 1997, p. 198), we must acknowledge the significant drawback of study tours: they offer a limited peek into several ‘slices’ or ‘chapters’ (the term we adopt) of the supply chain and the perspective is usually that of an external visitor, limited to predefined walk-ways in safe areas and without access to deeper knowledge or data about the location. Obviously, site tours cannot be included in all programmes due to the high costs (i.e., financial resources and time requirements), limited access to suitable and connected companies in their region, the distribution of distance education learners, and the maintenance of appropriate learning objectives in well-designed and coordinated visits (Hanna, 2000), as well as risk factors involved in visiting some sites without appropriate training and/or clearance. Depending on the geographical location of the class, it may be possible to tour several connected stages of a supply chain; yet other areas may be forced to sample related chapters from different supply chains that are not connected together, losing the customer-supplier relationships (Hanna, 2000).

In this paper, we tell a story that describes the research project ’nDiVE’ (see acknowledgment) about the immersion of the learner in an authentic n-dimensional environment. The following section, logistics as a journey, describes how we condense the multiple dimensions (the exact number depends on specific learning outcomes for the programme) into a restricted, authentic, immersive story (using a virtual environment for visualisation) to demonstrate, simulate, and control real-world situations in a format that allows students to grasp the highly complex and interwoven processes. We decided to encode the learning material as an interactive story similar to the Grand Theft Auto (GTA) video games or the old Dungeons & Dragons games (Loh, 2007) as this supports the establishment of suitable scope and narratives while leaving the learner free to explore the space and create their own perspective on the established learning outcomes. In the next section, realism and authenticity, we outline the importance of deciding on the appropriate balance of realism and authenticity in presenting learning materials. We use different technologies depending on the learning objectives as well as the perspective the learner inhabits. Gamification is the use of game thinking and mechanics in a non-game context in order to engage users and solve problems (Werbach & Hunter, 2012; Wood & Reiners, in press). Gamification addresses the problem that the perfectly designed learning environment is not sufficient for a complete learning experience; learners have to be engaged and motivated as well. We integrate gamification mechanics to trigger each learner’s “fun, play, and passion” (Deloitte, 2012). We conclude the paper with an outlook on the future plans of nDiVE and opportunities to transfer the demonstrated concepts to other areas.

Logistics as a Journey

While the sheer magnitude and complexity of a full, intertwined and networked supply chain makes a comprehensive simulation impossible and undesirable to implement, we aim to maintain some of the scope and complexity. For nDiVE, we use an exemplary supply chain to 1) follow one product starting from mining raw materials, processing and manufacture, through to providing goods to customers; 2) demonstrate the need and application of knowledge, experience, and skills; 3) taking a different perspective or role within the same scenario; and 4) relaying it to the real-world. The supply chain is presented as a map showing the key chapters of the supply chain story: sourcing raw material, processing, transport, manufacturing, distribution, and the customer. Within the overview provided by the map, each chapter is a ‘black box’ (i.e., the internal function is not important). The map in Figure 1 shows the sequence of chapters to be opened for further investigation.

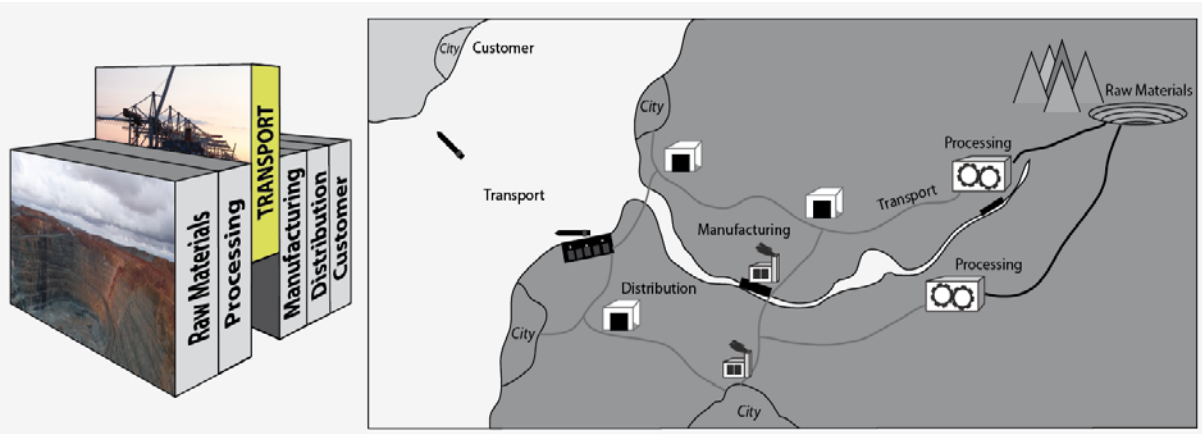

Figure 1: The map – corresponding chapters for each step in the supply chain

This representation encapsulates a logical ordering similar to the chapters in a textbook, mimicking the real-world flow of materials from supply to consumer. Similar to the textbook, the supply chain is only complete if all steps (chapters) are included, yet each step addresses a distinct subset of the whole that can be selected as a topic for a learning unit (Reiners et al., 2012). Before continuing with the storytelling of nDiVE, we first outline how we address different kinds of ‘immersion’ in this project to create a more compelling learning experience.

Immersion and authentic learning

Immersion is the feeling that one is participating in a realistic experience (Dede, 2009). The more one is immersed, the more one ignores other things for significant times. People can be captivated in movies, books, or games and not realise that they have not moved for some time or maybe even eaten (Reiners, Wood, & Gregory, under review). Authentic learning occurs when an environment replicates practices and actions found in real-world environments. Students receive feedback following immersion in authentic materials or activities. The learner can make mistakes in context without real life consequences through authentic tasks using gamification (Herrington, Reeves, & Oliver, 2010); that is, adding game-based elements into a non-game based activity. Truly authentic learning can be costly, dangerous, or administratively difficult to arrange. Simply using technology does not create an authentic learning scenario but authentic learning can take place supported by technology (Teräs & Myllylä, 2011). 3D representations of the real world can heighten immersion for learners in activities whilst increasing the learning experience authenticity.

We use the simplified map (Figure 1) to guide learners and to connect learning materials to sections, fixing and defining context. Together, this transforms classrooms from a place for slides to a space for conveyance of “information in a compelling and memorable way” (Neal, 2001, abstract, para. 1) in the “original form of teaching”: storytelling (Pederson, 1995, para. 1). Storytelling is the art of using words and gestures to manifest a story in learners’ minds, creating connections that result in creativity, combining shared impressions with our personal experiences, understanding, and knowledge to generate our own, individual story. Similar to observations of the film industry and script writer roles, instructional designers make use of both given contexts and technologies to support their design and sculpturing of an environment: the story. Subsequent narratives, or unique paths, through the story also enliven the story and allow it to “unfold in space” (Nitsche & Thomas, 2003, p. 85).

Stories rely on narratives; within educational settings narratives may be created by either the teacher or by learners. Teachers provide domain-expertise and knowledge-based design of model answers in addition to suggestions about traversing the story. Milestones can be defined by teachers, representing sequences of actions in the scenario, with continuity between scenario segments). Learners are guided by teachers’ narrative but interact with the teacher-driven narrative to form their own perception and awareness. Narratives support the process of understanding and building cognitive structures (Bruner, 1990; Riedl & Young, 2003); they are dynamic whereby every disturbance within the classroom-bound pond of passivity results in a change of narrative and, simultaneously, the path to the achievement of the learning objectives.

The teacher occupies the role of the storyteller and is responsible for the story and for maintaining the paradoxical tension between flexibility/openness and defined outcomes/requirements; a role similar to the

‘Dungeon Master’ in ‘Dungeons & Dragons’(Log, 2007), the teacher becomes a ‘Lecture Master’. The storyteller allows learners freedom to explore the learning space incorporated activities scoped to keeps learners on track. Within an industrial context, a manager can monitor employees’ activities towards objectives providing the opportunity to gently (or brusquely) provide the employee with guidance to ensure that activities are finished on time. Such maintenance of schedules and progress ensures that employees’ efforts are not wasted. In nDiVE, we use a plot-based- (i.e., the teacher-created narrative) and character-based-storytelling (i.e., the narrative created by interactions between the learner and environment) (Danilicheva, Klimenko, Baturin, & Serebrov, 2009). The plot-based storytelling is used at the top-level, where we outline the story and define the focus of the supply chain and constituent chapters to meet topic coverage requirements and learning material. The chapters are intended to be character-based; where the achievement of learning objectives is more important than a static path. This aligns with Nitsche and Thomas’ (2003) *Story Map*: the learner explores the virtual environment and maps the space and story. The story is tied to the navigation of the space (Murray, 1997) rather than being purely teacher-defined and -implemented.

In nDiVE, the design of the story includes the following core tasks:

1. *Defining the goal with respect to the context and stakeholders:* What is the knowledge and skills we want to teach while the story is completed? How do we tell the story? While an academic post-graduate course must include theories, the same topic taught to workers that must understand the real-world challenges during their workplace induction would require a more routine, training-orientated focus.
2. *Outlining the main milestones:* Here, the milestones do not necessarily reflect the completion of chapters or the narrative, but the main topics to be covered with respect to the learning objectives. Chapters and narratives remain independent as it is often impossible or impractical to aggregate everything in one chapter; elements may be embedded in several chapters where they demonstrate strong fit.
3. *Setting the main scope of the chapters:* The learning objectives for each chapter must be ascertained and material to be excluded explicated. Following our analogy, each is similar to chapters within a supply chain textbook, each emphasising a different topic within nDiVE. The learning objectives dictate the design of the map and inclusion of particular landmarks. At this point there are no details about the learning material or how to encode and present these details to learners.
4. *Deciding on the methodology and technology to use for the chapters:* Using technology has two facets: 1) it can create the right environment for the learner with respect to immersion, authenticity, or availability, but 2) it might distract from the content and intimidate learners who possess poor technological knowledge or lack access to appropriate equipment. For nDiVE, we require the technology for content as it simulates specific real-world scenarios and must be immersive and authentic; e.g., learning about safety and health or specific processes. Alternatives are available, but will reduce effectiveness of experience. In general, technology is used as needed, but not just to ‘show-off’ or provide a ‘wow-factor’. Requirements are minimised to support distant education and classroom lectures as users may not have access to specialised technology.

A key question is whether the story requires a restrictive framework, which constrains the learners’ freedom. The learning objectives should be selected according to the wider context (e.g., a university course, training for a job, or a certificate relating to a specific task). The general framework must fulfil the requirements and be accepted and accredited. Figure 2 illustrates a possible story, including a brief example of a teacher’s narrative. The visualisation of the individual chapters of the story demonstrates another element related to immersion (which we return to next): realism and authenticity. These should be part of the story design. Thus, chapters should allow for alternative pathways, particularly in respect to technological limitations and the subject of study; shown in Figure 2 by branching the story into alternative narratives. Not shown in the figure are the learner narratives (see description for Chapter 5; distribution), representing a subset of the teacher narrative (according to pre-existing knowledge) in an individual order. The freedom is constrained as a (reduced) number of learning objects has to be fulfilled to pass the course. Note that each chapter has a unique narrative representing a challenge or a side-story.

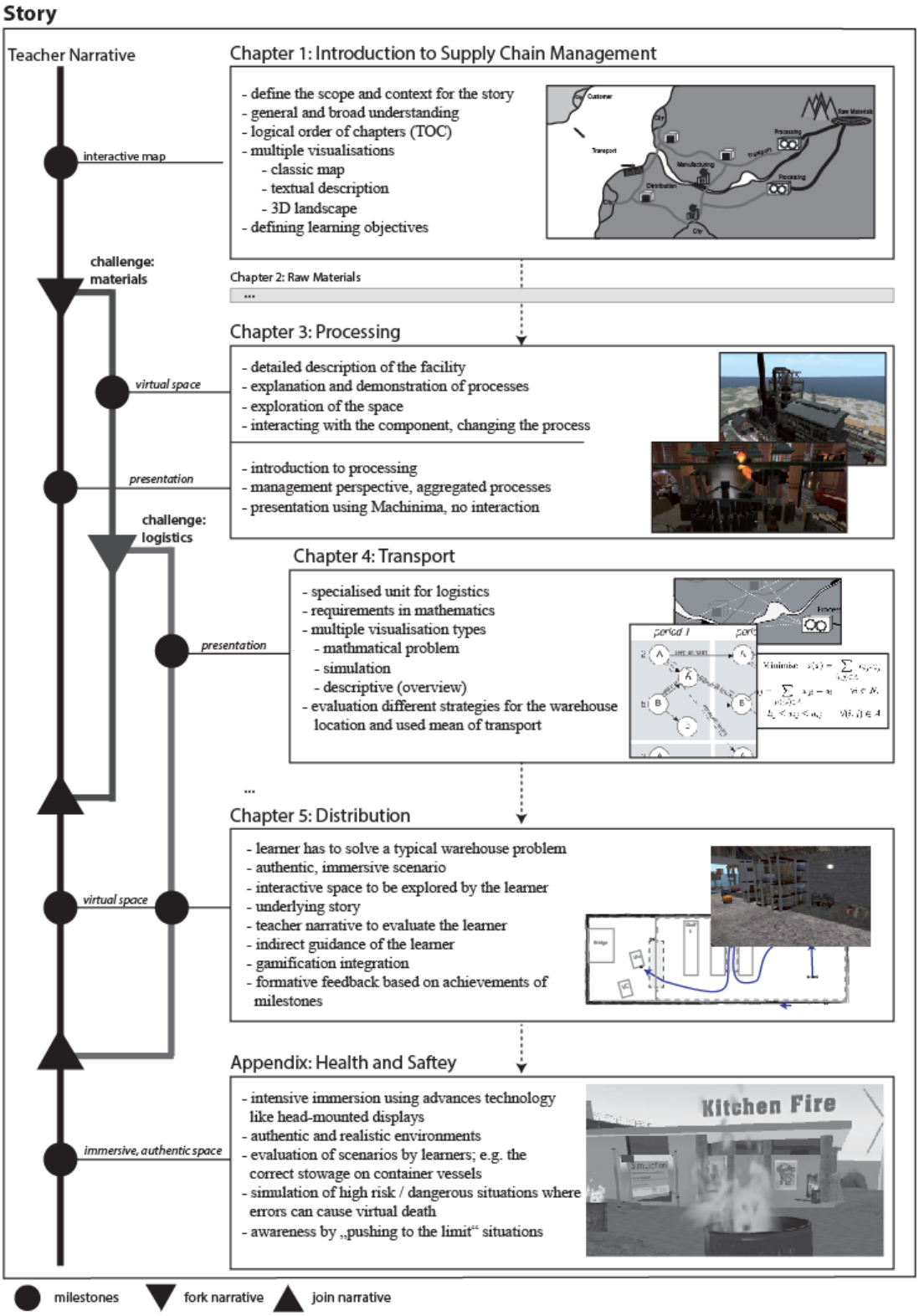

Figure 2: A possible story

The chapters in Figure 2 depict a subset of examples from our supply chain story, illustrating the outline and variability of learning material presentation (extracted from the map in Figure 1). This is a possible selection of chapters from one story and there may be more topics than visualised as locations on the map (e.g., ‘health and safety’ is a topic applicable to most map locations and could therefore be inserted multiple times on the narrative path).

Chapter 1: The introduction describes the scenario and the terminology. We use the analogy to the real world; i.e., to lower the scepticism that many learners have towards this area.

Chapter 2 (not shown in Figure 2): Introduction to mining; i.e. layout, equipment, and processes. The unit includes a mine site induction that creates awareness of risks of injuries and/or death. This chapter requires a high degree of authenticity and immersion to gain experience beyond currently common inductions consisting of written examples and multiple choice questions; see Chapter 5 for a short example as well as Reiners, Wood, and Dron (in press).

Chapter 3: Introduction to raw materials processing; illustrated here by a Second Life-based steel production facility. The site allows for exploration without risk or restrictions. The learner can investigate details and learn about processes by following them (e.g., walking with the train carrying molten iron-ore). Where details are not required other means of presentation can be used; e.g., Machinima (i.e., in-world videos).

Chapter 4: This chapter exemplifies a non-technology-based presentation that can be interwoven with nDiVE to address specialised students in Logistics or Operations Research. While Chapter 1 introduced the supply chain and warehouse locations, it is important for students to understand warehouse location decisions and how goods should be distributed throughout processing and manufacturing; i.e., how many items are stored in which warehouse and how the transport is organised. Here, developing mathematical models and solution algorithms is relevant; which can be taught by lecture, tutorials, exercises, and textbooks.

Chapter 5: Gamified explorative learning about order fulfilment in a warehouse. The learner is positioned in an authentic, immersive environment. Besides clues from the general context, the learner receives only rudimentary instructions and instead acquires guidance from indirect signals, communication with bots (non-player characters), or placed messages; e.g. a customer call is received when the learner walks out of the warehouse without the order or the boss talks to the learner via the speaker if incorrect or unhelpful activities are undertaken. This triggered (formative) feedback is achieved by monitoring the learner continuously for activating triggers associated with corresponding reactions. For example, if the learner uses the wrong forklift (e.g., one with insufficient capacity) it will tilt over and the learner must restart or use gamified mechanisms such as rewinding to a previous state (the moment where the learner picked the forklift) or restarting the whole scenario (Reiners et al., 2012). The final evaluation assigns scores for the time required, number of orders being fulfilled, amount of damage caused, or hints received by the environment. The learner can repeat the chapter to improve the score for a better position on a leaderboard.

Appendix: Scenarios with high authenticity and realism at the end of the unit to demonstrate the application of the knowledge and skills, smooth the transition from the (virtual) learning environment to the real world and teach about real-world risks.

The main narrative path connects the chapters in a logical order (i.e., the progression of chapters as we might see in a textbook), while each chapter has its own narrative path (e.g., shown in the 'distribution scenario' in Chapter 5 of Figure 2). The narrative path provides guidance and establishes comprehension of relevant elements that may be required to fulfil learning objectives. This is a simple but effective mechanism to address the manifold backgrounds and interests in a class (similar to adaptive/intelligent learning environments). The main teacher path on the left in Figure 2 bypasses the transport chapter; which is intended for specialist education for logisticians about optimisation algorithms. We use milestones on the path to indicate requirements for learning content and learning methods. For learners without special focus on processing and materials it might be sufficient to illustrate elements of the topic using Machinima and case studies; while others may wish to explore the processing facility independently in greater depth (see explanation of Chapter 3 in the dot-point list above). To acknowledge the different learning needs, we allow splitting/forking and joining of narratives. Note that the logical order of the chapter can largely be considered as a suggestion or a requirement, while all milestones must be met. Clearly there are time/action dependencies for milestones; e.g., in the example of Chapter 5, the forklift must be started before it can be driven.

A key objective of nDiVE is to create awareness of, and appreciation for, the complexity of supply chains, particularly manifested by the dependencies between causes and effects, often separated by time and space. Learning periods of ten or twelve weeks make it is impossible to observe real-world scenarios; i.e., those with manufacturing lead times of two weeks and six-weeks in transit between continents. Figure 3 demonstrates chapter connections where a learning outcome from one chapter is reflected in the following chapters. That is, the created output of the 'processing chapter' is input for the 'transport chapter', which is linked to the 'manufacturing chapter'. An example is: 1) the learner mistakenly allows a component to cool down too quickly; the resulting micro-fractures are not visible but can be detected with specialised equipment. This component is packaged and then later used in a machine elsewhere, which malfunctions and halts production, causes damage to equipment or workers, and significant financial loss. These interdependencies are implemented within the narrative, allowing the learner to track the part back to the production, and reflect on the

processes and connections that may not otherwise have been apparent. The learner can track the component back to the moment of error; meanwhile, learning how to prevent this mistake and becoming sensitised to cause and impact, even where problems are separated in time and space from the cause. In some respect, the learner follows the path until some event or incident; whereupon the story turns into an investigation where the learner has to take the role of the detective tracing back the evidence to the cause.

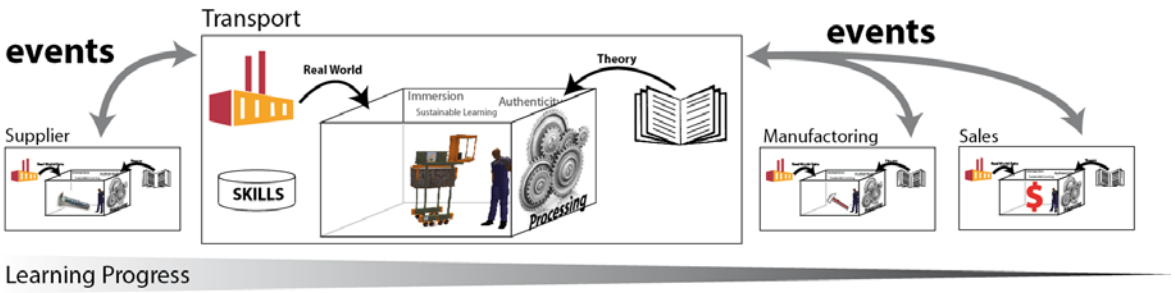

Figure 3: Chapter connections

This approach means that the classroom itself becomes a reflective and team-based learning space, while the story in the virtual environment "provides relevance and meaning to the experience. It provides context" (Kapp, 2012, p. 41).

The realism and authenticity

nDiVE aims to enable and support authentic learning, requiring learning to occur within environments that replicate actions and requirements as they may be presented or experienced in a real working environment. Reading corporate negotiation dialogue in a textbook may be inauthentic; negotiating with a classmate about who should lead the assignment project is more authentic; negotiating with a businessperson in a meeting room about the project requirements in a work-integrated-learning paper is more highly authentic. Authentic learning enables experiences and learning to be more completely contextualised. However, it can be costly and difficult to implement, as well as administratively difficult to arrange (Reiners & Wood, 2013).

While 'authenticity' is often assumed to imply 'realistic', this is not necessarily the case; it is most important that the learning and activities reflect the development and use of the knowledge as required in the given real or virtual environments (Herrington et al., 2010). Thus, a process can be highly authentic, but in a non-realistic setting, creating disconnect between what is being accomplished and the setting it is accomplished within. This can be overcome by increasing immersion in the task.

Fidelity is a measure of resemblance to real environments; thus, high fidelity environments have a high degree of resemblance to real environments, where a very realistic simulation has been employed. While it may be expected that fidelity is required for learning, it has been demonstrated that learning environments need not be high-fidelity to encourage positive learning results. Practically, this means that a low-fidelity environment may be adequate to gain the benefits with minimal resourcing. Similarly, high-fidelity may not be required for high levels of immersion (Bastiaens, Wood, & Reiners, under review). The 'sweet spot' must be identified where adequate resources allow creation of suitably immersive materials that can be relatively easily constructed and developed to gain the outcome with minimal effort; see Figure 4.

Research indicates that head-mounted displays (HMD) like the Oculus Rift headset (Wikipedia, 2013b) can significantly increase the immersion of the user within the virtual scenario. Here, the realism of the display is significantly lower than what most users will experience with their 3D virtual environment on a monitor; the Oculus Rift development kit uses a 640x800 pixels display per eye, compared to HD monitors using 1920x1080 pixels. However, participants in a research experiment reported that scenarios with the Oculus Rift felt 'very real, almost perfect' in comparison to other 3D environments like Second Life (Reiners, Wood, & Gregory, under review). The perceived realism caused the majority of participants to investigate potentially hazardous scenarios (e.g., walking on an oil rig) with greater caution when using the Oculus Rift, despite their awareness that this was a game-like environment. In almost all cases, participants experienced strong physical responses to purely visual stimuli (Reiners et al., under review). Most participants tried to grab a supporting structure that existed only virtually and most participants moved their bodies in response to events in the virtual environment. All users rated the use of Oculus Rift in Unity-game-based environments as being more realistic, usable, interesting, engaging and compelling than Second Life on a normal monitor.

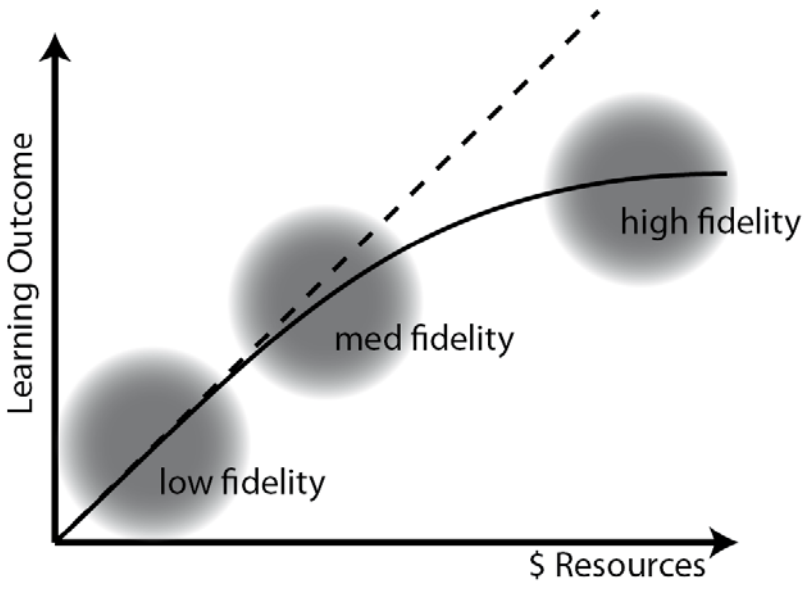

Figure 4: Relation between resources and learning outcome regarding fidelity

The fun, play, and passion

Storytelling is about creating illusions and building up suspense to finally reach full immersion in the narrative. The learner needs to connect and stay connected with the story. The narrative must be adapted to the characteristics of the learner and must trigger further attributes like fun, play, and passion to drive user motivation and engagement. Recently, the idea of using game design elements in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011) became prominent under the term gamification; i.e., to incentivise and alter user behaviours. Games are acknowledged for being able to cast a spell on the player (Jennett et al., 2008), immersing them to such a level that they disconnect with the real world and forget about immediate needs (e.g., thirst) and time. Our task as instructional designers and lecturers is to learn about the motivational properties of games and embed their mechanics in the learning material (Landers & Callan, 2011). The intention is not to create a game but insert an extra layer of game-based elements to provoke desired behaviours.

Gamification appeals to learners because people like to find solutions to challenges and puzzles, they enjoy the adrenaline rush of winning and want to elevate levels (Hokkanen et al., 2011). As we drive to work we can subconsciously gamify the experience to pass the time: we can imagine what other travellers are doing and their ‘stories’, we play games such as counting the number of different coloured cars, or play guessing games as to where different commuters are travelling. Systematised gamification can include multiple recordings, rewinding and elevation of levels through badge systems.

Our use of gamification is not linear or fixed. We provide an open space for learning; even though having boundaries to maintain the user within the scope of the learning objectives. Users can deviate in the open space. It is all about achieving the outcome; not necessarily how this is achieved. (Note that verification of the state of objects or the environment is necessary to prevent certain critical states or actions. Moving a box from the twentieth floor can be accomplished by dropping it from a window; yet, using a pulley and rope would cause less damage and lower the risk of hurting innocent people. Still, it is the learners’ choice to pick from valid methods like pulley, lift, carrying, cranes, or helicopters as long as the aim of the scenario is fulfilled). On completion, the result is assessed by criteria such as time taken, cost, or damage; thus, while a helicopter ride may be fun, it is not the most cost-efficient solution in a commuting problem and therefore maybe not preferable over others. Recorded variables like completion time are used to calculate a score; which the learner can improve on further runs. If a learner ‘gets themselves killed’ or a makes a ‘fatal mistake’, points are deducted but it does not have an impact on the actual person. Virtual learning environments enhanced with gamification enables learners to repeat situations over and over to discover the correct solution to improve their score (McGonigal, 2011). When playing games, there is a very high percentage of failure rates, approximately 80% (Fujimoto, 2012), where the player is engaged to master the game and complete the task – a failure rate we do

not often see in the classroom.

Learners receive points, badges or leader-board merits through gamification techniques, promoting a competitive atmosphere where users attempt to outdo others, while immersed in the learning scenario. Familiarisation with the learning environment can motivate learners to challenge more experienced learners (i.e., progressing up the leaderboard). In theory, it can promote a competitive atmosphere, full of rivalry, as users compete to outdo one another. In practice, such an approach can produce stunningly negative dynamics, as unintended consequences spring forth from the thoughtless application. Consider what it would feel like if you were to join an internet-based social media where there are some well-recognised users with astronomical points and a collection of badges that would make a boy scout green with envy. While this might inspire you, it will undoubtedly turn-off other users. Instructional designers must balance gamification components; for example, introducing handicaps in golf or by comparing learners only at the same level. A comprehensive overview extending beyond gamification elements of points, badges, and leader-boards is provided by Reiners et al. (2012); Wood and Reiners (2012) provide a model for including elements in a logistics and supply chain management class.

The past and future

All lecturers are eager to teach comprehensively about their discipline; however, time and other constraints restrict them to focus on subjects and abstract from the complexity and magnitude of real-world scenarios. This can result in disconnected islands of specific knowledge, lacking perspective from the entire object of study; e.g., the supply chain as the example within the nDiVE project. This paper described a system that uses the concept of a story with embedded narratives to link the subjects and to demonstrate how an effect at the beginning ripples through the story. nDiVE incorporates well-established and emerging technologies to tell each chapter of the story in the most captivating and engaging manner by using a well-balanced mix of authenticity, realism, immersion, and interactivity. We further include gamification concepts by mapping outcomes of the learning process to present the learner with feedback about the quality of their learning.

nDiVE is an ongoing project with first prototypes for evaluation purposes being implemented. We selected the Unity 3D development tool as it provides a realistic physics engine that allows accurate simulation of behaviours in real-world scenarios (e.g., falling shipping containers). Another advantage is how the underlying game engine supports fast prototyping and the later cross-platform publishing and, therewith, increasing the flexibility for the learner to choose the preferred technology and to support distant education. Our studies showed that specialised hardware like the HMD Oculus Rift can and should be used to improve the effect of immersion (Reiners et al., under review); a topic of further investigation within nDiVE. Another relevant aspect in the future is about solving the struggle over the focus of the learning material and the learning objectives.

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Feedback to reviewers

We thank the reviewers for their work and their feedback provided to improve the submission.

REVIEWER 1. (Abstract + para 1 pg 1) "the required management of multiple dimensions to become highly productive and efficient" This needs some indication as to whether it is the organisation or the student that is the subject of the improvement.

The sentences were changed to be non-ambiguous, the relevant part is “and the efficient management of the multiple dimensions in supply chains”. The change was done in the abstract and in the first paragraph.

(Abstract) "or manifold production systems " - expect this should be 'and' not 'or'

This sentence was deleted in the abstract as we shortened the abstract to the max of 150 words. Nevertheless, we changed it in the first paragraph in the introduction.

"a limited peak into several ‘slices’ or ‘chapters’" I think you mean 'peek'

Agreed on this, changed the word

"old Dungeons & Dragons games (Wikipedia, 2013a)" Not a particularly useful citation, consider possibly referencing academic works examining the pedagogical role of narrative games and case studies? The use of D&D here and later in the paper will be clear to some readers but doesn't seem to add anything to the paper in itself.

We agree that Wikipedia is not the best choice of reference, replaced it with Loh, 2007. The reference to Dungeon Masters and D&D itself is not crucial to the paper, yet we believe that the inclusion of this idea is not confusing for the reader (in case they do not know D&D) but will provide for many people an understanding of how the storyteller leads through the story but that the listener (and actors) can have an influence and make it their own story. D&D is one of the most famous ones, similar to what GTA is for the currently younger generation.

REVIEWER 2.

p1. para 3 line 5 '. . . a limited peak. . . ' should be '. . . a limited peek'. . .

Changed, see above

p2. para 1 line 11 'Gamification' is undefined. I suggest moving the sentence that defines it (lines 14-15) to before the sentence beginning 'Gamification'

Changed according to the feedback

This is a copy of the ‘post-print’; i.e., the final draft, post-refereeing.

p2 para 4 line2 'One can be captivated . . .' seems awkward, suggest replacing this by 'People can be captivated . . .'

Changed according to the feedback

p4 para 2 line 8 'Not show in . . .' should be 'Not shown in . . .

Changed according to the feedback