Chapter VII
The DODDEL Model: A Flexible Document-Oriented Model for the Design of Serious Games

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ABSTRACT
This chapter proposes a document-oriented instructional design model to inform the development of serious games. The model has key features in that it promotes a theoretically inclusive approach to learning, a focus on game elements and an emphasis on documentation to provide the rigour necessary to be used as part of a broader project management model. The model defines increasingly granular stages leading to final production documentation for software development. Each design stage contains a series of iterative co-dependent elements. It is proposed that the model can form a base for prescribing and managing activities within an industry context but also as a means to teach the instructional design process for serious games within a higher education setting. A case study of the initial implementation of the model is discussed in order to contextualise it and provide a basis for future enhancement.

INTRODUCTION
Instructional design models are often used to guide the process of designing and developing a range of learning media. They have value in describing the design process; managing the process; prescribing activities within it; communicating with the clients and other key stakeholders; and finally, teaching and conducting research about the process.

There are a number of well known design models for instructional technology that have been well received and implemented in many settings. Most are influenced by the common
procedural phases of Analyse, Design, Develop, Implement, and Evaluate (ADDIE). They vary in the extent to which they can be described as a design model, project management model, or instructional theory. They also vary in the extent to which they are prescriptive in the nature of the activities involved in design. One of the most common models, developed by Dick and Carey (1990) demonstrates both the strengths and weakness of traditional instructional design models. It provides a structure similar to the generic ADDIE model that identifies the stages inherent in instructional design and emphasis key points such as evaluation and setting objectives. However, the terminology used (such as ‘write performance objectives’ and ‘develop criteria referenced tests’) emphasises the behaviourist nature of the approach and its focus on traditional computer-based training rather than the multiplicity of learning experiences available in games and more contemporary approaches to learning. This level of prescription can restrict the types of products that can be developed, particularly when working within a more open epistemology such as constructivism, which seeks to create environments that facilitate learning rather than promote content acquisition (Jonassen, 1994). Others such as the Layers of Necessity Model proposed by Tessmar and Wedman (1990) accommodate the multiplicity of decisions inherent in the design process but are based on broad principles rather than procedures. This can limit their direct applicability, particularly for novice designers.

This chapter represents an attempt to draw from the best of existing methodologies. The goal is to provide a clear structure to guide the instructional design process, while allowing for the iterative and creative elements of game design and its inherent focus on the end user experience.

A PROPOSAL FOR A DESIGN MODEL FOR SERIOUS GAMES

There is some precedent when exploring instructional models that may have value in the design of serious games. Ryder (2003) lists a range of models, some of which are quite prescriptive in nature. The vast majority however can be more effectively described as approaches, since he includes reference to fundamental psychological approaches as well as general guidelines which would underpin the design and development process, including Bloom’s Taxonomy of cognitive outcomes and Keller’s ARCS theory of motivation. Many of these have potential to be integrated into a model for serious games design, particularly those that focus on experiential aspects of design such as motivation, flow, and end-user attributes.

These features tend to form the focus of game design models. The MDA model for example (Hunicke, LeBlanc & Zubek, 2004) provides a simple framework for game design based upon three components of:

- Mechanics, describing the components of the game that can be represented as algorithms;
- Dynamics, the interaction of the game based upon user input over time; and
- Aesthetics, describing the intended emotional responses evoked in the player throughout gameplay.

Björk, Lundgren, and Holopainen (2003) provide another model that is deliberately ‘interaction-centric’, using game ‘patterns’ as an approach to articulate the gameplay underpinning design. Such models are inherently game oriented but provide little benefit to the instructional designer, who may be guided primarily by stated learning outcomes rather than an archetypal form of gameplay.
There have been some attempts to integrate instructional design models into the game development process. The Fidge model, for example depicts standard analysis, design and evaluation stages and emphasises their codependence (Akilli & Cagiltay, 2006), however it does not have a strong focus on documentation or provide a level of detail to support novice designers. A more relevant model is one proposed by Kirkley, Tomblin and Kirkley (2005) that underpins an authoring system for the design of mixed reality training. In attempting to reconcile traditional instructional systems approaches used in learning design and ‘waterfall’ phases of game design, the authors provide a tool that breaks the design and development process into a system of interactive wizards.

The model proposed here is less formal but still provides the structure required for novices. Figure 1 demonstrates the approach that has been developed for implementation at Edith Cowan University in Australia. With a focus on Document-Oriented Design and Development for Experiential Learning, the DODDEL model draws heavily on existing approaches but is unique in that it emphasises games as the instructional medium and a high level of documentation, while attempting to be inclusive enough to include the multiplicity of learning approaches and game styles available to the designer.

The model is deployed in an undergraduate course of Game Design and Culture, where students undertake units in serious games as well as completing team-based industry projects. It has been designed to facilitate teaching and learning about serious game design, while providing a sound basis for communication about the process within teams, and among teachers, clients and developers. As such, it incorporates elements that focus on development issues, though these are not fully articulated here.

Figure 1. The DODDEL model
OVERVIEW OF THE MODEL

The Situation Analysis and Design Proposal phases of the proposed model roughly correlate with the analysis phase of the ADDIE model. The first explores the potential of a product in the marketplace and the feasibility of a game for the target audience and within the prescribed learning context. This contributes to the final Design Proposal, which adds to the analysis and provides a more detailed depiction to assist in communicating the goals and overall strategy for the game to key stakeholders. Given the cost inherent in game development it is likely that most projects will be need to be ‘green lit’ as a result of such a proposal that has been presented in the form of an expression of interest, pitch, or tender.

This is a necessary precursor to the actual design. Within the design phase, Design Documentation and Production Documentation stages represent different levels of aggregation. Design Documentation is typically less formal and detailed than Production Documentation, and this is necessary because of its predominantly internal role in helping designers communicate with each other and clients. Production documentation on the other hand should provide detailed specifications for the final product that can be used by programmers and graphic artists. Should development be outsourced, the signed off production documentation can form a contractual basis for developers. It also has an educational role in that it requires designers to fully articulate final designs and deal with the issues that may result in communicating complex gameplay.

The extent to which designers are involved in the actual production can vary greatly. The Game Design and Culture major at ECU, for example, attracts students with skills and interests in visual design, communication and media theory, but not necessarily strong technical skills. Subject matter experts often have even less skills in product development. This scenario is somewhat similar to traditional instructional design, where designers may come from backgrounds as face-to-face educators or editors of print material. Nevertheless their role is central to the value of the final product.

The centrality of the designer in this process is underpinned by the integration of prototyping into the model. It would be a rare case where a game design goes into full development without a prototyping stage. For every successful game there are many that merely sit on library bookshelves and being able to judge important aspects relating to the affective dimensions of games would be very difficult without real testing at an early stage. One common approach to development is rapid prototyping, which provides an iterative and evolutionary model for development, with evaluation playing an important role in the further refinement of the product.

As can be seen in Figure 1, evaluation is both diagrammatically and conceptually central to the proposed game design model. Formative and summative evaluation are frequently cited as important in project management literature. Game designers need to play role in this particularly in the early stages. In this model, distinction is made between the evaluation of the design itself and game balancing. The former involves the inclusion of key stakeholders in the evaluation of the documentation at every stage as the game design evolves. The latter focuses on the prototype. Developers would be looking at technological aspects of the design such as maintaining adequate frame rate through optimising code, while for designers, game balancing involves moderating the level of challenge to ensure an appropriate sense of flow for the user. This is a process of sweetening the gameplay rather than fundamentally changing the design. It refers to the dynamic balancing that occurs throughout gameplay rather than the static balancing inherent in setting up the transitive and intransitive relationships between gameplay elements. It has been argued that game balancing should occur early, before full development and does not require the graphics to be fully refined.
It is different therefore from summative evaluation, which aims to test the effectiveness of a product once it is completed, and impact evaluation, which identifies the value of the product in real world settings. Ultimately, at the implementation phase, a post-mortem project evaluation can be used to identify the lessons that can be learnt for future projects.

There is a movement in game development towards more ‘agile’ practices. Agile approaches have a focus on people and communication, an ability to respond to change, and prototype development over the more linear methodologies that traditionally drive software development (Keith, 2007). While project management, plans, documentation and milestones are still important elements of the process, particularly for students and novice designers, the levels of iteration within each phase of this model and the role of prototyping and evaluation as an ongoing processes allow for the integration of agility into the approach to design and development.

THE DESIGN STAGES IN DETAIL

The proposed document-oriented approach can make a strong contribution to quality assurance by providing sign-off points and an audit trail as the design progresses from broad specifications to detailed content. Each stage of the model has document outputs underpinned by three main foci:

- End user experience, which progresses from an analysis of user characteristics, through the mechanisms implemented for challenge and feedback, to a definition of the game logic and variables
- Game treatment, which begins with a fundamental statement of a learning philosophy, through a depiction of the game genre and design, to the final templates and interface.
- Learning outcomes, which increases in detail from a basic statement of aims and outcomes, through the description of underpinning concepts and objectives, leading to the structuring of content and interactivity to the final scripts and storyboards.

Each of the design stages is discussed in terms of these three components and their documented outputs.

Situation Analysis

A Situation Analysis may take the form of an expression of need or problem statement, and may be incorporated into the Design Proposal or act as a basis for a request for tender depending on whether the document is created from a developer or client perspective. Regardless, the analysis should provide a sound basis for the exploration of designs. Such analysis identifies the aims and learning outcomes of the product as well as user attributes and contextual requirements that will all affect the product design in a manner where each of the elements inform each other.

Aims and Outcomes

Aims and outcomes provide the basis for design. The main difference between the two relates to where each is situated. While aims relate to the goals of the organization and development team, outcomes are specific to results of the learning and described in terms of end user attributes. So, an organization may aim to lower student attrition in first year of higher education. The outcome however could be that students are able to manage their course workload and identify appropriate sources of student support. The term outcomes is used because it is represents a general shift away from fixed behavioural objectives towards a more inclusive term (King & Evans, 1991). This supports the generation of secondary forms of learning that may not be fully anticipated in
environments that may have social or simulation bases, but may be equally valuable. At this stage, aims and outcomes are represented as broad statements to act as a focus for design and describe a general competence rather than any underpinning skills or knowledge.

Learning Approach

To make the designers’ intent transparent, as well as ensuring the proposed product is grounded in existing empirical research, it is important to place design within a theoretical framework. The articulation of a learning approach acts as a philosophical statement and should provide a basis for the learning design. Typical learning approaches may argue for a specific epistemological or psychological orientation such as an objective behaviourist approach or a more cognitive or constructivist approach. They may also incorporate specific theories of learning or intelligence. For example, Gardner’s theory of multiple intelligences (Gardner & Hatch, 1989) can provide a basis for ensuring an inclusive approach to the selection of media and activity to accommodate a range of learners. Regardless of the underpinning philosophy, the learning approach should be suited to the aims and outcomes of the product. A product that aims to teach first aid, for example, will be inherently more behaviouristic than one that seeks to assist learners in constructing an appreciation for a certain type of music or literature.

Learner and Context

Any development project must take into account its target audience, and an understanding of the learner and context are crucial to enable design to be targeted towards those needs. This would involve a fairly lengthy discussion that accommodates the attributes of the end users, but also the constraints and affordances of the environment in which the product will be used.

With regard to end user attributes, there have been many attempts to describe individual learning and personality styles and how these impact on the experiences of learners. Within a learning approach that accommodates multiple intelligences, consideration will need to be given to the likely bias of users in terms of their orientation to visual/special, musical, linguistic, kinesthetic approaches and so on. Tools have been developed that try to tease out these attributes (e.g. Museum Libraries Archives Council, 2004). Other approaches include the Myers-Briggs Type Indicator (Briggs Myers, 1980) and Kolb’s Learning Style Inventory (Kolb, 1976). While such approaches may be treated with some scepticism regarding their empirical validity (Hunsley, Lee & Wood, 2004) they may still provide a lens through which to consider issues relating to the styles and preferences that end users bring to their experiences.

Beyond accommodating a range of individual differences, a game may also have a focus on a particular group as an audience. Games have a reputation for being primarily oriented towards male users, although there are indications that these differences are less intractable than previously thought (Brand, 2007). Nevertheless, considerable research is being done in this area, for example examining gender differences in neurocognitive propensities and their implications for games (Bonanno, 2005). Other impacting factors may be age and ethnicity. One regularly cited value of serious games is their potential to engage so called Millennial students who have distinct traits such as an intolerance for delay, an IT mindset, a social orientation to learning and a disposition towards multitasking (Oblinger & Oblinger, 2003). Such characteristics have been confirmed by the author’s own research (McMahon & Pospisil, 2005). Research has also shown that serious games can be effective with babyboomers and the elderly. Such diversity demands consideration of the nature of product design since ‘babyboomers are not interested in
shooting things’ (Montet, 2006). At the same time, an increasing focus on games as cultural practice is identifying cultural determinants within countries that impact greatly on the nature of games that are played, particularly in Asian compared to Western cultures (Hjorth, 2006).

At this early stage, some consideration may need to be given to aspects are external to the end user but just as crucial to the design and potential success of a project. Before engaging in any product development it is important to determine whether there is really a need for it. Alternative off the shelf products may diminish the feasibility of the product or there may be other factors that suggest a game may not even be the best approach to the problem. Factors that can be considered include:

- The technology to be used and the installed base within the target audience;
- How the product will be implemented (e.g. as part of a course, to be self-directed, within a classroom etc);
- The overall scope of the product as defined by its outcomes; and
- Proposed development time and availability of resources.

This may result in the inclusion of a detailed project plan and costing, depending on the extent to which this is required (e.g. a broad proposal compared to a response to a request for tender).

The Situation Analysis should integrate the three components of aims/outcomes, learning approach and an analysis of the learners and context of learning. The goal is to provide a cohesive picture of the major determinants that will allow a proposed product to meet the needs of a specific target audience in order to achieve the set outcomes through a particular theory or theories of learning. Once developed, these concepts can form the basis of the Design Proposal.

### Design Proposal

The Design Proposal extends on the previous document to propose a general approach to meet the needs identified within the Situation Analysis. At this stage, the solutions are expressed in quite vague terms but will be closely linked to the issues relating to the learning outcomes, game treatment and end user experience. In particular, specific concepts that underpin the broad learning outcome, a description of the type of game that will be implemented and the nature of cause and effect interaction within the game need to be identified.

### Specific Concepts

To achieve an outcome, there are usually a number of types of skills and knowledge that need to be developed. These must be identified and mapped to the aims and outcomes of the product. For example, a photography game may have the ultimate aim of making learners better photographers, but a range of underpinning skills may be required within that, such as the ability to operate photographic equipment, understand light and exposure, focus and depth of field, and so on. Therefore an important step in teasing out the aims and outcomes is to specify these subordinate skills. They may be conceptual in nature, such as understanding the impact of a particular colour or they may be quite behavioural such as the ability to select the correct shutter speed to ensure correct exposure. In defining specific concepts or objectives, the author has found it useful to have them articulated as active phrases addressing specific levels of Bloom’s Taxonomy (Bloom, 1956). Knowledge based outcomes for example may require learners to name the parts of a single lens reflex camera. An analytical outcome might be that they are required to compare and contrast two photographs for their quality, while a synthesis outcome may require students to create
their own picture using a simulated camera. This list of concepts can then be used later to inform the architecture of the game.

**Game Approach**

The game approach situates the product in a genre and identifies some basic criteria for its look and feel of the product. It is the experience of the author that genres are well understood by novice designers who have an interest in games. Most would be able to identify the salient characteristics of first and third person shooters, real-time and turn-based strategy games, puzzles, adventure games, platform games and so on. The game approach sets up expectations about the gameplay within the environment and the associated setting and context of the game. These can often be analogous to learning strategies too, and defining an approach to the game can be done effectively by giving consideration to the relevance of traditional e-learning techniques such as those identified by Newbey et al. (1999). These include simulations, tutorials, drill & practice, problem solving, discovery learning, discussion and collaborative learning. Such activities underpin a variety of game approaches. For example, quizzes are an ideal mechanism for drill and practice, online role-playing games promote collaborative learning and discussion and so on. Once again, consideration needs to be given to all aspects of design when making decisions about the nature of a game. While quizzes may provide a valuable approach to building knowledge, their lack of authenticity makes them difficult to tie them to applied outcomes. Likewise, online role-playing may be a valuable tool for the social construction of understanding, but in training for fire safety some topics may not be suitable for discussion. Instead learners may be required to apply skills without even necessarily understanding them.

**Challenge and Feedback**

Ultimately games can be defined by the nature of the challenge and feedback within them. Gameplay can be seen as a balance between the challenge and feedback within a game with the end users’ capacity to use the feedback to enhance their skill.

Once again, this section should be integrated with the other aspects of design. A game challenge will be a learning challenge, and the feedback that the user receives will enhance their performance in the game but also their achievement of the learning outcome. Much traditional ‘edutainment’ can be criticized of failing to meet one or both of these goals. Games are not simply a mechanism for making learning palatable. A rigorous approach to designing challenge and feedback should ensure that activity within the game is goal directed and leads to positive consequences for the learner.

Most game genres are ultimately derived from the nature of the challenge that is inherent in them. Rollings and Adams (2003) describe a range of pure challenges that are archetypal forms of interaction that underpin game approaches:

- Logic and inference challenges;
- Lateral thinking challenges;
- Memory challenges;
- Intelligence-based challenges;
- Knowledge-based challenges;
- Pattern recognition challenges;
- Moral challenges;
- Spatial awareness challenges;
- Co-ordination challenges;
- Reflex/Reaction time challenges; and
- Physical challenges.

It is not an exhaustive list—one may for example think of adding social challenges to the canon, with a view to delineating the challenge inherent in online games where one of the goals may be to create effective teams/squads. By defining the
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nature of the challenge, however, one is a step closer to defining the nature of activity in the game. Most importantly it takes the developer to a point where it is possible to define the feedback inherent in the game.

Feedback is crucial to the user’s performance in the game and by extension, the ability for the end user to monitor his or her learning. Games have feedback embedded in them through achievements, scores, health, money and other tokens within the game economy. Effective e-learning should be able to harness these forms to provide a naturalistic mechanism for learners to practise their learning and monitor their performance. From the most basic quiz score to the most complex performance criteria within simulations, it is imperative that the learner receives support that is tied directly to the challenge. This section of the Design Proposal provides the opportunity to define the mechanisms to support goal achievement and offer remediation to learners.

Design Documentation

The design phase is in many ways the most complex in that it defines the qualitative aspects of the game. As such, it needs to accommodate formal elements relating to how the game will be manifest, yet support the creativity and dynamic flexibility required for innovative and evolutionary design. The documentation produced within this stage should be able to effectively communicate the design of the game to clients and within the design team. While it may be rougher and less detailed than Production Documentation, it serves an important role in coalescing the various elements into a cohesive description of how the final product will look, feel and behave. It also acts as a transitional form of documentation to the more formal scripts and storyboards. There are a number of forms the documentation may take, but at this stage the design should be able to offer a high level depiction of the game treatment, gameplay and structure of the product.

Structure Concepts

An important means of ensuring learning outcomes are achieved is to structure concepts in a way that maps them across the design of the product. In many cases, but not all, there will be a hierarchy of concepts that need to be covered which will guide the path the user takes through the game. Even if that is not the case, the process of structuring concepts will assist in defining the types of instructional content that may be required and give a sense of the scope of the final game in terms of its playable hours. This could also involve developing a proposed sequence through the concepts. In some cases the learning concepts will cross many or all parts of the final product, in others, they may be dealt with discretely within sections of the product. One obvious approach to creating this structure is to develop an organisational chart. This is particularly useful when the domain that the product seeks to address can be represented within a hierarchical or linear path.

Game Treatment

As well as structuring the underpinning concepts to be addressed in the product, it is also important to define how this basic structure will be treated. The game treatment should give a sense of the look and feel of the product. Within any genre of game there are many decisions to be made about the visual and narrative aspects of the game experience. Within the basic sections that have been identified it is important to consider what the game world will actually look like, what characters inhabit it (both player and non player), the overall story arc and key plot points and events that drive the game. It is something of a truism that games often lack a depth of content, storyline, and emotion (British Screen Advisory Council, 2005). Attention to these aspects in the game treatment can do much to enhance its value as an engaging environment. Character descriptions, plot outlines and concept graphics are important tools for driv-
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Integrating Structure, Gameplay and Game Treatment

Defining the relationship between the above elements is a necessary but difficult task, rendered even more complex by the fact that none of the elements discussed in this section are mutually exclusive. Interface, for example is part of the game treatment in terms of the look and feel of the product, but also plays a vital role in the user’s ability to perform a task within the game world. So while the game treatment may focus on the comprehensibility of the interface, the gameplay will need to specify the types of controls and actions that are possible in the game.

Further analysis may be required to clearly delineate the relationship between the above elements into a cohesive environment. This analysis goes beyond situational issues to look at the critical factors related to the learning as it is both manifest in the game world and applied in the real world. In virtual reality simulations, Stone (2008) highlights the difference between physical and psychological fidelity. The former relates to how accurately the environment mimics the real world while the latter refers to actual level of fidelity required to transfer skills to it. Since psychological fidelity is the ultimate goal of learning, there are obvious implications in terms of the gameplay, game treatment and concepts to address which aspects of the real world actually need to be fully modelled. Stone breaks fidelity down into the following criteria:

- Task fidelity
- Interactive technology fidelity
- Context fidelity
- Hypo- and Hyper- fidelity

Decisions need to be made for example about what physical and cognitive aspects of the task are important, whether the environment requires specific interfaces such as haptic devices or visualisation screens, the background stimuli that may

Gameplay

This is also the point at which the basic forms of challenge and feedback that have been identified are expanded on to describe the gameplay. This crucial aspect of game design addresses how the elements of the game are combined to create a sense of achievability but uncertainty in meeting the game challenge. If a game is too hard it will be frustrating for the end user. Conversely an excessively easy game can be boring. Oxland (2004) identifies a number of elements that contribute to gameplay such as:

- Rules;
- Boundaries;
- Feedback;
- Interface;
- Goals; and
- Challenge.

So, while the overarching challenge of the game may be to apply lateral thinking to solve a problem, the problem may be based around the goal of rescuing a character. User activity in achieving this goal is governed by the rules that are placed on the decisions that can be made and the constraints of the game world in terms of where the player can go at a given point in the storyline and what is available to help solve the problem.
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impact on performance and the extent to which fidelity supports or detracts from the concepts to be learnt. All of these obviously have great impact on the gameplay, treatment and structure of the product.

Also at this stage consideration needs to be given to the motivational and immersive aspects of the design to ensure learner engagement. These can include the development of game flow, where the tension between challenge and skill are optimised but also the affective aspects of the game experience, such as narrative curiosity that is developed through the plot or the sense of care and identification that can be developed for an emotionally deep and complex character or their predicament.

One way of accommodating this is to try to economise in design documentation by creating more holistic forms. The structure maps, concept graphics, and the gameplay document can be integrated into a more complete document that describes each module.

The format that these module descriptors take will vary depending on the nature of the product. They may take the form of a story outline broken down into chapters, or game levels. They may be based around ‘dungeons’ in the game world, or specific scenarios or activities. One way of presenting such a document may be in the form of a table with columns assigned to key design features such as:

- The specific learning outcome(s) or concept(s) being addressed
- Visual media in the form of characters present, descriptions of any instructional or illustrative graphics and so on
- Auditory media - which may include environmental sounds, dialogue or sound effects
- Interaction - which will describe the ways in which the user can manipulate the elements in this particular module of the game.

Ultimately these elements will need to be balanced in a way that manages all of the factors that influence design. A highly realistic simulation may act as a very stimulating environment but ultimately distracting from the concepts to be learnt. In another case, a level of abstraction, while effective in promoting broad conceptual understanding, may limit transfer to real situations.

Production Documentation

The results of Design Documentation may vary, but would include: structure maps; descriptions of gameplay elements; character arcs; concept graphics; and the overall game, broken down into module descriptors. The main difference between Design Documentation and Production Documentation is that the former describes the design, while the latter prescribes the development of the product.

It is a necessary distinction. The main focus of Design Documentation is communication and much detail can be omitted in the earlier stages of design to get across the main ‘ideas’. Unfortunately these types of documentation do not ensure quality in the final product. The purpose of Production Documentation is to be a paper-based analogue of the final game. This ensures that the product is built to specification and accurately reflects the design. Production documentation is fully detailed to the extent that it can contribute to the quality assurance and contractual aspects of the project. For example, once a storyboard has been signed off by the client it is given to the developers to build. At that point there is a clear demarcation of responsibility between the client, developer and designer. Anything not built to the storyboard specifications becomes the developer’s responsibility to fix. Another common scenario is where the client seeks to change the scope of the design. If the storyboard has been signed then these changes can be negotiated beyond the origi-
nal contract scope. The designer’s responsibility is to ensure that the production documentation itself accurately reflects the design.

Just as approaches to Design Documentation vary, there are many ways to approach Production Documentation. An in-house development may allow more flexibility and commensurately less detail in documentation than an outsourced project. However, best practice would suggest that the more detail in the documentation the less margin for error between the design and the final product.

Many organizations develop approaches to production documentation that are part of their overall quality management system. Typically, however, the types of documents that are produced draw from multiple disciplines such as interactive media development, film and video and software engineering. Therefore they can include documentation as diverse as:

- Storyboards (textual scripts and/or visual storyboards)
- Flowcharts of specific interactions
- Tables of entities and variables, and media assets

The list is not exhaustive and typically multiple forms of documentation are required at the production stage.

To avoid duplication between documents, it is proposed that a distinction is made between global and specific types of documentation. Global forms of documentation define the game elements that are common throughout the product. A common document would be a set of specifications that would define:

- Colours
- Fonts
- Standard screen dimensions and layouts for specific parts of the product
- Game controls, standard cursors, interaction styles and forms of feedback
- Libraries of elements that may be used in certain parts of the game, e.g. character animations, game variables and their impacts on other variables, media assets used in several parts of the game etc.

Some of these are extensions of the design documentation already provided but in more detail.

The role of the storyboards then is to flesh out the detail within specific parts of the game that differ to or build on the global forms of documentation. For example, the user may be required to interact with a character in an adventure game. The approach to animation and interaction may be defined within the global specifications, but the actual dialogue and the results of the interaction at a specific point in the game will vary. At this point it is useful to embed these in storyboards.

The exact nature of storyboards will depend on the type of game. Two common forms are textual storyboards (scripts) and visual storyboards. The difference is the focus of each. In a virtual house which consists of 5 rooms, little may change between the rooms but the character interaction and dialogue within them. A textually based document which refers to templates in global specifications would therefore be appropriate. In a tutorial-based game which presents unique graphical information on each screen, then it may be more appropriate to foreground the visuals. A common visual storyboard template would include a placeholder for a drawing of the screen as well as sections to write the graphical and audio media and interactions within that screen.

Ultimately there is no single ‘magic bullet’ to production documentation. Often the best approaches are developed over time and may vary depending on the type of project. It is important however that the documentation represents the final product accurately enough to be developed according to the design specifications.

This is a marked extension of the functionality of design documentation. For example, in defin-
ing the gameplay at a design documentation level of a shooter, the role of weapons, health, shields and so on will be discussed. At the production level, it is not enough to describe these in general terms. The quality of the final gameplay will be dependent on specific factors. For example, exactly how much health is lost when the user is hit with a pistol? Or a phase rifle? Or a rocket launcher? At what distance? To what extent do shields minimise the damage and how many health points are lost? These must be represented algorithmically and in a manner that can be understood by programmers. Designers often use tools like flowcharts or pseudocode to define the logic of a game in enough detail to ensure the final product represents these relationships.

**SUMMARY**

Example outputs in terms of the documentation required for each stage of the design phases of the DODDEL model is outlined in Table 1. It is neither an exhaustive nor prescriptive list, as the requirements of a particular project may emphasise some forms of documentation over others. Nevertheless, it provides a framework that can be used to guide the serious game design process.

**CASE STUDY**

The model has been applied to a final year undergraduate unit in Serious Games at Edith Cowan University as part of a new Creative Industries major in Game Design and Culture. The group

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**Table 1. Example documentation outputs**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Components</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
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<td>Aims and Outcomes</td>
<td>Aims</td>
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<tr>
<td></td>
<td>Learner and Context</td>
<td>Outcomes</td>
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<tr>
<td></td>
<td>Learning Approach</td>
<td>Learning approach</td>
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<tr>
<td>Design Proposal</td>
<td>Specific Concepts</td>
<td>Concepts/Objectives</td>
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<tr>
<td></td>
<td>Challenges and Feedback</td>
<td>Learning strategy</td>
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<tr>
<td></td>
<td>Game Approach</td>
<td>Game approach/Genre</td>
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<tr>
<td>Design Documentation</td>
<td>Structure Concepts</td>
<td>Nature of challenge</td>
</tr>
<tr>
<td></td>
<td>Gameplay</td>
<td>Remediation/feedback</td>
</tr>
<tr>
<td></td>
<td>Game Treatment</td>
<td></td>
</tr>
<tr>
<td>Production Documentation</td>
<td>Scripts &amp; Storyboards</td>
<td>Game overview</td>
</tr>
<tr>
<td></td>
<td>Game Logic &amp; Variables</td>
<td>Structure/Organisational chart</td>
</tr>
<tr>
<td></td>
<td>Global Specs &amp; Templates</td>
<td>Module descriptors</td>
</tr>
</tbody>
</table>

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*The DODDEL Model*
The DODDEL Model consisted of 10 students. One of the requirements was that the students work in teams of two or three, using the model to document a serious game design of their choice. The following example was submitted by a pair of students who chose to teach spelling within the context of an adventure game, SpellStory, set within the context of the seven wonders of the ancient world.

The Situation Analysis provided by the students demonstrated the connectedness of the elements of the model. Stated outcomes that the user would know how to spell a range of words, understand their uses, apply this knowledge to authentic spelling task and use contextually provided historical information to solve problems, pointed to a requirement for a blended cognitive/behavioural approach. Behavioural learning was proposed due to the inert nature of the spelling knowledge required, which in turn suggested an approach that would involve repeated drill and practice to provide rehearsal of the spelling skills and promote automaticity. Some of the more cognitive elements of the project were in the use of knowledge of the seven wonders of the ancient world to solve problems and help progress the story. The students argued an adventure game was most appropriate to the target group of 7-11 year olds with varied difficulty within the spelling tasks to accommodate the diverse literacy levels of this group.

These ideas were carried through a Design Proposal that separated SpellStory into the 7 modules (wonders) and tied specific concepts to each. The game was described in terms of being a quest, where the user needs to find 7 keys which promoted mastery learning of the concepts within each individual wonder. The concept of variable degrees of difficulty was more thoroughly explained in this section as well as elements of logic, inference and pattern recognition that would underpin the challenges for the user.

The three main forms of design documentation that were provided in this case included a structure map which essentially broke the game down into the seven modules (Figure 2), module descriptors (Table 2) and rough concept graphics (Figure 3). As can be seen, there is a corollary between the structure map and the module descriptors, though the lack of numbering within the structure map does not highlight this connection.

The Production Documentation was handled somewhat differently from several of the other teams’ submissions in that, through negotiation with their lecturer, the team members chose to submit a prototype as part of their design. This
The DODDEL Model

Table 2. SpellStory module descriptors

<table>
<thead>
<tr>
<th>Module</th>
<th>Objective</th>
<th>Content</th>
<th>Media</th>
<th>Interaction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0. Menu and setup</td>
<td>1) Choose a skill level</td>
<td>Map showing all the Wonders, options to choose levels and design</td>
<td>Background music, parchment graphic, character with changeable</td>
<td>Player can click on the attribute lists to get different styles e.g. for</td>
<td>Player has a sense of ownership from being able to design their own</td>
</tr>
<tr>
<td></td>
<td>2) Design a character to represent the player</td>
<td>character</td>
<td>attributes</td>
<td>hair, skin colour, eyes etc; has to click on the first screen to start</td>
<td>character and start the game.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>game.</td>
<td></td>
</tr>
<tr>
<td>1. The Great Pyramid</td>
<td>1) Navigate through the pyramids to reach the treasure chamber and</td>
<td>Spelling games, information about the pyramids</td>
<td>Animated sequences, character voices, background music, hieroglyphics</td>
<td>Player can click correct options with the mouse or enter with keypad; can</td>
<td>The player has to get through all the spelling challenges to complete</td>
</tr>
<tr>
<td>of Egypt – (spelling)</td>
<td>obtain key</td>
<td></td>
<td></td>
<td>choose a path to go through</td>
<td>the level; on completion they receive a fact card (as a printable) and a</td>
</tr>
<tr>
<td></td>
<td>2) Learn spelling through drill and practice exercises.</td>
<td></td>
<td></td>
<td></td>
<td>game key.</td>
</tr>
<tr>
<td>2. Lighthouse at</td>
<td>1) Run up the stairs to reach the top of the lighthouse and guide the</td>
<td>Tests about types of words (nouns, verbs, adjectives, adverbs)</td>
<td>Animated sequences, character voices, background music, Sounds of the</td>
<td>The player had to click on the steps to advance; would have to click on</td>
<td>The player has to succeed at the challenge to reach the end of the level</td>
</tr>
<tr>
<td>Alexandria (types of</td>
<td>friendly ships (named by a certain type of word) to safety.</td>
<td></td>
<td>Sounds of the sea, images of ships on the sea.</td>
<td>correct options to determine the type of words in the game, click on</td>
<td>ad hence should know what the different classifications of words are;</td>
</tr>
<tr>
<td>words)</td>
<td>2) Learn about the types of words by correctly identifying</td>
<td></td>
<td></td>
<td>the ship and the shore to guide them safely to land.</td>
<td>the player receives a fact card</td>
</tr>
</tbody>
</table>

Figure 3. SpellStory rough concept graphics

negated the need for fully realised visuals and templates, as these were embedded in the prototype. This decision also highlights the need for flexibility in deciding which forms of documentation to use. Rather than complex interrelated variables within a simulation, the design was characterised by smaller quizzes and puzzles and underpinned by a narrative. This meant that textual storyboards with an emphasis on the sequences and decisions within the gameplay were the most appropriate
The DODDEL Model

Table 3. SpellStory textual storyboards

<table>
<thead>
<tr>
<th>Number</th>
<th>Visual</th>
<th>Audio (spoken)</th>
<th>Audio (sound effects)</th>
<th>Intentionality/authoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Outside of pyramid. Question in front of door with space to type in. Buttons with 'enter' and 'hint'.</td>
<td>Background music - Egyptian theme (global for this module)</td>
<td>Keyboard: Type out the letters (or answer as var 'answer') Mouse over: If 'hint', display hint. Mouse click: If 'answer' equals 'correct', go to 1.1 else if 'answer' does not equal 'correct', go to 1.0.</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Wall with hieroglyphics. Player's character walks in from the left with a wood torch. Companion (Egyptian boy called Ahmed) walks in from the right. Player character shows the artifact from intro sequence. Buttons at top corners of screen: &quot;Go&quot; and &quot;Quit&quot; (global)</td>
<td>Ahmed: &quot;Hello! I'm Ahmed... I heard you're looking for something...&quot; Player: &quot;Yes, I need a key for this.&quot; Ahmed: &quot;I think you'll have to go to the treasure chamber to find that.&quot; Player: &quot;Do you know where that is?&quot; Ahmed: &quot;I've never been there but I've heard about it... someone told me there are a lot of traps and mummmies guarding it though...&quot;</td>
<td>Effects - burning torch, footsteps Mouse click: If 'Go' then go to 1.2 If 'Quit' then go to 0.1 (global)</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Player and Ahmed peering down passageway nervously. Hieroglyphics in background. They come to two panels in the wall representing different paths.</td>
<td>Mouse click:</td>
<td>Effects - burning torch, footsteps Mouse click: On either door, go to 1.3</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Darkness around player and Ahmed. They look around.</td>
<td>Ahmed: &quot;I don't like the sound of that...&quot;</td>
<td>Effects - burning torch, scratching noise, distant thud. Randomly generated option: If var 'challenge' = mummy, go to 1.3.1</td>
<td></td>
</tr>
</tbody>
</table>

choice for communicating the design at a detailed level. A sample is shown in Table 3.

The logic of the game was primarily articulated through pseudocode within the interactions and authoring column of the storyboards. While it could be argued that there is some detail still missing within these (for example distinction between graphical and textual information within the visual column) their role as a primary production document is evident. This is particularly true when considering the other linked supporting documentation that could be used to clarify them. In this case they took the forms of a guide that identified global characteristics and documentation style (such as the convention of spoken audio being represented between quotes) as well as discrete forms of content such as question and vocabulary banks.

One of the advantages of the prototype as an instantiation of the design is its immediacy (Figure 4). It provided a direct and accessible proof of concept that, when presented to the class prior to submission, allow students to respond to without their reading of the design being heavily guided by the team itself. It was interesting to note that the quality of feedback from students as they
reviewed each other’s designs was significantly higher for the team that selected to develop a prototype. While this may be something of an ideal – not every student group in this course would have members with such development skills – it reinforces the potential of a prototype, not just as an evolutionary model of the final product, but as a communication tool throughout development.

FINDINGS AND RECOMMENDATIONS FOLLOWING THE INITIAL IMPLEMENTATION

Following submission of their designs for assessment, students were asked to participate in a review of the model with a view to improving it. Data was gathered from an online five point Likert scale survey. Students were required to state the extent of their agreement to ten statements about the model as well as respond to four open ended questions that interrogated students’ opinions about the strengths and weaknesses of the model as well as specific elements that were problematic and how the model could be improved. While the cohort of 10 students was not enough to provide statistical validity, this method provided an extra form of data to complement the analysis of the quality of student submissions themselves, discussions about the model in class and peer presentations of design. Further data was sourced in the form of an informal focus group from a group of students who used the model; not in this serious games unit, but as part of a multimedia project which took the form of a serious game.

The survey indicated a positive perception of the model by the students, with no item returning an average less than 3.5 when result scores were averaged, from 1 being Strongly Disagree to 5 being Strongly Agree. In particular, the survey yielded 100% agreement that the model was clearly explained and performed a useful framework for their game design project. It was also felt that each stage was logically sequenced, that the notion of broad to detailed design within the stages was useful and that it provided an effective framework for novice users. The most neutral responses were to the specific questions about whether the model helped the students apply learning, gameplay and visual design principles. It appeared that the difficulty in grasping some of the concepts themselves impacted on the ease of implementation within the model. Learning design, for example, was new to all of the students, and careful scaffolding was required to help students see the connectedness for example between problem-based learning and simulation games.

The strengths of the model as demonstrated by verbal discussion, responses to the open-ended survey questions and the quality of the submitted designs, were in the disaggregation of the design process into clearly structured stages and elements. Students valued it to provide way
The DODDEL Model

points and milestones within the process as well as to allocate responsibilities and the links to the concepts that were covered within the course.

This structure was also one of the main weaknesses in that it felt overly regimented to some participants. Some students did feel that the elements within each stage overlapped and had difficulty in managing this. A number of students felt that they did not know which order to present discussion about elements within each stage when developing their design. While the connectedness between the elements of each stage was a deliberate feature of the model it could be possible to promote an order where this makes sense. For example, a statement of aims and outcomes may occur logically in some instances before a discussion of situational factors and potential approaches to learning.

Specific parts of the model that students had most difficulty were the Situation Analysis and Design Proposal, which were perceived by some students to be quite similar. One weakness observed in most submissions was a tendency to deal with the situation analysis as a description of the game rather than a study of the characteristics of the environment and aims that would impact on the game. In one case students’ description of the target users were framed within their tendency to play certain types of games rather than a depiction of learner characteristics such as numeracy and literacy levels, inherent level of motivation and so on. It was understandable therefore that there was some duplication between that and the game approach. Another area that tended to cause confusion was the distinction between game treatment and gameplay. While this distinction seems quite a natural one to the author, it did cause some confusion for a few students. Those that provided a set of module descriptors seemed better able to identify the connections and distinctions between them as they could be integrated into a single document.

A final concern that was raised was with how the design model was implemented as a teaching tool. Two students found that there was too much to take in during one semester, and one commented that the model was too complex. Only one student provided a specific comment about how the model could be improved and that was to combine the situation analysis and design proposal or to make them more distinct.

Overall it appeared that the DODDEL model provided an effective framework to help students design games with an educational focus. Most of the issues raised with the model could be addressed with a revised approach to its implementation. One of the reasons why most situation analyses were rather descriptive related to the fact that students could invent their own projects and frame them within an arbitrary choice of target group, nominal budget and available technology. A positive outcome of this was a diversity of designs. For example SpellStory took the form of a Flash-based adventure game for primary school children. Another team chose to design a complex ethical game within a military 3D game engine for adults. While both of these designs were legitimate, they were artificial projects. It also meant that contextual factors were quite arbitrary, though it did allow learners to develop their own aims and outcomes rather than work with a received list. Providing a more authentic project and having students conduct a situation analysis as a separate activity at an earlier stage of the project should remove some of the confusion between the Situation Analysis and Design Proposal.

To overcome the complexity of the model, a more succinct summary will be provided with the unit plan in future to complement a more detailed reading. This implementation also had students introduced to the model mid-way through semester. In future it will be introduced at an earlier stage and this will form the basis of the unit structure.

While the model has been developed in line with the literature and is valid in terms of its capacity to provide structure for novices to design
a range of educational games, there is still a great deal of research that may be conducted to enhance it. The model was positively received when presented as a concept at a recent game industry forum. Nevertheless, it lacks expert validity from the industry itself. This can be achieved by having students use the model as they progress through their course into a Games Project unit that has them work with real clients to develop working prototypes. Engaging the clients in the evaluation process should provide a rich dataset from which to further develop it. The growing nature of the course should also provide a greater sample size when conducting future evaluations.

The DODDEL model has been designed to provide flexibility. As technologies and theories of learning develop as well as new markets and audiences for serious games, there will be opportunities to enhance and modify the model. This is particularly true of the developmental stages which currently only exist in their broadest terms. The emergence of a range of rapid application development environments, from 2D game and web-based development tools to increasingly accessible 3D game engines, is undoubtedly going to have further impact on the game development industry and there is great potential for this to be reflected in the model.

CONCLUSION

The DODDEL model has been developed as a heuristic for novice designers to produce documentation that supports the development of innovation and creative games while enabling communication between key stakeholders and leading to the development of quality production documentation. While the actual forms of documentation may vary between organizations, it is believed that the methodology itself is flexible enough to accommodate a range of learning approaches and game types.

The key to the success of the model is in ensuring that the phases create a clear articulation of detail and complexity from rough ideas to final documentation while maintaining an iterative approach to design within each phase of the process. The focus on end user experience, game treatment and learning outcomes should contribute to a cohesive design, where each aspect is informed by the other, leading to a product that is fun, empowering, and leads to durable learning outcomes.

REFERENCES


The DODDEL Model


http://carbon.cudenver.edu/~mryder/ite_data/id-models.html.

