Fizzees

(Physical Electronic Energisers)

A context paper

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FOREWORD

> "But I am absolutely clear that the scandal of junk food served every day in school canteens must end. So today I can announce that I will ban low quality reprocessed bangers and burgers high in fat, salt and sugar being served in schools, from next September. And because children need healthy options throughout the school day, I can also announce that from next September no school will be able to have vending machines selling crisps, chocolate and sugary fizzy drinks." Ruth Kelly, Labour Party Conference (2005)
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> "A healthy school promotes physical and emotional health by providing accessible and relevant information and equipping pupils with the skills and attitudes to make informed decisions about their health. It understands the importance of investing in health to assist in raising levels of pupil achievement and improving standards. It also recognises the need to provide both a physical and social environment that is conducive to learning." Healthy Schools: Every Child Matters www.everychildmatters.gov.uk/health/healthyschools
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> "We believe that good health and effective learning go hand in hand, and habits started young are more likely to continue throughout adult life." Charles Clarke, 'Healthy Living Blueprint for Schools' (2004)
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> "Child obesity has doubled in a decade. Junk food and lack of exercise have created 'public health timebomb'." The Guardian Newspaper (22 April 2006)

As the above statements highlight, there is a clear need to consider new ways of educating young people about the importance of healthy eating and exercise, and more generally to encourage the development of behaviours that promote a healthier lifestyle throughout the life-span.

The aim of this project is to develop a prototype that encourages young people to undertake a greater amount of physical activity and to develop an understanding of what constitutes a healthy lifestyle. The prototype accurately measures the player's exercise levels (specifically a measurement of heart-rate linked to movement that is compared to previous activity scores) which is then represented visually in the form of an animated character 'living' on a wristwatch-type device – a Fizzee. The Fizzee's maturation and appearance changes are dependent upon the activity levels of the user: the young person cares for and nurtures their digital pet by caring for and nurturing themselves. A website is also provided as an opportunity for children to compare their Fizzees with those of others and to enable further interrogation of their own health data. As young people play at caring for the Fizzee, they are encouraged to become an active part of the game world, controlling, caring for and nurturing their own Fizzee.

The prototype is a combination of a chest-worn heart-rate sensor and a bespoke wearable technology worn on the wrist. The (wrist) wearable technology combines a screen (displaying the constantly updated Fizzee), a processor (which uses the heart-rate data within the scoring system to provide appropriate feedback), a battery (allowing up to 12 hours' continuous use) and a port for syncing to a computer and recharging the device. An accelerometer is worn to measure movement and to provide further health/activity data.

The scoring system has been developed to reward long-term, real-world health benefits with short-term benefits to the Fizzee, based upon research into physical activity and medical health. The scoring system is founded on current expert knowledge about recommended amounts of exercise for young people in the target groups.

1. DISCUSSION OF SUBJECT AREA IN RELATION TO THE CURRENT CURRICULUM

1.1 Introduction

This project has strong links with physical education (PE), personal, social and health education (PSHE), science, and links to non-curriculum areas such as the Healthy Schools and Walk to School initiatives. There are of course wider implications for learning as research suggests young people's health impacts upon their ability to act and to learn (Hickey 2003).

The National Curriculum for PE (at Key Stages 2 and 3) is currently subject to an ever-increasing debate about whether the requirement of two hours of quality PE lessons per week per child is a) being fulfilled and b) enough exercise for young people. Some lobbying groups are calling for a doubling of this requirement and this is seemingly supported by the Chief Medical Officer who states that every child should do 60 minutes of physical activity per day[1].

1.2 Current curriculum requirements

At Key Stages 2 and 3, every child is expected to take part in two hours of quality Physical Education. These hours are broken down into various activities, sports and games that aim to build children's understanding of health whilst providing opportunity for motor skill development and activity-specific skill development.

The PE National Curriculum Programme of study states:

Knowledge and understanding of fitness and health

Pupils should be taught:

a) how exercise affects the body in the short term

b) to warm up and prepare appropriately for different activities

c) why physical activity is good for their health and well-being

d) why wearing appropriate clothing and being hygienic is good for health and safety.

At Key Stage 2 the (National Curriculum) PSHE and citizenship recommendations include:

Developing a healthy, safer lifestyle

Pupils should be taught:

a) what makes a healthy lifestyle; including the benefits of exercise and healthy eating, what affects mental health, and how to make informed choices.

At Key Stage 3, the aims and purposes of PE are to provide opportunities for students to develop a wide range of skills. Below are the aims that have distinct relevance to the Fizzees project:

[1] 'At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health', a report from the Chief Medical Officer, 2004, ref 2389

- set targets for themselves and compete against others, individually and as team members
- understand what it takes to persevere, succeed and acknowledge others' success
- respond to a variety of challenges in a range of physical contexts and environments
- take the initiative, lead activity and focus on improving aspects of their own performance
- discover their own aptitudes and preferences for different activities
- make informed decisions about the importance of exercise in their lives
- develop positive attitudes to participation in physical activity.

The PE curriculum requirements are mandatory for all pupils in Key Stages 2 and 3 and teaching of these requirements is varied between school to school based upon a variety of different schemes of work[2], the specialist training of the teacher(s) and the facilities available.

1.3 How is it currently being taught

Physical education has, for a substantial period of time, been on the periphery of 'serious academic subjects'. PE is often seen as a mix between an opportunity for young people to 'let off steam' and a belief that "active bodies are healthy bodies, and healthy bodies are more productive bodies" (Hickey 2003).

Traditionally PE has been taught so that "young people acquire understandings through and about their bodies" (Hickey 2003). This is mobilised through a belief (or folk pedagogy) that makes strong relationships between classroom environment and student achievement; clarity of instruction and student understanding; motor engagement and physical development; brevity of instructions and time on-task; quality of feedback and student development, and positive reinforcement and student enthusiasm (Rovegno and Kirk 1995; Tinning, Kirk and Evans 1993). From this folk-pedagogy, it might be argued that PE teaching falls largely under a behaviourist approach to learning and teaching with action followed by reaction (coaching) to gain improvement. Learning and teaching about health becomes an event based mainly in the classroom rather than integrated into physical activity.

> "In the context of educating young people, physical education has continuously been viewed as the curriculum site where young bodies learn the virtues of discipline and dexterity. Here, the channelling of (excess) energy through physical activity is seen as a vital way of promoting productive citizenship." (Hickey 2003)

The non-activity based aspects of PE play an important role in the development of self and in the development of longer-term lifestyle choices, both in developing 'productive citizenship' and long-term health. The importance of a mixture of health-related understanding and physical activity becomes apparent. This is mirrored by the separation between 'knowing' about the components of a healthy lifestyle and 'acting' out those understandings. A core concept of the Fizzees project is in developing a prototype that allows 'applied understanding' of the components of a healthy lifestyle through actual activity. Essentially the students need to not only investigate and discover what activities would benefit their health, but they also need to apply them in order to benefit their Fizzee.

Research shows that despite the strong pedagogical principles governing the teaching of PE, pupils are spending only a limited amount of time in their PE lessons actively (with varying amounts of time spent on receiving instruction, managerial tasks and turn waiting). This has a dramatic impact upon the two hours of quality PE demanded by the National Curriculum which transpires to be only 30 minutes of physical activity per week. However, despite this bleak

[2] For example the QCA scheme of work: www.standards.dfes.gov.uk/schemes2/Secondary_PE/?view

picture, there is a strong movement (nationally and internationally) to improve the quality of PE teaching. This is through developing initial teacher training (ITT), ongoing professional development and nationwide activities such as the School Olympics[3] and the School Sports Coordinator Programme (SSCo)[4]. This development began in Australia three decades ago and is now making an impact in the UK.

> "The full thrust of scientised notions of health was realised in physical education curricula around Australia in the 1970s and 80s. Fuelled by concerns about the contemporary health risks in a changing social landscape (namely more sedentary patterns of work, increased reliance on mechanised forms of transport and altered nutritional consumption) and the proliferation of scientific discourses in undergraduate teacher training programs, a new wave of health consciousness enveloped physical education. The fundamental assertion that emerged around this time was that active people were happier, healthier and more productive people." (Hickey 2003)

What materialised from this was 'Daily Physical Exercise', a movement in Australia that developed through the 1970s and 1980s. This links closely to current work in UK primary schools dubbed Brain Gym, based upon research led by Dr Paul Dennison into physical movement, education, vision and kinesiology that attempts to develop learning through linking curriculum activities with exercise.

In addition to activities such as Brain Gym and Walk to School, the formal curriculum requirements are taught through a mixture of providing opportunities for activity and opportunities for reflecting upon lifestyle choices. The physical activities are taught and developed through a series of thematic approaches (games, gymnastic, dance and swimming), which cover the curriculum requirements whilst developing generic and particular skill sets. For example, generic skills such as teamwork and tactics are developed through 'coaching' of sports, whilst health data is discussed during warm-up periods or classroom activities.

Other recent initiatives that particularly attempt to enable young people to develop an understanding of a healthy lifestyle are the Healthy Schools Initiative, the School Sports Coordinator Programme (SSCo), and the Walk to School initiative[5].

A key issue in the provision of high quality PE is the training of teachers. This is currently being addressed through a re-designed CPD programme (through the SSCo programme) and at Initial Teacher Training (ITT) level. This is crucial if two hours of 'high quality' PE is to be provided.

> "Within this context it was widely mandated that some form of physical exercise be carried out in schools on a daily basis. This was seen to be particularly problematic in Primary schools where life-long habits are thought to be established. The relative shortage of physical education specialists in the Primary sector was seen as an impediment to young people accessing the values and practices needed to develop the grounding for a healthy and active existence." (Hickey 2003)

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[3] www.ukschoolgames.com/about.htm

[4] www.dfes.gov.uk/rsgateway/DB/RRP/u014102/index.shtml

[5] www.thegrid.org.uk/learning/cit-pshe-healthy/healthy/programme/index.shtml

2. DISCUSSION OF RELATIONSHIP BETWEEN PROPOSED PROJECT AND POLICY CHANGES

As highlighted above, there is a current national debate about the health of children, something reinforced in Ruth Kelly's speech to the Labour Party Conference[6]. The importance of young people's health is evidenced through ongoing public debate in the national press, national initiatives to improve the opportunity for healthy lifestyles (supermarket tokens for sports equipment etc), as well as debate amongst educationalists about the relationships between physical activity, health, digital technologies and children.

This project adheres to the view that children should be provided with greater opportunities for safe, physical activity and that provision should be made to encourage children to develop an interest in healthy lifestyles for the life-course. The intention of the project is to provide a tool that enables students to monitor their own lifestyle choices whilst finding new ways of being physically active – within part of their daily lives (game play). In this way, we are attempting to use digital technologies as a way of providing interesting and stimulating ways of engaging with the concept of physical health.

Children are entitled to two hours of PE each week. The Chief Medical Officer states that children should have seven hours of physical activity a week. This project provides a tool that could potentially be used within the two hours of school-led activity as well as helping students to further develop their understanding during physical activity outside of school lessons.

The National Curriculum covers important issues in raising awareness of what constitutes a healthy lifestyle as well as providing space for various types of physical activity. In these terms, this project does not attempt to change the curriculum guidelines but to find a way in which young people can be empowered to reflect further upon the link between their actual lifestyle choices and those 'taught' during PE, science and PSHE lessons. To this end, Fizzees is not about in-school teaching (although it would be beneficial to use this as a tool within science, PE and PSHE). The intention of the project is that it will demonstrate new ways in which the immersion and engagement of digital game play can be linked to encouraging reflection upon personal health choices.

The learning context being developed in partnership between Futurelab, the University of Bristol and South Gloucestershire LEA Sports Development Team is one that privileges community knowledge within the classroom and advocates the developed relationship between young people's personal/social interests and classroom practice. The classroom/school activities developed during this project also need to demonstrate methods for creating scaffolded interactions between experts and learners, starting from the students' own understanding of health issues and their own activity.

The Fizzees project has much relevance to wider policy initiatives. The Every Child Matters[7] programme has at its heart five key objectives, in order to support young people from birth to 19 years old, to: "Be healthy, stay safe, enjoy and achieve, make a positive contribution and to achieve economic well-being". Within its aims and outcomes, the Every Child Matters approach recommends and demonstrates cross-team working and national/local agency collaboration in improving health for children. Integrated within this approach is the National Service Framework, the Healthy Schools Initiative and nationally supported local initiatives. The Every Child Matters programme is underpinned by the Children Act 2004.

The National Service Framework of Children, Young People and Maternity Services 'Supporting Local Delivery' (DoH 2004) provides many examples of nationally supported local initiatives to encourage children to take control of their future health; strengthening health promotion in

[6] www.labour.org.uk/index.php?id=news2005&ux_news[id]=ac05rk&cHash=774f34c861

[7] www.everychildmatters.gov.uk

local communities, and developing child health promotion programmes. These public activities share key targets with the Fizzees project and in this way, the project does not look to alter national policy about the importance of health in young people, but to offer a method for integrating the current policy suggestions into current models of schooling and to provide a tool that makes links between health awareness in and out of school.

The DfES' five-year strategy highlights the importance of healthy lifestyles to learning and lifelong achievement. A key statement within this document states that:

> "Every school - not just extended schools - should do their utmost to serve the needs of the whole child. In particular, our aim is that every school should be a healthy school, giving good teaching and advice about nutrition and exercise backed up by its school lunches, by its PE and school sport, and by its playground activities. Through this work, we will tackle levels of obesity in children, aiming to halt the growth in obesity among under-11s by 2010." www.dfes.gov.uk/publications/5yearstrategy/chap3.shtml

This highlights the importance of good health and the understanding of health issues at a young age, and the need to find methods of introducing new practices to schools in order to achieve the five-year aims. Specific short-term methods for achieving this are stated by the DfES as follows:

> "We will make sure that every child can have two hours of high quality PE and sport each week. Some of this will be during the school day, and some will be through more after-school and lunchtime sports clubs. Through our PE, School Sport and Club Links Strategy, in which we are investing over £1 billion in total across Government by 2006, we are developing a network of primary School Sports Co-ordinators, who help link primary schools to support from Sports Colleges and clubs and build up their sports opportunities. 6,000 primary schools are already included within these school sports partnerships."

Further, as part of the five-year strategy, the DfES references and reports on the National Healthy School Standard which sets the following themes for assessing school achievements: Personal, Social and Health Education; Citizenship; Drug Education (including alcohol and tobacco); Emotional Health and Wellbeing; Healthy Eating; Physical Activity; Safety, and Sex and Relationship Education. Again, the policy highlights the importance of health education and physical activity as a key area of school delivery.

By targeting these areas, the strategy aims to ensure (by 2008):

- most primary children will be getting two hours of high quality PE and school sport each week

with a long-term aim that:

- every child will have at least two hours of good quality PE and school sport each week
- all schools will make an extended offer to children and parents, either on their own or working with other schools, enriched by a huge range of out-of-school activities and opportunities, from chess to karate
- schools to contribute to reversing year-on-year increases in childhood obesity.

The implications for these targets is that the long term aims should be considered as achievable by 2008 if schools can find ways of utilising pupils' out-of-school activities within PE, science, PSHE (etc) to develop students' applied understanding of health issues.

Recent policies and Government activities, then, have raised awareness of the importance of health and health education, not solely for wellness but for learning throughout the life-course.

3. DISCUSSION OF LITERATURE

This section is divided into three sections in order to provide an overview of the key themes related to the Fizzees project. These are:

- research into health and activity of young people
- research into nurture/interaction with avatars
- the relationship between technology and physical activity.

3.1 Literature review on health/activity in young people

One of the key principles on which the Fizzees project is based, is the privileging of real-world knowledge within a game domain. For players to improve their Fizzee, they are able to ask their local doctor, family members or sports instructor for information about how to become fitter, and that information (when put into practice) will correspond to an improvement in the Fizzee's score. With this in mind, this section of the paper provides an overview of research into current trends in physical activity for young people and reports upon the suggested guidelines for physical activity for young people based upon the Chief Medical Officer's report[8].

The Fizzees scoring system is an attempt to provide appropriate feedback to players in relation to their physical activity as they undertake it (in this way, technology is used to support mobile learners). It attempts to privilege personal health data (within the recommendations from research into health/activity in young people) by rewarding amounts and types of exercise. An additional objective of the scoring system is to provide a model of 'healthy amounts of physical activity' for the players to follow through their game play. By investigating and discovering how to get the best score to improve their Fizzee, the player is uncovering the best ways for developing and sustaining a healthy lifestyle. Again, the link between real-world knowledge and game play becomes evident.

Physical educationalists agree upon the importance of physical activity and health understanding amongst young people. A variety of explanations are given about the role of PE in schools ranging from the importance of health through the life-course to the development of international athletes. Yet despite the perceived importance, national statistics show that there is a rise in obesity and a decrease in levels of physical activity.

Between 1995 and 2000 the proportion of overweight boys in England aged 2 to 19 years increased by 2%. The increase for girls was by 3%, so that by 2000, 20% of boys and 27% of girls were overweight. An updated report on obesity in children under 11 (published in April 2006) showed that increases in obesity prevalence was most significant among older children aged 8-10, rising from 11.2% in 1995 to 16.5% in 2003 (DoH 2006)[9]. In addition to the continuing rise in childhood obesity, the proportion of school children spending less than one hour per week on physical education increased from 5% in 1994 to 18% in 1999 (National Statistics 2004)[10].

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[8] For further information and data, see 'At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health', a report from the Chief Medical Officer, 2004, ref 2389; and 'The Health of Children and Young People' , National Statistics: www.statistics.gov.uk/cci/nugget.asp?id=718

[9] 'Obesity Among Children Under 11', Department of Heath: www.dh.gov.uk/PublicationsAndStatistics/Publications/PublicationsStatistics/PublicationsStatisticsArticle/fs/en?CONTENT_ID=4109245&chk=WB/AR1

[10] 'The Health of Children and Young People', National Statistics: www.statistics.gov.uk/cci/nugget.asp?id=718

The National Diet and Nutrition Survey (published 2000) found that 40% of boys and 60% of girls surveyed were failing to meet a Health Education Authority recommendation that young people should participate in physical activity of at least moderate intensity for one hour per day (National Statistics 2004). This, and wider research, combine to show that childhood obesity is now seen as a health crisis with excess body weight being the most common childhood disorder in Europe. The 2002 Health Survey for England[11] found that over a fifth of boys (21.8%) and over a quarter of girls (27.5%) aged 2 to 15 were either overweight or obese. In addition it found that:

- mean body mass index (BMI) increased steadily between 1995 and 2002 with more marked increases among children aged 6-10 and 11-15 years
- there was a steady upward trend in the prevalence of obesity for children and young adults during the period from 1995 and 2002
- the prevalence of obesity almost doubled among boys (from 2.9% to 5.7%) and increased by over a half among girls (from 4.9% to 7.8%) between 1995 and 2002.

The link between research into childhood obesity and that of adult health issues is highlighted as important for consideration.

> "Not all obese infants become obese children, and not all obese children become obese adults. However, the prevalence of obesity increases with age among both males and females (Lohman 1987), and there is a greater likelihood that obesity beginning even in early childhood will persist through the life span (Epstein, Wing, Koeske and Valoski 1987)." ERIC Digest 1990 ED 328556

The increase in childhood obesity is not solely due to an increase in sedentary lifestyles. Indeed Westerterp (1999) reports "the majority of obese subjects are moderately active, and an increase in the activity level of obese subjects is limited by the ability to perform exercise of higher intensity". This highlights how important it is to not only provide a space for physical activity, but to ensure opportunities for learning and teaching about the effects of healthy lifestyles.

Within the Fizzees game, an obese or unfit player will be able to perform at levels appropriate to them. The long-term benefits of this exercise could be lower heart rate, weight loss and an increase in fitness, whilst the short-term benefits to the Fizzee are higher than the same exercise being performed by a fitter/more active player. This is due to a scoring system that privileges the relationship between actual and perceived exertion (see section 4).

However, it is more than simply providing opportunities for young people to exercise that is at the heart of this project, despite the important role it plays in developing children's physical wellbeing. Wolf et al (1985) highlight the importance of education in the development of understanding of health issues that leads to a sustained healthy lifestyle. This *applied understanding* is the target for the Fizzees project that not only provides the motivation for physical activity, but the support and motivation for personal investigation into the components of a healthy lifestyle.

> "Adopting a formal exercise program, or simply becoming more active, is valuable to burn fat, increase energy expenditure, and maintain lost weight. Most studies of children have not shown exercise to be a successful strategy for weight loss unless coupled with another intervention, such as nutrition education or behaviour modification (Wolf et al., 1985). However, exercise has additional health benefits. Even when children's body weight and fatness did not change following 50 minutes of aerobic exercise three times per week, blood lipid profiles and blood pressure did

[11] www.archive2.official-documents.co.uk/document/deps/doh/survey02/hse02.htm

improve (Becque, Katch, Rocchini, Marks and Moorehead 1988).” ERIC Digest 1990 ED 328556

In a similar way, studies by Van Wersch et al (1992) and Papaionnou (1997) highlight how a distinction can be drawn between knowledge of suggested physical activity and actual physical activity. Further, a key finding from Hassandar et al's (2003) study shows that participants that have low intrinsic motivation to become involved in activity know the advantages of exercise, yet do not apply them. Fizzees, then, attempts to provide the motivation needed for students to become involved in physical activity.

'At Least Five a Week: Evidence on the Impact of Physical Activity and its Relationship to Health', the Chief Medial Officer's report published by the Department of Health, Physical Activity, Health Improvement and Prevention (2004), is a key publication that sums up the current research into health and physical activity in order to present recommendations of physical activity amongst the general population.

The following recommendations have direct implications for the Fizzees scoring system and overall context of use. Of relevance to the scoring system, the report states:

> "For children and young people, the advice has been for one hour of moderate intensity physical activity each day and this can be continuous activity or intermittent throughout the day". (DoH 2004, p2)
>
> "Recommendations for active living throughout the lifecourse:
>
> • Children and young people should achieve a total of at least 60 minutes of at least moderate intensity physical activity each day. At least twice a week this should include activities to improve bone health (activities that produce high physical stresses on the bones), muscle strength and flexibility…
> • The recommended levels of activity can be achieved either by doing all the daily activity in one session, or through several shorter bouts of activity of 10 minutes or more. The activity can be lifestyle activity[12] or structured exercise or sport, or a combination of these." (DoH 2004, p3)

By providing a tool that a) allows young people to become aware of their current physical activity levels, b) motivates young people to increase their amounts of physical activity, and c) fits closely with current lifestyle choices, the Fizzees project provides a mechanism for sustained behaviour change[13].

National statistics and medical research show that the transfer between Key Stage 2 and Key Stage 3 is a key age group where physical activity decreases[14]. By providing a tool that spans the school divide (as the tool is not location-dependant) and by providing increased learning opportunities for young people to investigate health issues, Fizzees may act as an intervention mechanism.

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[12] "Lifestyle activity means activities that are performed as part of everyday life, such as climbing stairs or brisk walking"

[13] "For most people, the easiest and most acceptable forms of physical activity are those that can be incorporated into everyday life" (DoH 2004, p2)

[14] "Boys are normally reported to be more active than girls, but this difference is greatly reduced when moderate activity alone is compared, indicating that activity levels peak in children at around 13 to 14 years of age, and then markedly boys participate in more vigorous exercise than girls" (Riddoch and Boreham 1997)

However, as current research has not identified the exact amount and type of physical activity that is appropriate for young people (current research takes its lead largely from research into adult activity levels), Fizzees uses a programmable scoring system that is based upon current understanding of children's health and activity. As research into this area develops, so the scoring system can develop to ensure that reward is given for appropriate amounts and types of activity.

3.2 Literature review on nurture/fostering avatars/digital representations

This section presents a summary of the current literature on nurture of digital characters, taking into account the relationship between game players and the avatars that they choose to use and the nurture of techno-babies (such as Tamagotchis, Neopets etc). It sets out an overview of the literature that relates to the relationships users generate with digital characters, the effects of those relationships and the way in which such relationships are fostered by designers.

A key issue in the design of Fizzees is that this prototype is a mixture of an informative device and a phatic technology[15]. The phatic element encourages players to interact with the Fizzee in order to nurture and develop it. This side of the relationship with the Fizzee is based upon a personal connection to a digital pet that is developed as the Fizzee matures and is more responsive to the players' actions. The Fizzees project is unique in that rather than being an entirely phatic technology (as all other digital pets available commercially are), a Fizzee also provides precise, personal information to the user about health activity. This mixture of phatic and informative technology is key to the design and intention of the Fizzees project.

The starting point for initiating a relationship with a digital character is based upon 'aspectual shape' - the reason or approach to interacting with the character.

There are three main approaches to the use of Fizzees that bring with them different social and temporal implications:

- Fizzees as a game (or toy)
- Fizzees as a learning device
- Fizzees as a 'living' creature (or pet).

An example of the differences in approach (due to aspectual shape) can be seen through the following metaphors for the project:

Fizzees as a game (or toy)

The player spends time interacting with the Fizzee for entertainment. Success implies that the player is skilled and failure that the player is unskilled. Different views on the benefits of computer game-play will lead to Fizzees being accepted/rejected by different social groups as a beneficial activity. For example, a parent may not see the positive benefits to their child if they view the Fizzee solely as a toy.

Fizzees as a learning device

The learner is developing an understanding of nurture and the component parts of a healthy lifestyle; the time spent doing so will (mostly) be deemed beneficial. Success in using the Fizzee denotes a developing understanding of a healthy lifestyle and that the learner has

[15] Phatic technology enables 'small talk' - exchanges meant to provide a social connection rather than to transmit information

shown responsibility in nurturing. Again, different views on the benefits of learning with digital technologies and of learning in new ways will lead to Fizzees being accepted/rejected by different social groups, however, it is generally expected that more groups will find this activity to be acceptable (in comparison to Fizzees as a game).

Fizzees as a living creature

The carer devotes time to looking after the creature that is reliant upon them. Time spent caring is more generally more widely accepted as the carer is acting responsibly in spending time interacting with the creature.

Fizzees is aligned, at some level, to all of these metaphors. The design of the learning context and the introduction to the project will have an impact upon the way in which 'users' interact with the Fizzee. Describing Fizzees as a creature to be nurtured, or even as a pet, requires the design of the Fizzees to reflect this choice. This design choice is not largely dependent upon the look of the creature, but upon a number of 'behaviours'.

Donath (2004) suggests that artificial toys "share several key behaviours: they appear to act autonomously, they require frequent interaction and they develop in response to their owner's actions." Donath goes on to develop this categorisation of artificial toys through the following descriptions:

Autonomy:

"…When machines work exactly as we expect them to do what we request of them, we think of them as simply machines. It is when they do not work as expected that they appear to have a will of their own and we ascribe intelligence to them."

Dependence:

"Most artificial pets start as 'infants', which elicits nurturing and affection: we instinctively take care of the young… The pet's dependence makes the owner feel responsible for it."

Interaction:

"…The pet becomes integrated into the owner's daily routine. Having spent a considerable amount of time and energy on the pet, the owner becomes invested in its well-being."

Development:

"Artificial pets are designed to develop in response to the owner's treatment of them… The owner thus is encouraged to take pride in their pet's well-being."

The importance of autonomy or 'freeness' of the pet then, is a key feature in the design of the Fizzee, in order to foster a sense of responsibility and nurture within the player. Kaplan (2000) argues that free creatures are likely to instill a greater feeling of responsibility because "the owner has to have a reason for interacting with it [the digital pet]". In most commercially available pets, repeated interactions are achieved because the owner feels responsible for their pet due to the key behaviours mentioned above. In the design of the digital pet, Kaplan explains that:

> "One way of showing that the pet is a free creature is to allow it to refuse the order of its owner. In our daily use of language, we tend to attribute intentions to devices that are not doing their job well… The freedom of the pet, its apparent autonomy in the choice of its goals, seems a *necessary* feature for the development of an interesting relationship." (Kaplan 2000, p1)

This seems especially important in the early stages of fostering a relationship with a digital pet. At the early stages, signifiers of autonomy encourage the inference of an emotional interaction with the pet. From this point, it is the development of a strong link between the interaction of the user and the maturation processes of the Fizzee. This will, as Kaplan (2002) suggests, provide ongoing and positive feedback to the user on their investment in taking care of the pet. "The more the user has spent time interacting with the pet the more it is crucial for him that the pet does not die or run away and matures properly. The initial investment may simply rely on the money spent to buy the pet. Then, the relationship emerges from this self-reinforcing dynamic" (Kaplan 2000, p2). In order to replicate this initial investment or 'buy in' by the user (they will not be choosing to spend their own money on a Fizzee), the participants will be able to choose from a selection of coloured facias and customise the design of the strap (through drawing, colouring etc).

A further consideration regarding digital pets is the debate between the positive development of 'nurturing skills' and negative 'wasting' of empathy on digital pets.

"There is considerable controversy about the social implication of artificial pets. Whether they teach children to nurture or whether they 'waste empathy' on artificial, commercial objects. Some argue that they are useful for teaching responsible behaviour in a safe setting. Others say that they erode responsibility, by providing people with pseudo-animals that can be neglected to the point of simulated death without moral repercussions" (Donath 2004). Many authors describe this controversy, yet few reference it outside of the national press. However, Fizzees attempts to utilise the positive aspects of 'nurture' whilst negating the 'wasted empathy' by developing a prototype that encourages children to learn nurture skills that are directly related to real lives (as the nurture system is based upon real-world knowledge).

Holzinger and Maurer (1999) report a project called TRIANGLE (a multimedia test-bed for examining incidental learning, motivation and the Tamagtochi-Effect within a gameshow-like computer-based learning module). This project investigated the motivational aspect of digital avatars within incidental and situated learning activities. These two learning theories have strong links to the learning context and context of use within the Fizzees project.

> "A big problem in successful learning is keeping the motivation for continued learning. This problem is most crucial if the material to be learnt is difficult to understand or even worse, the learners do not have much personal interest in the material but have to learn it for some 'external' reason. In learning as such we have on the one hand intentional learning – used in traditional computer assisted learning systems – on the other we have incidental learning." (Holzinger and Maurer 1999)

Within the Fizzees project, the intentional learning is of the game rules (within a real-life situation), investigating the scoring system, and developing an understanding of activity levels in order to improve the Fizzee representation (the in-game activities). The incidental learning covers subjects such as personal lifestyle choices and the health benefits of an active lifestyle etc.

"Incidental learning, then, includes such things as learning from mistakes, learning by doing, learning through networking, learning from a series of interpersonal experiments. It is clearly obvious that incidental learning is particularly powerful for children" (Holzinger and Maurer 1999, p15). Holzinger goes on to describe the results from a research project (Anderson and Bower 1972) where an intentional group were outperformed by an incidental group:

> "Motivational arousal may be a function of the extent to which the learner assumes personal responsibility for the outcome of behaviour. That is directly connected with something we call the 'Tamagotchi-Effect'". (Holzinger and Maurer 1999)

The TRIANGLE project used a Tamagotchi-type avatar as a motivational factor, requiring students to take care of it whilst incidentally learning about maths. A key distinction between the TRIANGLE project and the Fizzees project is in the purpose of the avatar. In the TRIANGLE

project its use is an example of a fabricated reason to take care of an avatar – in order for it to do well in a quiz game. The Fizzees project attempts to provide a real (or at least simulated) reason for the learner to look after the Fizzee.

3.3 Literature review on technology impacting on health projects

This section presents an overview of current research and development projects that use various digital technologies to enhance, record and encourage greater amounts of physical activity. This overview reports on commercially available technologies as well as emerging technologies.

Sallis and Owen (1999) emphasise the need to motivate students to make use of existing facilities/environments in order to find new ways to exercise. This is a key theme that runs through the Fizzees project as the game play is intended to fit into the student's current lifestyle (including taking advantage of current environments used) whilst providing further motivation and opportunity for activity and learning about health issues. From a negative perspective, Nigg (2003) highlights the detrimental effect that technology has had on exercise. This view takes a broad definition of technology to include cars, washing machines, computer games and televisions, yet it is also adhered to by those highlighting computer games and television as prompts for a decrease in children's (physically active) play. However, Nigg then moves on to describe a number of points where technologies can support physical activity and a developing understanding of healthy lifestyles. Within these definitions, Nigg describes the continuum between minimally individualised 'one-size-fits-all' interventions, moving through targeted interventions to tailored interventions, where the feedback is individualised and timely. Nigg's 'tailored intervention' refers to the way in which digital technologies can provide personal, appropriate and timely feedback. By providing feedback based upon personal heart-rate and actual movement, the Fizzees project aims to be at the tailored end of this spectrum.

Providing personally relevant health information is thought to increase the consideration and processing of the information (Skinner, Strecher and Hospers 1994), increasing the potential for the information to be applied to a change in behaviour. Further, the provision of individualised feedback has been shown to be effective for physical activity promotion (Marcus et al 1998).

Recently, consideration has been given to the role of environmental factors in affecting physical activity. Sallis and Owen (1999), for example, highlight the aim of motivating individuals to make greater use of existing facilities (taking stairs instead of lifts, parking further from your destination, etc) as well as the need to improve the infrastructure - providing surroundings conducive to a physical active lifestyle, eg providing more parks and bike paths. The Fizzees project attempts to provide a technology that supports young people in determining their activities whilst mobile and going about their daily lives. Part of this process is highlighting the beneficial natures of (for example) skateboarding and bike riding, which could be encouraged as 'healthy activities', as well as prompting players to take advantage of other local amenities.

With regard to the use of sensor technologies to motivate and help young people to develop active lifestyles, much research has investigated appropriate technologies in order to provide the most timely and accurate feedback possible.

> "In recent years, several attempts have been made to combine sensors in order to achieve greater accuracy. To date, most attempts at combining sensors have relied on motion sensing with the addition of one other type of sensor. A combination that utilised heart rate monitoring in association with motion sensing (Rennie et al 2000; Luke et al 1997) demonstrated improved accuracy over either approach used in isolation." (Liden et al 2002)

The importance of the accuracy of the personal health data (in relation to a scoring system that models good practice) is vital. In this way, the Fizzees prototype uses dual sensors of accelerometer and heart-rate sensors. The accelerometer provides feedback in relation to movement, acknowledging (and rewarding) non-sedentary behaviour. The heart-rate monitor's main use is to acknowledge effort/intensity. This is important to reward personal effort in activity and also to measure non-ambulatory exercise, such as walking and running. However, further key factors within the scoring system are described in section 4.

Sensor devices can provide personal, accurate and appropriate feedback to activity and health data. By harnessing this information and presenting it in an easily accessible way, digital technologies may support the development of an understanding of healthy lifestyle choices and act as a motivator to undertake greater amounts of physical activity.

4. FIZZEES SCORING SYSTEM

The Fizzees scoring system is an integral part of the core concept of this project and is central to the effectiveness of the prototype as a learning device. Within game play generally, learners interrogate the activity/environment to work out the rule systems in order to maximise their scoring. Within the Fizzees project, making sense of the scoring system will uncover the suggested components of a healthy (active) lifestyle as well as the recommended levels of activity for young people. In doing this, learners are revealing the recommendations for their own activity and therefore the scoring system must be closely based upon current research into the recommendations for physical activity for young people. In this way, the scoring system has been developed in partnership between Futurelab and the University of Bristol's Centre for Sport, Exercise & Health, taking particular reference from the Chief Medial Officer's Report: "Evidence on the impact of physical activity and its relationship to health".

The governing principles within the Fizzees scoring system are:

- **To use personal, accurate health data to provide immediate, appropriate and accurate feedback**
- **To privilege the interplay between multiple sensors to provide a greater understanding of personal activity in relation to actual exertion.**

The scoring system described below uses particular descriptions of scoring in order to be precise about the intentions.

The system is made up of:

Steps: increments that grow and fall within each level (six steps)

Level: represented by a change in the maturation of the Fizzee

Points: a numeric representation of the score

Below is a table that segments each component of the scoring system in order to link it to:

- what needs to be measured
- how each component can be measured
- how each component effects the overall score
- justification for the component.

Requirement/ recommendation	What do we need to measure	How do we measure it	Reward/ indicator	Justification
1 hour moderate activity	Movement over time	Acc count shows Mod activity for 60 mins H/R shows % H/R > 60% for 60 mins in a day	Base requirement for 1 step improvement of Fizzee	Baseline requirement from CMO for young people
3 hours moderate activity	Movement over time	Acc count shows Mod activity for 180 mins in a day H/R shows % H/R > 60% for 180 mins in a day	Target recommendation for 3 step improvement	Target activity recommendation for active/healthy lifestyle
Movement every hour	Movement within time frame	Acc data to show more than 2 mins moderate activity per hour	Flashing to show no activity within each hour and decrease of 1 point if no movement	Disrupting sedentary lifestyle
Frequency of activity	Number of 'active periods'	Acc counts show Mod for 10 mins or more throughout day	Mod activity 5 times a day or more = 1 step	Encouraging activity/sustained activity
High impact work 3 times a week	Vigorous movement/high heart rate	Acc counts shows Vig for 30 mins throughout week H/R shows % H/R > 80% for 30 mins per week	2 steps – awarded weekly	Bone strengthening activities
Variability of activity	Various types of movement, various levels of heart rate	H/R = % H/R in different bands for >20 mins (per band) Acc counts show Mod for those 20 mins	Measures met within day = 1 step	Encouraging variability in activity (related to long term sustainability)
Less than 7 hours activity a day!	Movement over time	Acc count shows Mod activity for 420 mins in a day H/R shows % H/R > 60% for 420 mins in a day	Over 420 mins = minus 1 step	Diminishing return of activity – disrupting 'over training'
Rewarding any activity	Active periods	H/R = % H/R > 50% AND Acc shows mod	Fizzee moving to show activity	Immediate feedback for any amount/type of activity
Less than 1 hour exercise accumulative	Movement over time	Acc count shows Mod activity for <60 mins H/R shows % H/R < 60% for 60 mins in a day	Decrease in Fizzee fitness Highlight time needed/activity	Discouraging minimal exercise
Demonstrating understanding of healthy eating*	Knowledge and understanding - classroom based	Teacher measure	Teacher/DS to be able to add scores through web	Encouraging healthy eating
Demonstrating understanding of activity*	Knowledge and understanding - classroom based	Teacher measure	Teacher/DS to be able to add scores through web	Encouraging further interrogation of healthy lifestyle
Swimming/water sports*	Time spent in water and activity type	Young person/parent self reporting	Teacher/DS to be able to add scores through web	Encouraging activity where Fizzee cannot be worn

Key: **Acc** = Accelerometer data; **H/R** = Heart-rate data as percentage of maximum heart-rate); **CMO** = Chief Medical Officer; ***** Not vital to current scoring system but highly desired; **LeMod** = Less than moderate activity; **Mod** = Moderate activity; **ModV** = Moderately Vigorous activity; **Vig** = Vigorous activity

4.1 Governing principles

The governing principles of the scoring system need to be highlighted and explained in order to ensure that they are integrated into the design of the scoring system.

To use personal, accurate health data to provide immediate, appropriate and accurate feedback

The player's heart-rate needs to be measured at the beginning of the project in order to accurately measure their resting and maximum heart-rate. This process will take place during a whole-class activity at the beginning of the intervention (whilst the students are wearing the Fizzees) within an introductory PE lesson. This process is undertaken in order to ensure accurate measurement of percentage heart-rate throughout the project.

The accelerometer also needs to be personalised to each individual at the beginning of the project in order to ensure that the data provided by the accelerometer is accurate in relation to the players' gait, leg length etc. If this is not possible, then the cut points taken from the Trost bands for intensity (Trost et al 1998) will be used. The Trost bands are taken from large-scale research into young people's exercise (whilst wearing accelerometers).

To privilege the interplay between multiple sensors to provide a greater understanding of personal activity in relation to actual exertion

Two key points arise from this principle. First, that the heart-rate data is only used for the scoring system when the accelerometer data suggests that the player is active or moving. This is to discount stress and excitement as signals of activity.

Second, the *relationship* between the data provided by the accelerometer and the heart-rate monitor is a key feature that affects the factor within the scoring system. The following description exemplifies this point using the Trost bands for intensity (accelerometer) and estimated heart-rate scores for two 10 year-old males.

Example:

Trost score	**Activity type (assuming Trost Score)**	**'Fit' player (% heart-rate)**	**'Unfit' player (% heart-rate)**
1017	Moderate (eg walking)	50% (mod)	60% (vigorous)
3696	Vigorous (eg running)	60% (vigorous)	73% (very vigorous)
6374	Very vigorous (eg sprinting)	70% (very vigorous)	85% (anaerobic++)

The accelerometer states an assumed activity based upon counts - which imply an intensity level (moderate for walking, vigorous for running etc). The percentage heart-rate accurately reflects the actual intensity of the activity based upon the fitness of the player (where fitness is the ability to perform a task). The difference in the zones reported by the data collection devices becomes a factor by which to multiply the scoring – so to reward actual intensity rather than perceived intensity.

The 'actual-perceived exertion' factor

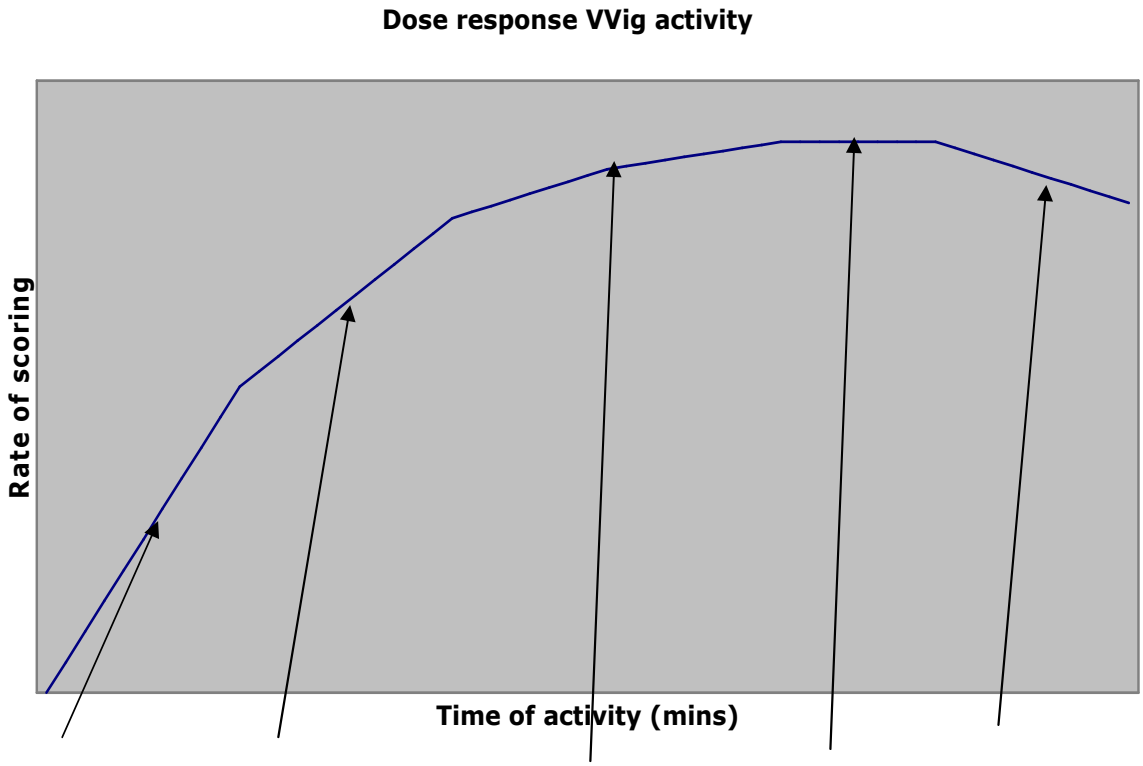
Accelerometer data	**Heart-rate data**	**Factor**
Low intensity	Low	X 1
	Moderate	X 1.2
	Vigorous	X 1.35
	Very vigorous	X 1.5

Moderate	Low	X 1
	Moderate	X 1
	Vigorous	X 1.35
	Very vigorous	X 2
Vigorous	Low	X 1
	Moderate	X 1
	Vigorous	X 1
	Very vigorous	X 1.2
Very vigorous	Low	X 1
	Moderate	X 1
	Vigorous	X 1
	Very vigorous	X 1

Discouraging 'over training' – at 'very vigorous levels' of activity

The relationship between gaining more points for an activity and the rate at which the points can be gained is also central to the scoring system. In order to encourage *more* activity, initial activity is rewarded with more feedback. The rate at which this feedback/score is given is a 'dose rate' – in that the greater the amount of activity at 'very vigorous levels', the slower the score improves. This is represented in the diagram below that shows how the speed of gaining points slows over time until the number of points actually decreases at a point where the activity becomes considered overtraining.

The following diagram shows the 'dose response':



Decreasing score to discourage minimal/lack of exercise

In order to show the Fizzees' deterioration if the player does not exercise, the Fizzee representation will deteriorate over the day if no exercise (or under one hour of Mod activity) is taken. **The score for the Fizzee should not decrease**. The Fizzees' deterioration should only decrease in steps and not move down a level to show the deterioration. **Every hour with less than 2 minutes of Mod activity is equal to a decrease of 1 step.**

The complexity of the scoring system is such that players are not expected to unveil the specific detail of it in order to better develop their Fizzee. As the player observes the changes in their Fizzee and reflects upon their own physical activity, they will be able to make connections between the digital feedback and their own types and levels of activity. As they discuss these connections and observations with other players they will be able to interrogate the most appropriate levels of activity for both their Fizzee and themselves.

4.2 Feedback to the scoring system

The Fizzee character progresses from a simple shaped 'young' character towards a more complex, animated appearance. Within each change of character (each step) there are several levels that indicate the health of the Fizzee. This health is shown by the expression of the Fizzee and in the later stages of each step, by the addition of hearts (heart health) next to the Fizzee.

In addition to the development of the Fizzee's appearance, further feedback is given through two types of animation: character animation and screen animation. The character animation shows the Fizzee jumping up and down in reaction to the players' significant increase in score. This character animation is intended to both reward the players' activity and also to help develop the nurture relationship between the player and the Fizzee. The two screen animations work in two different ways, first as an indicator that the Fizzee is changing its state (a positive change to a new level) and also to represent that the wearable pod is being synced with the desktop computer and/or that the pod battery is being recharged. Further feedback and interactions are available on the Fizzees website.

5. CONCLUSIONS

The Fizzees project has two objectives: to encourage young people to become more physically active, and to enable them to develop a better understanding of the components of a healthy, active lifestyle. The combination of these two objectives is for young people to develop *applied understanding* of a healthy lifestyle.

By combining a complex maturation structure for the Fizzee, based upon research into healthy activity for young people, coupled with the development of a digital pet, this project aims to provide both the motivation and supporting information and resources to enable young people to develop such applied understanding.

The key principles are:

- designing a virtual pet that players look after and nurture through their own physical activity
- long-term benefit to self shown in short-term benefit to Fizzee
- accurate, personal health data shown in easily interpretable form
- match between recommended activity levels and the Fizzee's scoring system
- applied understanding of healthy lifestyle.

Fizzees… developing a wearable/mobile digital tool that converts actual physical activity into onscreen game character appearance. Providing a virtual world where Fizzees can be compared, can interact and 'players' can swap playing tactics.

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Tamagotchi and Aspectual Shape web article: www.virtualpet.com/vp/farm/lleg/critical/ov.htm

6.3.2 Child targeted/supportive web resources

Children First: www.childrenfirst.nhs.uk
Content about health – how body works, an A-Z of body parts, Dear Doc, Q&A, body tour and real stories. Also includes games and celebrity health stories.

Galaxy-H: www.galaxy-h.gov.uk
Targeted at 5-7 (Key Stage 2) with a mixture of interactivities, which are health-related descriptions.

Health.e.school: www.healtheschool.org.uk
Quizzes, newsletter, worksheets and activities for preschool, primary, secondary students (as well as sections for parents and teachers).

NHS Direct Online: www.nhsdrect.nhs.uk
A more corporate presentation of information.

Sport England: www.sportengland.org
An adult-focused site for health and sport-related information. A particular initiative is that of the National Survey of Culture, Leisure and Sport which aims to monitor and record the lifestyles of 28,000 adults across the UK.

6.3.3 Related projects

Children of the 90s: www.alspac.bris.ac.uk/welcome/whoarewe.shtml

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