Personalised Learning for Casual Games: The 'Language Trap' Online Language Learning Game

Neil Peirce and Vincent Wade
Trinity College Dublin, Ireland
peircen@cs.tcd.ie
Vincent.Wade@cs.tcd.ie

Abstract:
The features of video games that contribute to effective learning are drawing increasing attention in the world of technology enhanced learning. To date, game based learning has focussed on the learning benefits provided by the inherent motivation, rich visualizations, and low risk of failure, provided by contemporary educational games. Although these advantages create highly engaging and immersive learning environments, there remain additional techniques that can further aid the learning process. The integration of personalisation into educational games presents unique challenges, the most important being the preservation of the gaming experience. In consideration that a well designed educational game can seamlessly blend learning and gaming content, any adaptation of the learning content will ultimately affect the gaming experience. In effect all educational adaptations must be achieved in a manner that is non-invasive to the game play. In this paper we introduce the 'Language Trap' German language learning game that provides learners with an online casual gaming environment that also benefits from a personalised learning experience. We demonstrate how a game playable online in a browser, using simple controls, and with low production costs, can effectively deliver this personalised learning experience. Through using the ALIGN (Adaptive Learning In Games through Non-invasion) system the game delivers adaptive dialogue difficulty, performance feedback, motivational support, and meta-cognitive hints, all within a highly interactive adventure role-playing game. The results of an authentic evaluation of the Language Trap game are presented, additionally we demonstrate how the ALIGN system can effectively adapt the learning experience within the game in manner that is non-invasive to the game play. A discussion on the benefits of adaptive educational games is presented, with particular reference to the benefits provided by the ALIGN system.

Keywords: Adaptive learning, personalisation, casual game, user modelling

1. Introduction

The intensely engaging and immersive experiences provided by video games have long been pursued by instructional designers as a means to motivate students. Through a combination of ludic activities, interesting narratives, and rich visual worlds, video games present an environment that is inherently motivating and an experience that is rewarding to pursue. The effective integration of instructional design and video games has been an active research topic since the 1980s, however efforts were stifled by early attempts that created uninteresting games and ineffective learning outcomes. Such games often termed "Shavian reversals" (Papert 1998) and branded as 'edutainment' were often the result of 'applying' gaming to existing educational content and resulted in experiences that lacked any synergies between the gameplay and the learning content (Kirriemuir & McFarlane n.d.; Papert 1998). Despite such a hindered start, educational games gained recognition and acceptance through the emergence of serious games. The work of James Paul Gee, Clark Aldrich, and Marc Prensky amongst others has helped to identify the affordances of educational games and the approaches to maximise their benefit. The most significant considerations are the tight integration of learning and gaming content, the suitability of the game genre to the content, and the preservation of a *flow* experience (Csikszentmihalyi 1990).

As play itself is one of the most fundamental forms of learning (Huizinga 1949), it is not surprising that games present an inherent learning experience. However, the learning within entertainment video games often surrounds understanding the mechanics of the game, and its rules. These forms of learning, comprehension, practice, experimentation, and discovery are all keenly focussed on learning about the game itself. In order for educational games to be effective they must seamlessly integrate learning content to present a game that blurs the boundary between where the game stops and the learning content begins.

As well as the requirement for tight integration, the need to match learning content with an appropriate game genre has been identified by several authors(Amory et al. 1999; Prensky 2001; Frazer et al.

2008). Although well integrated content within an appropriate game genre is a progression beyond earlier edutainment games, the significance of maintaining a flow experience cannot be overlooked. Whereas games can present many of the constituents of a flow experience such as clear goals, immediate feedback, task feasibility, and self-governance, the most important factor, that of balanced skills and challenges, is determined not only by the difficulty of the game but also by the player's abilities.

In considering the flow experience, the significance of the learner in educational game design becomes apparent. Whereas games can be designed to accommodate for static learner attributes such as genre preferences, game platform, gender, and gaming context, they seldom cater well for dynamic attributes. Typically dynamic learner attributes such as knowledge, skills, motivation, and meta-cognitive skills, are catered for by assuming static levels for these attributes, i.e. a single difficulty level. Whereas entertainment games utilise Dynamic Difficulty Adjustment (DDA) and Non-Playing Character (NPC) behaviour (Charles 2003; Van Eck 2007) it would seem that personalised learning within educational games is a natural progression. In consideration of the success of personalised learning within the fields of Adaptive Hypermedia (AH) (Brusilovsky 2001) and Intelligent Tutoring Systems (ITSs) (Wenger 1987), personalised educational games present the opportunity to cater for dynamic learner attributes in a personalised manner and within an inherently motivating learning environment.

In this paper we address the issue of integrating personalised learning into educational games. The key benefits of this allow for reduced development costs, the separation of game and adaptation logic, and the possibility for increased instances of adaptive games. Whereas the practicality of separating game logic and adaptation logic was demonstrated in (Peirce et al. 2008) the need to assess the generality of the approach and the educational benefits of the personalisation remain. In this paper we introduce the 'Language Trap' game as a second case study using the ALIGN system. Through a comparative evaluation of the game with both basic and advanced personalisation, the benefits of the ALIGN system as an approach to personalised educational games in demonstrated.

1.1 The Changing Game Market

In the past five years there has been a major change underway in the commercial video game market. This has been characterised by the shift of the mainstream games market away from so called hardcore games towards casual games. As a market, hardcore games are typified by their steep learning curve, cutting edge graphics, high production costs, and long gameplay durations. They are readily identifiable by their high quality and associated high technical requirements and are most commonly associated with first person shooter game series' such as *Unreal Tournament*, *Far Cry*, *BioShock*, and *Call of Duty*. In contrast, casual games have simple controls, more varied game genres, lower production costs, and are playable on a multitude of devices and regularly online. Some of the more popular casual games available include *Wii Sports*, *World of Goo*, *FarmVille*, and *Mafia Wars*.

The emergence of the casual games market has broadened the demographic appeal of video games away from traditional male dominated demographics (Dickey 2006), towards a more equal gender balance and a greater age range. In consideration of this broader appeal, it would seem a natural choice to progress educational games into this domain whereby a greater captive audience can be engaged. As well as having reduced development costs, simple controls, and varied genres, the educational benefits of casual or mini-games has been supported by such authors as (Frazer et al. 2007; Prensky 2008).

2. Adaptive Educational Games

The integration of personalisation into educational games presents challenges beyond those faced in ITS or AH systems. The most significant challenge being that the objectives of instructional design and engaging gameplay can conflict. This evidently requires compromises in either gameplay or

learning personalisation. Although prioritising the learning personalisation is desirable in an educational game, it can in fact result in a worse learning experience. This may seem counterintuitive, however, when you consider that adaptations to a game can create inconsistent game characters, excessive feedback, a confusing game world, and distraction from the gameplay, one risks creating a game that is no longer fun to play, and so fails a key requirement of any educational game.

To allow for personalisation within a game it must be achieved in a manner that is considerate of, and non-invasive to the gameplay. As it has been identified by a number of authors that a educational game must be a game first and learning tool second (Van Eck 2007; Prensky 2001), similarly an adaptive game must be a game first and a personalised learning experience second.

Despite the potential benefits of adaptive educational games, the instances of adaptive educational games are scarce. One possible cause for this scarcity is the complexity of integrating personalised learning into a gaming environment. Whereas games such as the DARPA funded Tactical Language & Cultural Training System (TLCTS) have shown that through the use of multi-model adaptation, effective educational outcomes can be achieved (Johnson et al. 2007), the considerable development cost involved can limit similar approaches. One alternative approach to addressing this problem can be found in the <e-adventure> framework (Moreno-Ger et al. 2007) that simplifies the development of adaptive educational games and allows for their integration into Learning Management Systems (LMS).

The use of a storyline is often used within educational games and is known to be a motivating factor (Salen & Zimmerman 2003). In consideration of this, the potential benefits of adapting the storyline for immersive and educational benefit have been considered in both the Façade game (Mateas & Stern 2005) and in Virtual Team Collaborator (VTC) (Spring & Ito 2007). Although this approach presents the potential to improve immersion it further adds to the complexity of integrating adaptive educational content within an educational game. Despite the commonality of narrative based games, a storyline is not a prerequisite of an educational game. In the case of the puzzle based Prime Climb game (Conati 2002) a pedagogical agent is effectively employed to provide adaptive feedback and support.

One of the many hurdles in creating adaptive educational games is the development cost involved in authoring both the educational game and the adaptation system within the game. An approach to alleviate this is to retro fit existing educational games with personalisation features. Such an approach was successfully taken with the Ecotoons and Ecotoons 2 games (Carro et al. 2002).

Although the research area of adaptive educational games is still emerging there are already significant strides being taken in the variety, complexity, and reusability of adaptation provided. With EU projects such as ELEKTRA (see section 2.2) and 80Days (80Days-Project n.d.) there is evidently a growing interest in adaptive educational games. In consideration of the growing popularity of casual games, there is considerable interest in how education and personalisation can be applied to reach the broadest spectrum of game based learners.

2.1 The ALIGN System

The design of personalised education within an educational game requires consideration of how any adaptation will affect the game. As it is vital to prioritise the gaming experience over the adaptation, considerable effort must be taken in ensuring that all adaptations are non-invasive to the gameplay. Whereas typically an adaptive educational game will tightly couple personalisation and game design, this approach limits the reuse and flexibility of the adaptation. The ALIGN (Adaptive Learning In Games through Non-invasion) system (Peirce et al. 2008) addresses this problem by decoupling the educational game from the learning personalisation, enable the reuse and independent authoring of both components.

Through a four stage process of 1) Inference, 2) Context accumulation, 3) Adaptation constraint, and 4) Adaptation selection, the ALIGN system ensures only pertinent, appropriate, and non-invasive

adaptations occur within the game. Through a flexible rule-based inference approach the ALIGN system can abstract away game specifics allowing it to operate over varying learning content and game styles. In its first case study the ALIGN system effectively adapted the learning experience for the ELEKTRA game as detailed in the following section. For a further discussion on the ALIGN system and its architecture see (Peirce et al. 2008).

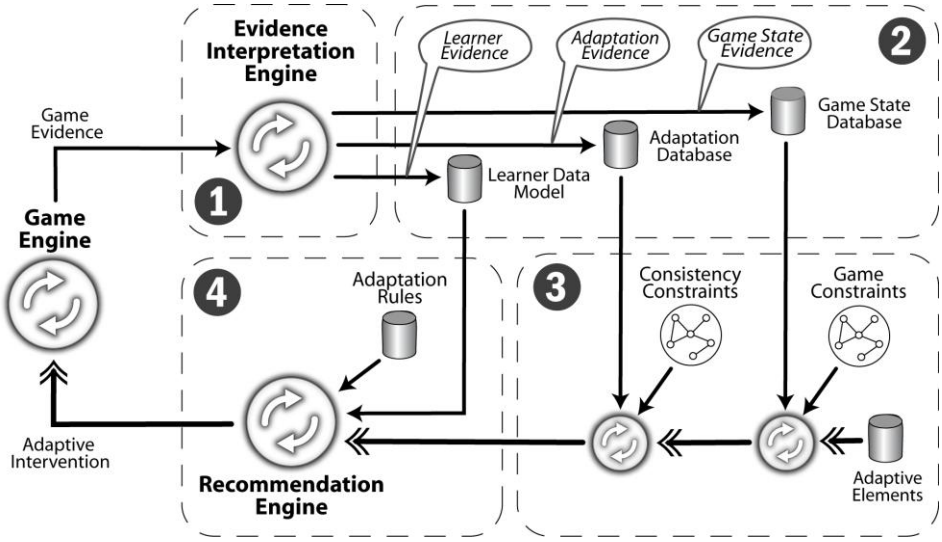

Figure 1. The ALIGN system architecture

2.2 ELEKTRA

The ELEKTRA project (ELEKTRA Project n.d.) aimed to revolutionise technology-enhanced learning through merging expertise in cognitive science, pedagogical theory, computer science and neuroscience with the innovations of computer gaming, design and development. As a demonstrator of the methodology created as part the ELEKTRA project, the ELEKTRA game is an engaging 3D educational adventure game targeting the physics of optics as studied by 13-15 year old students under the French state curriculum. The rich visual style of the game; including the complex 3D graphics, animated characters, and speech actors firmly establish it as more hard-core game.

Figure 2. The ELEKTRA game showing the Galileo Galilei NPC

Through the use of experiment based gameplay and a pedagogical agent in the form of Galileo Galilei, students were engaged in a motivating storyline. Throughout the ELEKTRA game the ALIGN system continuously modelled the learner to provide motivational, guiding support and meta-cognitive feedback. Employing such user modelling techniques as Competence based Knowledge Space

Theory (CbKST) (Conlan et al. 2009) the ALIGN system effectively personalised the learning experience to suit each individual learner.

3. The Language Trap Game

In order to demonstrate the generality of the ALIGN architecture across multiple games genres and varying learning content the Language Trap game was developed as a second case study targeting a different game genre and different learning content. The game was developed as an online casual educational game for Irish secondary school students of German who are preparing for their Leaving Certificate exams (taken in the final year of secondary school). The game focuses on the prescribed role-play scenarios that form part of the oral examinations. Using an interactive dialogue system featuring synthesised speech the students play through the role-playing adventure game and encounter conversations, vocabulary and grammar that are relevant to their examinations.

Figure 3. The Language Trap game showing the player (centre) and two NPCs

3.1 Learning Content

The learning content within the Language Trap game covers two of the prescribed role-plays that students will encounter in their final exams. These role-plays involve an examiner and a student engaging in a verbal conversation around particular scenarios. This aspect of the curriculum was selected as it is an area that is difficult to learn from a text book or classroom lesson (due to its interactive nature), and is difficult to rehearse on a one-to-one basis due to time constraints and class sizes. Additionally the learning content covered lends itself to game based learning as its role-play nature allows it to be integrated into a storyline.

As the prescribed role-plays are only given as guidelines an experienced secondary school teacher aided in elaborating and creating the variety of dialogues used in the game.

The core-mechanic of the Language Trap game is the conversations that take place between the learner and various NPCs in the game. Each conversation involves the learner choosing from a list of possible dialogues that range in difficulty and appropriateness. The more difficult dialogues are identifiable implicitly by their more complex grammar and vocabulary and explicitly by their associated star rating (see figure 4), the higher the star rating the greater difficulty. The appropriateness of the dialogues presented depends on the ongoing conversation. Appropriate dialogues are those which naturally continue the conversation or give a reasonable answer to an asked question.

As a reward mechanism within the game the learner collects the stars for each appropriate dialogue they choose. These stars can subsequently be exchanged for translations of difficult Although the learner looses a star when requesting a translation, the practice is encouraged as they will lose a greater number of stars for choosing inappropriate sentences. This game mechanism aims to encourage prudence among learners to translate words as opposed to taking risks with inappropriate sentences they don't fully understand. Within the game any word that is underlined can be translated by clicking on it (see figure 4).

3.2 Game design

The choice of the isometric game style used for the 'Language Trap' game allowed for the development of the game without the large overheads typically associated with 3D games. Further to this it enabled a simplified control system whereby the player needs only to use a mouse to navigate and interact with the game world, a feature common among casual games.

Figure 4. A conversation within the game, showing multiple choice options on the left and a history of the conversation on the right. In this case an inappropriate sentence has caused the NPC to show a confused emotion.

The game storyline was developed around influences from 1) the learning content, 2) best practices in educational games, 3) the game style, and 4) the feedback received from students during a participatory design session (Schuler & Namioka 1993). The respective requirements derived for the storyline were:

- The natural integration of the role-play scenarios in a meaningful manner
- The use of pedagogical agents and feedback mechanisms that are natural within the game world.
- Motivating factors to encourage exploration and interaction with game characters.
- A mature storyline incorporating mystery, exploration, and tension.

As a result of these requirements the final storyline places the learner in the role of a newly qualified secret agent on their first undercover mission. The learner is accompanied by a companion agent

(aka ‘Agent White Jacket’) who will help and guide the learner. A mysterious character sets the learner the task of identifying and gaining the trust of a double agent, whilst being careful not to blow their secret cover. The first scene takes place in a hotel where several German speaking guests, including the double agent, are staying.

3.3 Personalisation

The personalisation of the learning experience within the Language Trap game is provided by the ALIGN system (Peirce et al. 2008). Within the Language Trap game the ALIGN system provides four forms of personalisation, in particular the system provides adaptive dialogue difficulty, performance feedback, motivational support, and meta-cognitive hints.

3.3.1 Adaptive Dialogue Difficulty

Within the Language Trap game the difficulty of the game is adjusted by varying the difficulty of the multiple choice dialogues presented. For each conversation within the game a variety of dialogues were developed of varying difficulty. At run time the ALIGN system chooses three of the possible dialogues (up to eight can be available) to present to the learner. The chosen difficulty is based on the learner’s previous performance including the appropriateness of the dialogues, the difficulty of dialogues chosen, and the context of the chosen dialogue i.e. were easier or harder options available. Importantly all of the dialogues chosen progress the story at the same pace and to the same ultimate ending.

Figure 5. An example of varying dialogue difficulty for a weaker learner (left) and a stronger learner (right).

The above choices (figure 5) were presented in response to the question: “Wird Irisch noch gesprochen?” (“Is Irish still spoken?”). Translations for the left hand side: “Yes! And the street signs are in Irish”; ”Yes”; ”No”. Translations for the right hand side: “Yes! And one can see Irish street signs”; “Yes! And the street signs are in Irish”; “Yes! Everyone speaks Irish”.

3.3.2 Adaptive Performance Feedback

An important aspect of any learning experience is the provision for timely and relevant feedback. In the Language Trap game personalised feedback is delivered through the companion NPC. In this way the companion NPC acts both as a character in the game’s story, and also as a pedagogical agent. Following conversations in German the companion character provides feedback to the learner on their performance to date. This feedback is based around the history of the learner’s performance and is also relevant to the most recent conversation completed. Importantly this feedback is appropriate as part of the game storyline i.e. your companion is guiding you, but is also an important pedagogical mechanism to inform the learner of their progress and how they can improve.

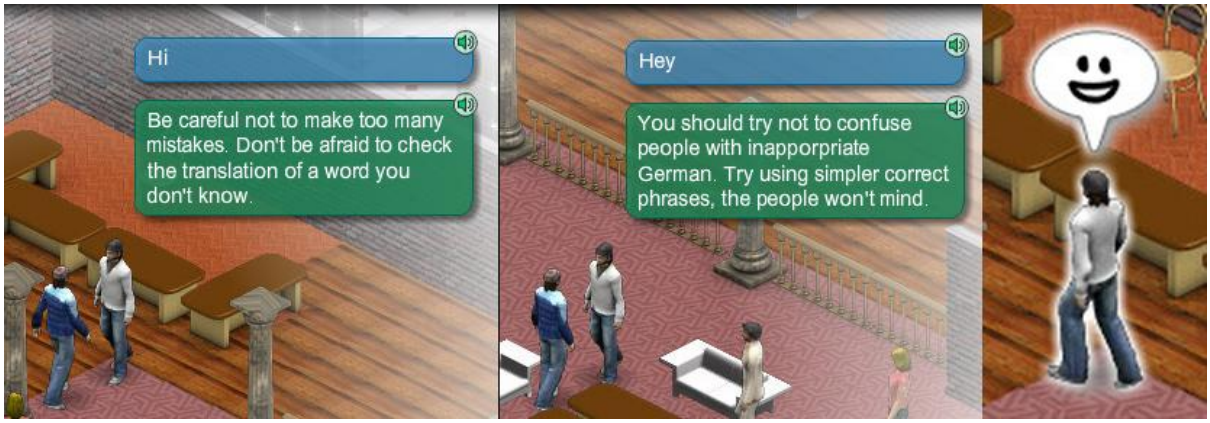

Figure 6. An example of two personalised performance feedbacks from the companion character (left, centre), and an example of positive performance feedback delivered through visual emotions (right).

3.3.3 Adaptive Motivational Support

In the game, adaptive motivational support is delivered when particular performance patterns are observed such as when the learner experiences a sequence of several inappropriate dialogues. This feedback is delivered in the same manner as for performance feedback through conversations with the companion character.

3.3.4 Adaptive Meta-cognitive Feedback

One of the many benefits of using video games as a learning medium is that all actions and events within the game world can be observed. The analysis of this information and the subsequent user modelling can be used in adapting the learning experience in many educationally beneficial ways. Whereas adaptive performance feedback can help a learner understand their own abilities, adaptive meta-cognitive feedback can help a learner understand how they approach challenges and what they can do to better their approach. In the context of the Language Trap game the user model maintained by the ALIGN system contains a record of every dialogue chosen and the context in which it was chosen. Through analysing these records over time it is possible to identify trends in the approaches a learner takes to answering dialogues. The following figure illustrates a number of hints delivered as thoughts from the learner's character that aim to encourage meta-cognitive reflection.

Figure 7. Examples of meta-cognitive hints for learners who are overly cautious(left), take excessive risks(centre), and are prudent and successful (right).

3.4 Technical details

The Language Trap game is implemented as a client-server architecture using a thin game client written in Adobe Flash and Flex, and a Java Servlet based game logic engine. In order to make the game light-weight and quick to load, all of the game logic is performed on the server side using a JBoss Drools rule engine running in a Java Servlet. The speech synthesis used in the game is generated by the open source MARY Text-to-speech system (Schröder & Trouvain 2003) using several MBROLA voices (Dutoit et al. 1996).

4. Evaluation of the Game

The evaluation of the Language Trap game took place between October 2009 and May 2010, and took the form of user trials based in five schools in and around Dublin city. In total 83 students played through the game and answered both pre and post questionnaires. Both questionnaires included a German proficiency test, marked out of 20 points, based around the content covered by the game. The participating students had an average age of 16.3 years (sd: 0.83 years), and a gender breakdown of 38 males (46%), 42 females (52%), and 2 participants (2%) who provided no answer. During each user trial the students were randomly allocated to a basic adaptation or an advanced adaptation group. The basic adaptation group played through a game with naïve and simple adaptation. The advanced adaptation group played through a game that featured a more sophisticated inference and assessment method for providing the adaptations. Both versions of the game featured the same story line and learning content. The students were not informed of the different adaptive groups until after the trials concluded. Unless otherwise indicated the following results relate to a students' opinions of statements on a seven step Likert scale ranging from 1 being not true at all, to 7 being entirely true.

4.1 Results

Overall there was a very positive response to the Language Trap game. The students found the game to be useful for learning German (mean: 5.5, sd:1.13) and was recommendable to a friend learning German (mean: 5.46, sd: 1.55). Additionally the students found the synthesised speech to be useful for learning German (5.42, sd: 1.58), and they didn't recognise how time went by whilst playing (5.14, sd:1.95). The design of the game as a casual game was reflected in how the students perceived the game to be easy to control (5.95, sd:1.4) and to have intuitive controls (5.05, sd:1.59).

In terms of the educational impact of the game it was found that the mean score from the pre-test 7.22 (sd. 3.99) increased to 8.87 (sd. 4.84) in the post-test. Using a paired t-test this effect was shown to be significant with $t(82)=-4.326$, $p < 0.0001$. Although the advanced adaptation group showed greater average improvement (1.91) over the basic group (1.35), this result was not statistically significant. It was shown that females performed better on the post test 10.26 (sd. 5.64) than the males 7.37 (sd. 3.34) and this result was significant $t(70)=-2.84$, $p = 0.006$. This was of interest considering that females played significantly less computer games than the males $t(74)=4.158$, $p < 0.0001$, with the females on average playing less than once a week and males playing at least once a week.

The results relating to the effectiveness of the adaptation showed that learners in the advanced adaptation group felt the dialogues presented were of a more suitable difficulty 5.29 (sd. 1.69) compared with the basic adaptation group 4.49 (sd. 1.66). This result was shown to be statistically significant $t(81) = 2.17$, $p = 0.03$. The advanced adaptation also was observed to have a positive impact on students not recognizing the time go by but this effect proved not to be significant.

In terms of the invasiveness of the adaptations provided there was no significant difference observed between the adaptation groups in terms of intelligent companion interaction, advanced: 4.79 (sd. 1.51), basic: 4.73 (sd. 1.47); the appropriateness of the companion's advice, advanced: 4.26 (sd.1.84), basic: 4.29 (sd. 1.72); and the consistency of the characters in general, advanced: 5.29 (sd.

1.44), basic: 5.24 (sd. 1.39). This is a positive outcome as it shows that improved adaptation does not negatively impact the gaming experience.

The impact of the advanced adaptation on the students confidence with the learning content was assessed using confidence scales on both the pre and post test. The advanced adaptation group showed improved confidence on five of the seven question groups. However, as these questions were only included for the last 33 students the results proved not to be statistically significant.

5. Conclusions/Discussion

In this paper we have presented the Language Trap video game as a casual online language learning game. The game was shown to be both enjoyable for the students to play through as well as having a significant educational benefit. As a second case study for the ALIGN system we have demonstrated how the flexible ALIGN architecture can effectively provide adaptation across a variety of game genres and learning content. Further to this, we have shown how the ALIGN system can allow for incremental improvements in the adaptation provided whilst mitigating any negative impact on the gaming experience. Importantly these improvements were achieved without the need to modify the game and without negatively impacting the gaming experience.

The ALIGN system and the Language Trap game present a unique experimental platform on which adaptation strategies can be evaluated. It his hoped this approach will progress research in adaptive educational games whilst minimizing the need for costly game development.

In consideration of the changing video game market towards casual games, the Language Trap game clearly demonstrates that the casual nature of the game does not impact it's affordances for presenting a personalised learning experience. In fact, the light weight nature of the game and its independence from the adaptation logic make it a viable approach for future research into adaptive educational games.

5.1 Acknowledgement

This research is supported by the Science Foundation Ireland (Grant 07/CE/I1142) as part of the Centre for Next Generation Localisation (www.cngl.ie) at Trinity College Dublin.

6. References

80Days-Project, 80Days - around an inspiring virtual learning world in eighty days. Available at: http://www.eightydays.eu/.

Amory, A. et al., 1999. The use of computer games as an educational tool: identification of appropriate game types and game elements. *British Journal of Educational Technology*,30(4),311-321.

Brusilovsky, P., 2001. Adaptive Hypermedia. *User Modeling and User-Adapted Interaction*,11(1),87-110.

Carro, R. et al., 2002. A methodology for developing adaptive educational-game environments. In *Adaptive Hypermedia and Adaptive Web-Based Systems*. Springer, p. 90–99.

Charles, D., 2003. Enhancing Gameplay: Challenges for Artificial Intelligence in Digital Games. In *Proceedings of Digital Games Research Conference 2003*. University of Utrecht, The Netherlands.

Conati, C., 2002. Probabilistic Assessment of User's Emotions in Educational Games. *Applied Artificial Intelligence*,16(7),555-575.

Conlan, O. et al., 2009. Realtime Knowledge Space Skill Assessment for Personalized Digital Educational Games. In *2009 Ninth IEEE International Conference on Advanced Learning Technologies*. Riga, Latvia:IEEE, p. 538–542.

Csikszentmihalyi, M., 1990. *Flow: The psychology of optimal experience.*, New York: Harper and Row.

Dickey, M.D., 2006. Girl gamers: the controversy of girl games and the relevance of female-oriented game design for instructional design. *British Journal of Educational Technology*,37(5),785-793.

Dutoit, T. et al., 1996. The MBROLA project: towards a set of high quality speech synthesizers free of use for non commercial purposes. In *Proceeding of Fourth International Conference on Spoken Language Processing. ICSLP '96*. IEEE, pp. 1393-1396.

ELEKTRA Project, ELEKTRA - Enhanced Learning Experience and Knowledge TRAnsfer (Accessed: 19th May 2010). Available at: http://www.elektra-project.org.

Frazer, A., Argles, D. & Wills, G., 2007. Is Less Actually More? The Usefulness Of Educational Mini-games. In *The 7th IEEE International Conference on Advanced Learning Technologies*. Niigata, Japan.

Frazer, A., Argles, D. & Wills, G., 2008. The Same, But Different: The Educational Affordances of Different Gaming Genres. In *Advanced Learning Technologies, 2008. ICALT '08. Eighth IEEE International Conference on*. pp. 891-893.

Huizinga, J., 1949. *Homo Ludens*, London, Boston and Henley:Routledge & Kegan Paul.

Johnson, W.L., Wang, N. & Wu, S., 2007. Experience with serious games for learning foreign languages and cultures. In *Proceedings of the SimTecT Conference*.

Kirriemuir, J. & McFarlane, A., Literature Review in Games and learning - Futurelab. Available at: http://www.futurelab.org.uk/resources/publications_reports_articles/literature_reviews/Literature_Review378/.

Mateas, M. & Stern, A., 2005. Build It to Understand It: Ludology Meets Narratology in Game Design Space. In *DiGRA Conference, Vancouver, BC*.

Moreno-Ger, P. et al., 2007. A Game-Based Adaptive Unit of Learning with IMS Learning Design and . In Lecture Notes in Computer Science 4753, 247–261 (Springer).

Papert, S., 1998. Does Easy Do It? Children, Games, and Learning. *Game Developer*,5(6).

Peirce, N., Conlan, O. & Wade, V., 2008. Adaptive Educational Games: Providing Non-invasive Personalised Learning Experiences. In *Digital Games and Intelligent Toys Based Education, 2008 Second IEEE International Conference on*. pp. 28-35.

Prensky, M., 2001. *Digital Game-Based Learning*, Paragon House, St. Paul, Minnesota, USA.

Prensky, M., 2008. Students as Designers and Creators of Educational Computer Games: Who Else? *British Journal of Educational Technology*,39(6),1004-1019.

Salen, K. & Zimmerman, E., 2003. *Rules of play: game design fundamentals*, MIT Press.

Schröder, M. & Trouvain, J., 2003. The German Text-to-Speech Synthesis System MARY: A Tool for Research, Development and Teaching. *International Journal of Speech Technology*,6(4),365-377.

Schuler, D. & Namioka, A., 1993. *Participatory design: principles and practices*, Routledge.

Spring, F. & Ito, T., 2007. Combining personalisation and adaptation in game-based learning systems. In *IASTED International Conference on Web-Based Education*. ACTA Press, pp. 159-163.

Van Eck, R., 2007. Building Artificially Intelligent Learning Games. In D. Gibson,C. Aldrich, & M. Prensky *Games and simulations in online learning: research and development frameworks*. Information Science Pub., pp. 271-307.

Wenger, E., 1987. *Artificial intelligence and tutoring systems: computational and cognitive approaches to the communication of knowledge*, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA.