A computer-aided learning system to assist pupils in KS2 with music composition

Daryl Astbury

The candidate confirms that the work submitted is their own and the appropriate credit has been given where reference has been made to the work of others.

I understand that failure to attribute material which is obtained from another source may be considered as plagiarism.

(Signature of student)________________________________
**Summary**

The main objective of this project was to design an interactive computer-aided learning system that would help Key Stage Two children with music composition as defined by the national curriculum. The name of the system will be called **The Music Teacher**.

Research was carried out to determine if there was need for such a system. This included research on music in primary education and computer-aided learning. The outcomes were positive, there was a definite need for such a system. On the outcome of this research, further research took place into a suitable methodology to follow in order for a user-centred approach to take place. It was decided on the usability engineering model.

The following activities took place as part of this model:

- Pre-design stage which identified individual user characteristics, the current approach undertaken to complete the task, a functional analysis and evolution of the user. In addition, a competitor analysis was undertaken and usability goals set.
- The user requirements where collected from Key Stage Two teacher by form of interviews
- The system was designed based on these requirements
- A vertical prototype was constructed with the main functionality of the system implemented
- Heuristic evaluation and empirical user testing took place to discover usability problems with the system.
- The prototype was adapted based on the results of these evaluations
- The final prototype was evaluated with the administrators (teachers) and the learners (children) of the system.
Acknowledgments

I would like to give a big thank my project supervisor, Julika Matravers for helping me throughout the project. I would also like to thank the all the staff at Bryn Coch Primary School for allowing me to conduct my user analysis, completing interviews and permit me t make constant visits in order to the evaluate the prototype.
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Chapter 1 – Introduction

1.1 Problem Definition.

The music education in primary schools specified by the National Curriculum provides numerous potential benefits to pupils. ‘However the potential benefits of music education are not being realised by most schools’ (QCA, 2004). One way in which the government are trying to raise the standard in schools is by the user of ICT. ‘In an ideal scenario ICT could be used effectively to reinforce and extend music learning’ (QCA, 2004). This project will attempt to utilise ICT in order to make these potential benefits possible.

1.2 Aim

The aim of the project is to design a computer aided learning program that will help primary school children with areas of the Key Stage Two music national curriculum.

1.3 Objectives

• An investigation into the teaching domain of music.
• Research alternative learning methods.
• Research on existing computer learning systems
• Exploration into different user-centred methodologies, subsequently one methodology will be chosen.
• Development of a system prototype of the computer based learning system.
• Evaluate the prototype.

1.4 Minimum Requirements

• Research on literature regarding learning techniques and the teaching of music.
• Investigation of three existing computer based learning applications.
• Design the components computer-aided learning systems focused.
• Develop a basic prototype of the system.
• Evaluate the prototype

1.5 Deliverables

• Report
• Software: Computer based learning system
1.6 Schedule

A Gantt chart has been produced to show the actual completion dates of the project. This chart is shown in Appendix B.

<table>
<thead>
<tr>
<th>Number</th>
<th>Completion Date</th>
<th>Objective</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12/10/04 - 22/10/04</td>
<td>Identify aim and minimum requirements</td>
<td>Minimum requirements and aim specified</td>
</tr>
<tr>
<td>2</td>
<td>23/10/04 - 6/12/04</td>
<td>Complete background reading</td>
<td>Complete literature search</td>
</tr>
<tr>
<td>3</td>
<td>7/12/04 - 10/12/04</td>
<td>Research questionnaire and interview techniques</td>
<td>Research user requirement methods</td>
</tr>
<tr>
<td>4</td>
<td>7/10/04 - 10/12/04</td>
<td>Mid-term report</td>
<td>Complete mid-term project report</td>
</tr>
<tr>
<td>5</td>
<td>11/12/04 - 26/12/04</td>
<td>Research software methodologies</td>
<td>Select appropriate methodology</td>
</tr>
<tr>
<td>6</td>
<td>27/12/04 - 19/01/05</td>
<td>Christmas and January exams</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>20/01/05 - 20/01/05</td>
<td>Questionnaires sent out</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>20/01/05 - 23/01/05</td>
<td>Research existing systems</td>
<td>Competitor analysis completed</td>
</tr>
<tr>
<td>9</td>
<td>24/02/05 - 25/02/05</td>
<td>Research software tools</td>
<td>Select appropriate design tools</td>
</tr>
<tr>
<td>10</td>
<td>26/02/05 - 26/02/05</td>
<td>Questionnaires returned</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>27/02/05 - 02/02/05</td>
<td>Analyse questionnaire responses</td>
<td>Define user requirement</td>
</tr>
<tr>
<td>12</td>
<td>03/02/05 - 10/03/05</td>
<td>Decision into content and structure of the prototype</td>
<td>Content and Structure of prototype decided</td>
</tr>
<tr>
<td>13</td>
<td>11/03/05 – 11/04/05</td>
<td>Create prototypes</td>
<td>Prototype completed</td>
</tr>
<tr>
<td>14</td>
<td>12/04/05 – 25/04/05</td>
<td>Evaluation</td>
<td>Evaluate the prototype</td>
</tr>
<tr>
<td>15</td>
<td>26/04/05 - 27/04/05</td>
<td>Complete project</td>
<td>Project completed</td>
</tr>
</tbody>
</table>

1.8 Relevance to Degree program

The degree program that is currently being undertaken at the University of Leeds is ‘Computing with Management Studies’. The dissertation subject chosen will only cover aspects of the computing domain. This project will include aspects of many modules undertaken at the school of computer in the past two years. Including elements of computer graphics modules (university codes GI21 and GI31), programming modules (university code SE21), software management module (university code SE22) and elements of database modules (university codes DB21 and DB31)
Chapter 2 - Teaching of Music

2.1 Music education for children.

As stated by David Blunkett (1998) the previous Secretary of State of Education and Employment; ‘Music can underline our campaign to raise standards and provide other valuable aspects of a child’s education. It can be a cross-curricular approach, helping with numeracy, developing the talents of those with special needs as well as the gifted. It can also draw on the tremendous history of folk music and ballad writing to reinforce understanding of the history of our culture.’

From this statement, we can perceive that the government consider the teaching of music to children in this day and age as becoming more and more important. It can be observed that the teaching of musical skills to children can influence their overall development.

The QCA (2004), the quality and curriculum authority found in their annual report that music significantly contributes to help increase concentration, motivation, sensitivity towards others and support learning of other subjects across the teaching curriculum. It has also been said that ‘music provides opportunities to promote: thinking skills... working creatively, reflectively and spontaneously’ (DfEE, 1999 in Nikolaidou. 2002). ‘However the potential benefits of music education are not being realised by most schools’ (QCA, 2004).

The fundamental aim of music education in schools is to ‘give all pupils the instrumental skills they need for an active and life-long involvement in music’ (QCA, 2004). This aim will not be realised at present as ‘the adequacy of learning resources for music in primary schools was seen to be good or excellent in only one in four schools’ (Ofsted, 2003 in QCA, 2004). Research conducted on this issues found that this is ‘due to the constant pressures experienced by primary school teacher, it is often difficult to find time within the school day to effectively accommodate the teaching of these skills, especially considering the emphasis on developing basic skills such as literacy and numeracy’ (nfer, 2001). Music is the subject that is most often ‘forgotten’ during the week, as it is only allocated on average four per cent of curriculum time (QCA, 2004).

Although the statement from the current government was many years ago, it does not seem like the government have done enough to for fill there potential benefits that can be achieved from music education.

2.2 Music in Key Stage Two

‘Music is seen to be the hardest subject to cover in key stage two’ (QCA, 2004). This is due to the fact that ‘many teachers do not have the confidence and experience to teach music effectively’ (QCA, 2004). This does not seem surprising that the QCA (2004) findings show that only four out of ten schools are attaining a good/excellent achievement of pupils in music.
2.2.1 The Key Stage Two Teacher.

The ideal music teacher is ‘expected to be all-round musician with a range of skills and a broad expertise, representing a style of musicianship characterised by its versatility and an ability to adapt and modify practices when circumstances demand’ (Plummeridge, 1991 in Nikolaidou, 2002). These ideal characteristics, required of a music teacher will not be present in a Key Stage Two teacher as they do not possess ‘the confidence and experience to teach music effectively’ (QCA, 2004).

Learning Theory

The technique used by the teachers to communicate the content of the curriculum to the pupils is objectivism. The underlying model of Objectivism is behavioural psychology. The most famous psychologist of this methodology was a Harvard professor B.F. Skinner (Skinner, 1968). It is viewed that an individual’s learning will occur where changes of behaviour takes place from a response to an event within an environment (Skinner, 1968). These changes in behaviour will take place from a positive reinforcement, this techniques is defined by operand conditioning.

Operant conditioning ‘specifies a response followed by a reinforcing stimulus is strengthened and more likely to occur again’ (Jarvis & Holford & Griffin, 1998). It is simple, direct and used in a variety of situations including in this case the classroom teaching. ‘Teaching is the arrangement of contingencies of reinforcement under which students learn’ (Skinner, 1968). Therefore the teacher’s knowledge is being passed to the learner. The way in which the students are programmed by the teachers is asking the pupil a question, the pupil answering the question and if a correct answer is given, this will be positively reinforced. However, if the wrong answer is given, the cycle will be repeated until the right answer is generated.

The knowledge that is required to be passed to the pupils by the teacher by the end of each Key Stage Two music is defined by the national curriculum.

2.2 National Curriculum

The national curriculum defines the ‘knowledge, skills and understanding that pupils of different abilities and maturities are expected to have by the end of each key stage’ (Education Act, 1996). Therefore, the curriculum provides the minimum acceptable level that each child should obtain from the learning taken place in the classroom lessons.

The national curriculum for Key Stage Two music is based on the balance of listening, performing, singing and composing (National Curriculum Online, 2004). The current specification for the Key Stage Two national curriculum for music is documented in Appendix B. As we can observe, all of these activities are creative (Mills, 1991 in Nikolaidou. 2002). The child’s creative ability can be enhanced if music lessons are designed with a combination of the four basic components of the curriculum (Nikolaidou, 2002). This statement is illustrated by Nikolaidou (2002) and is shown in Figure 2.1 below.
2.3 Music and Information Technology in schools.

Information technology contains more than just computers being used in the classroom. It contains any electronic technology for example recording equipment, MIDI equipment, keyboards, CD-ROMS are to name a few.

Ofsted (2003) report concludes that Information Technology’s use with music remains unsatisfactory in one in four primary schools. In a focus group with primary school teachers completed by QCA (2004), the teachers emphasize their concerns about Information Technology. They stated, ‘in an ideal scenario ICT could be used effectively to reinforce and extend music learning’ (QCA, 2004). Therefore it seems there is still much room for development in ICT for the future. QCA (2004) identify the following area of information technology that should be developed:

- ‘uses information and communication technology (ICT) and assessment to promote experimentation and creativity at all levels’ (QCA, 2004).
- ‘promotes an examination and assessment system that is sympathetic to good ICT practice in music’ (QCA, 2004).
- ‘develops ICT to help learners explore the role of new music technologies’ (QCA, 2004).

2.4 Summary

As the majority of teachers do not possess in detail knowledge regarding music at Key Stage Two, which the research suggested, ‘many teachers do not have the confidence and experience to teach music effectively’ (QCA, 2004). It is unlikely that the learning theory of objectivism that is used to pass the knowledge to the pupils will be completed successfully.

From these findings by QCA (2004) and Ofsted (2003), if more ICT resources where made available for
the teaching of music, children will develop musically. If extra ICT resources are available, the main objective of the music taught in schools, to ‘give all pupils the instrumental skills they need for an active and life-long involvement in music’ (QCA, 2004) seems to be a closer objective that it is at present. If such ICT resources such as computer-aided learning that focused on the music national curriculum where made available, the teacher would not need to possess as much confident and experience in the music domain, the teacher would be reinforced by the ICT resource. The computer-aided learning area of ICT will be discussed in the following chapter.
Chapter 3 - Computer-aided Learning (CAL)

Since the mid 1980s, the appliance of the phrase ‘CAL’ has been increasingly used to describe the use of technology to aid teaching. CAL has been described as ‘an educational environment where a computer program, or and application is used in order to assist the user in learning a particular subject’ (LTDU, 2001). The most important word above definition is the word ‘assist’. The program will not replace the work that the teachers are performing, it will merely aid the overall learning of the pupil. In this style of learning, the emphasis is put on the learner as the teacher is not involved in the learning process. Due to this fact, the learning theory of objectivism is not used for this form of learning. An alternative learning theory is required, that will place the learner at the centre of the process. This learning theory will be discussed below.

3.1 Cognitive psychology

The learner is of fundamental important to the success of the CAL. Therefore, CAL support an alternative learning theory to traditional classroom approaches, it is the learning theory of constructivism which used.

The underlying model of constructivism is cognitive psychology. There are many differences from the objectivism earning theory. The first contrast from the behavioural approach is in the definition of learning; behavioural psychologists state ‘that learning is a change in behaviour that results from reinforced practice’ (Gazda & Corsini, 1980), while the cognitive psychologists state ‘that practice alone is sufficient’ (Gazda & Corsini, 1980) for learning to take place, and ‘human thinking is much more complex than a set of behaviors’ (Gardner, 1983). The second contrast arrives in the measurement of learning. ‘Skinner proposes that change in the rate of behavior is the best measure of learning’ (Gazda & Corsini, 1980) while ‘other theorists prefer to measure the form or pattern of learning behavior’ (Gazda & Corsini, 1980).

The most influential individual to the cognitive theory was a Swiss psychologist, Jean Piaget. He developed a ‘radically different and extremely powerful view of human cognition’ (Gardner, 1983). His methodology presumed that ‘through development by growing from one state of equilibrium to another’ (Baker & Piburn, 1997) that learning takes place. Skinner (Skinner, 1968) stated that it was the environment that determines learning, but Piaget took a different perspective of this, he insists that ‘meaningful learning results only when a person reflects-that is, from the thoughts of the learning and not from the environment’ (Gazda & Corsini, 1980). In this theory ‘there exists a process of equilibration-how the person organizes pieces of information into a non-contradictory system of knowledge’ (Gazda & Corsini, 1980). Equilibration is a determinant that guides learning. ‘It does not result from what a person sees, rather it helps the person understand what he or she sees. With this inherited capability…the individual gradually constructs inferences about how things in the world must be’ (Gazda & Corsini, 1980).

The way in which Piaget investigated his theory was by doing ‘in-depth studies with small sample of
From Piaget’s investigation into children’s learning, he identified ‘development stages of intelligence’ (Gardner, 1983). The stages are summarised in the table below:

<table>
<thead>
<tr>
<th>Period</th>
<th>Age (in years)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensori-motor</td>
<td>0-2</td>
<td>Infant learns to differentiate between self and objects in the external world</td>
</tr>
<tr>
<td>Pre-operational thought</td>
<td>2-4</td>
<td>Child ego-centric but classifies objects by single salient features</td>
</tr>
<tr>
<td>Intuitive</td>
<td>4-7</td>
<td>Child thinks in classificatory way but may be unaware of classifications</td>
</tr>
<tr>
<td>Concrete operations</td>
<td>7-11</td>
<td>Child able to use logical operations such as reversibility, classification and serialisation</td>
</tr>
<tr>
<td>Formal operations</td>
<td>11-15</td>
<td>Trial steps towards abstract conceptualisation occur</td>
</tr>
</tbody>
</table>

Atkinson, 2001. However, a report evaluating integrated learning systems in the UK provided evidence to suggest that too often CAL has been used only for remedial work. Atkinson, 2001. However, with the Key Stage Two children being in the concrete operations stage, they are able to use rules and classify objects into units. This suggests that the Key Stage Two children are more capable of completing much higher demanding tasks using CAL.

In order for the CAL program to allow for these higher demanding tasks, the following characteristics should be achieved. The completion of these characteristics within the system will allow the task to be enjoyable to the target audience of children.

- To be in control and not be controlled (Druin & Solomon, 1996)
  In order to comply with this requirement, it is important that the children are able to navigate around the program as they wish and are not told what/where they must do/go next.
- To create things and to express themselves (Druin & Solomon, 1996)
  In this criterion, the program must be designed so that the child’s creative influence can be expressed. This will create an interesting system so that each time the child will access the program, there will be different feature that can be explored.
- To be social and to collaborate (Druin & Solomon, 1996)
  The system will be designed for a pair of student so they are able to collaborate and share their ideas.
By complying with the objectives stated above, the CAL program will be enjoyable to the children. This will hopefully make the children want to revisit the program over and over again, which will contribute to their knowledge of music each time the program is used. However, these characteristics will not achieve their goal unless the CAL system is centred around the principle of usability.

3.3 Usability of CAL programs

In the CAL system that will be designed, ‘one of the most deterministic quality parameters of the interactive system is usability’ (Bevan, 1999). Many CAL systems in recent years are not designed with the user in mind which means there is a wide gap between the users and the software (Henry, 1998). The standard definition of usability identified in the ISO 9241-11 is the ‘extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use’ (ISO 9241-11, 1998). Software product ‘with such characteristics actually promote learning and recall’ (Henry, 1998). This attribute of the CAL system will be the main focus of the project.
Chapter 4 - Methodologies

A methodology is a framework used form constructing any kind of product. It lays down ‘a set of guidelines, rules and, practices used in the development process’ (Nash, 2003). It is these sets that differentiate between methodologies. As stated in the chapter 3.3, the solution to a successful CAL system is usability. The key to making this characteristic achievable is to ensure that the methodology chosen will be primarily user-centred (ISO 13407, 1999).

4.1 User-centred design

‘There is still no real agreement on the definition of user-centred design’ (Karat & Atwood & Dray & Rantzer & Wixon, 1996). An industry standard (ISO 13407, 1999) describes how human-centred design process can be used in order to develop usable systems; however no definition on what human-centred design is given. Many people have given their opinion on what they believe it is. One definition on the user-centred design process:

‘For me, UCD is an interactive process whose goal is the development of usable systems, achieved through involvement of potential users of systems in system design’
(Karat & Atwood & Dray & Rantzer & Wixon, 1996).

As we can see from this definition, the user must be involved in the design process but to what extent is still undecided. It will be up to the designer of the system to this extent of user involvement. Therefore it has been decided to make the user the main focus of the design of the system, as undertaking this, the usability objective of the system will be met.

The ISO 13407 (1999), the industry standard for the development of interactive systems states types of activities that should be included in such development, however has not specified any specific techniques to be used. The following section will be dedicated to finding a methodology that is primarily user-centred in order to discover specific techniques that will be used.

4. 2 Methodologies

As a starting point to deciding which methodology should be used, the oldest methodology (Nash, 2003) will be examined first.

4.2.1 Waterfall Model

The waterfall model designed by Roy Royce in the 1970s is ‘one of the simplest and oldest methodologies’ (Nash, 2003). It follows a simple sequence in a ‘linear fashion from one step to the next’ (Nash, 2003). This model requires each phase to be completed before the developer may continue to the next.

The waterfall model, being foremost in methodologies is well tried and tested (Avison & Fitzgerald, 2003). This includes, preventing unexpected high costs and preventing low expected benefits (Avison &
Fitzgerald, 2003). On the other hand, the waterfall methodology may fail due to:

- Requirements changing frequently and rapidly (Nash, 2003). As this model is based on a linear process, it will be very complex to incorporate changes to requirements once the development is underway or if new requirements become clear in the next phase (Avison & Fitzgerald, 2003).
- The amount of risk may remain constant ‘until well into the testing stage when problems are identified’ (Nash, 2003). These problems may have been set in motion in the design stage (Nash, 2003) however not discovered.
- In order to manage the time, people and other resources, each resource must be estimated for each phase. These estimations may become unreliable due to complexity of a phase or poor estimations (Avison & Fitzgerald, 2003).

This methodology is still at present used for many development projects; however for the development of this project it would not be practical. As we can see from the areas where the waterfall model may fail, this methodology will work best in stable situations. This situation would apply for this project. Consequently a methodology must be chosen that will take less than the entire lifecycle to produce a product and therefore have the ability to test the usability with real-users before the end of this lifecycle (Neilson, 1993). The user must have continuous input in all phases on the lifecycle and not merely at the start to define the system requirements.

4.2.2 Spiral Model

Designed by Boeham as early as 1986 (Boehm, 1986), this methodology will produce a system that will continue to evolve all the time (Avison & Fitzgerald, 2003). This model has been developed based on the waterfall model; it adapts the phases into a circular process, each spiral representing one life cycle. ‘The key feature here is that the process loops back on itself’ (Nash, 2003), at each cycle the project will gain incremental functionality (Nash, 2003).

At the first iteration, a prototype with the main objectives (a subset of the total requirements) of the system is included. At each consecutive iteration, a fuller set of the total requirements are included into the prototype; this may include new requirements that may have been thought of as additional experience and knowledge of the system is gained. These iterations will stretch over the life of the system as the requirements continue to evolving and changing all the time however this will entail relatively small maintenance and change to the system (Avison & Fitzgerald, 2003).
This methodology eliminates the possibility of failure where the waterfall model may have. This is achieved by allowing the development of the system to be incremental and iterative. This methodology will resolve the problem of allowing great deal more user input at the beginning of each iteration. However there is need for input from users at each stage of development and not merely at the beginning of each iteration.

### 4.2.3 Rapid Application Development (RAD) Model

The aim of RAD methodologies is to produce high quality products quickly through the use of iterative prototyping. RAD will develop a system within a fixed deadline which may require sacrificing some functionality (Bosworth & Kabay, 2002). ‘The main techniques used in RAD are joint requirements planning (JRP) and joint application design (JAD)’ (Bosworth & Kabay, 2002). The word ‘joint’ in these techniques refers to the ‘developers and users working together through heavy use of workshops’ (Bosworth & Kabay, 2002).

The iterative processes only refers to the design and build phase and the user input only received from the JRP in this stage. Consequently this methodology is not user-centred throughout the process and therefore does not satisfy the credentials required for this project. Due to this, the usability engineering model (Neilson, 1992) is examined.

### 4.2.4 Usability Engineering Model

The usability engineering lifecycle (Neilson, 1992) has the user as the most integral part of its model. This model ‘described the various components that will make up a User Centred Design approach’ (Faulkner, 2000). This methodology has its foundations in the Human-Computer Interaction discipline and in software engineering (Granollers, 2003). This method identifies the clear importance of communication with the user at each of the three main processes; iterative design, prototyping and empirical user testing (Neilson, 1992). This combination of HCI and software engineering has been shown to deliver more usable systems.

As we can see, this model evidently has Boehm’s spiral model as a basis of it software engineering, through its use of iterative design. However it also combines elements of the RAD model through its use of user input. Nevertheless this model has a great deal more emphasis on user involvement throughout the development process and not only in one stage of the design process like RAD and the spiral model.

### 4.3 Methodology Chosen.

The usability engineering model has been chose due to its’ extensive user participation throughout the process. Therefore it is essential that the stages in this process are looked at in greater detail. Neilson (1992) divides this model into three main sections which are described below:


**Pre-design Stage**

This stage will gather information on the user. It should be gathered prior to the start of any design in order to reduce the amount of re-designing required hence reduce the expense of the project (Neilson, 1992). This stage is divided into three sub-sections:

**Know the user**

This is the first step in the usability process and its objective is to gain knowledge on the intended users of the system. The term user ‘should be defined to include everybody whose work will be affected by the product in some way’ (Neilson, 1992). Therefore this will not only include direct users but also any system administrators and support staff (Neilson, 1992). A visit to the user’s work place will be required in order to ‘gain a feel for how the product will be used’ (Neilson, 1992). The following should be identifies as part of this study:

- Any differentiations in individual user characteristics; this will include computer experience, educational level and age of users. (Neilson, 1992). This will make it ‘possible to articulate their learning difficulties to some extent and to better set appropriate limits for the complexity of the user interface’ (Neilson, 1993).
- The identification of the current approach to the task in hand is required. This will include the goal of the user, information required to complete the task and how emergencies and exceptional circumstances are dealt with (Neilson, 1992). This will give a suggestion of the weaknesses of the current approach to the task (Neilson, 1992), which will include ‘points where users failed to achieve goals, spend excessive time, or are made uncomfortable’ (Neilson, 1993).
- A functional analysis identifying the ‘underlying functional reason for the task’ (Neilson, 1992).
- The evolution of the user. ‘Using the system changes the users, and as they change they use the system in new ways’ (Neilson, 1993). In order to avoid designing a system for novice users only (Neilson, 1992), an educational estimate must be made on how users have changed in the past (Neilson, 1993). ‘A typical change is that users become experts after some time and want interaction shortcuts’ (Neilson, 1993).

**Competitive analysis**

Existing product offering solutions to the task in hand should be examined. This process often gives an initial, and possibly ‘best prototypes for our own product’ (Neilson, 1992). The products will be evaluated against a set of usability heuristics or guidelines and by empirical users testing (Neilson, 1992).

**Setting usability goals**
There are five different attributes that is associated with the notion of usability (Matera & Costabile, 2002).

- Learnability – ‘the easy of learning the behaviour of the system’ (Matera & Costabile, 2002)
- Effectiveness – ‘the level of attainable performances, once the user has learned the system’ (Matera & Costabile, 2002)
- Robustness – ‘likelihood of user error, and ease with which users can correct errors’ (Matera & Costabile, 2002)
- Memorability – ‘Ability of infrequent user to return to the system without having to learn it over again’ (Neilson, 1992).
- User’s satisfaction

These five attributes will need to be prioritised based on project type, as trying to achieve all of these to the same strength will no doubt end in conflict. The most important level of each attribute to define is the worst acceptable level as this ‘indicates the product would be of no use if that level of usability is not achieved’ (Neilson, 1992).

**Design Stage**

This stage is concerned with the issues relating to making the system as usable as possible.

**Participatory design / Empirical analysis**

Subsequent to the pre-design stage of knowing the user, we still do not ‘know the user sufficiently well to answer all issues that come up in doing the design’ (Neilson, 1993). Therefore the system users should be involved in the designing of the system by testing system prototypes. The user testing consists of testing ‘which usability properties are assessed by observing how the system is actually used by some representation of real users’ (Matera & Costabile, 2002). The main drawback of this type of empirical evaluation is the difficulty of selecting the correct user sample (Matera & Costabile, 2002). This project has added difficulty due to the relatively young age of the direct user (Neilson, 1993). This will limit the amount of development that can be completed with the pupils.

**Heuristic Analysis**

The heuristic analysis is a form of analytical evaluation (Neilson & Molich, 1990). It will uncover usability problems by using a set of recognised usability principles called the heuristics (Neilson, 1992). These heuristics ‘identify specific usability properties than an application should satisfy, in order to be usable’ (Matera & Costabile, 2002). Research has shown that this evaluation is a very efficient usability engineering technique (Desurvire & Jeffries, 1992) with high benefit cost-ratio (Neilson, 1993). There are many set of heuristics that have been designed to ensure a usable interface is designed. The heuristics that will be used for the evaluation
of this system will be a combination of a set of ten heuristics by Neilson (1993) and a set of eight rules by Shneiderman (2002). These two sets of heuristics are documented in Appendix E.

**Prototyping**

A final system that is based prototypes ‘can be developed much faster and much more cheaply’ (Neilson, 1993). This is due to ‘somehow reducing the number of features compare to with the full system’ (Neilson, 1993). The way this will be achieved for this product is by ‘vertical prototyping’ (Neilson, 1993). The prototype designed will be a ‘narrow system that does include in depth functionality, but only for a few selected features’ (Neilson, 1993).

**Iterative design**

The goal of the analytical and empirical testing is to ‘provide feedback in software development, supporting an iterative development process’ (Carroll & Rosson, 1985). Therefore a new prototype will be produced by refining the previous version with the use of the heuristic evaluation and the user testing (Neilson, 1993).

The principle of converging operations (Brinck & Gergle & Wood, 2002) will be applied in order to prioritise the problems discovered in the heuristic evaluation and user testing. This principle states ‘if you come to the same conclusion from more than one approach to a problem, then that conclusion is more likely to be correct’ (Brinck & Gergle & Wood, 2002). In other words, if a problem is detected through the heuristic and empirical evaluation methods, the problem should be given a high priority.

**Post-design Stage**

This stage is concerned with gathering usability information for the next version of the product (Neilson, 1992). As there will be no subsequently version of the product produced in this project, this section will not need to be discussed.

Following the definition of all the component of the usability engineering lifecycle required to produce a user-centred product, the fist phase of this methodology, the pre-design stage may be undertaken.
Chapter 5 – Pre-Design Stage

This chapter is based on the issues discussed by Neilson (1992) in the pre-design stage in the usability engineering lifecycle. Each of the sub-divisions of this phase will be examined.

5.1 Know the user

As described in Chapter 4.3, the pre-design stage of knowing the user is sub divided into the following subheading; differentiations in individual characteristics, current approach to task, functional analysis and evolution of user (Neilson, 1992). Consequently, the following section will follow this division. The following information has been deduced from a number of visits to Bryn Coch Primary School in North Wales.

5.1.1 Individual Characteristics

As the system will include the child as the learner and the teacher as the administrator, each of these users must be examined. The following information has been gathered by informal discussions with various Key Stage Two teachers at Bryn Coch Primary School.

The Teachers

The teachers in the school range from newly qualified being in their early twenties, to several teachers possessing several years teaching experience, to very experienced teachers with over twenty and twenty five plus years teaching experience. However, it must be assumed that the teacher’s age in a school could be anything up to the state retirement age of sixty for women and sixty five for men.

At the school, there is a wide range of computer experience among the teachers. The newly qualified and younger professionals tend to have ICT skills and up to date knowledge of current technologies, which have been an ongoing part of a university degree, through teacher training or postgraduate courses. All teachers at the school have further developed their computer skills through attending courses as part of their professional development.

The members of staff who are more ICT confident will allocate lesson time to pupils, allowing them to develop their computer skills. However, less confident members of staff, tend to be rather reluctant to timetable pupils to computer tasks while teaching a lesson. If errors occur on the computer, it is unlikely that the less confident teacher will be able to solve the problem and therefore unless the teacher has spare time to attempt to solve the problems, the computers will not be used.

Similarly, the music experience of the teacher range at the school. The music coordinator at the school contains the greatest amount of musical experience and knowledge and has numerous musical qualifications including being a Bachelor of music, Master of Art in performing art and Licentiate Trinity College of London (LTCL). The non-specialist teachers do not possess much musical knowledge, as all that is required of them is
to follow the schemes of work from the national curriculum.

**The Children**

The children in Key Stage Two range from the age of seven to eleven years of age. In extreme circumstances, for example health problems, pupils may not be in a year group corresponding to their chronological age.

On average, in a class of pupils at Bryn Coch Primary School, the children can range in education ability. The lower ability children are able to receive additional support from an ‘inclusion teacher’ at the school. The ‘inclusion teacher’ will support pupils that have problems with reading and writing skills. There is no additional support available for other subjects apart from reading and writing.

In addition there are two special needs schools in the district that on a regular basis will attend creative at the school. There are two schools which regularly attend, Ysgol Delyn (Delyn School), a school with SLD (sever learning disabilities) pupils and Ysgol Belmont (Belmont School), a school with MLD (moderate learning disabilities). Only around one child from each of the school will attend Bryn Coch Primary School with their Support Worker each week. The majority of the children will attend the equivalent year groups for their age. There pupils will gain a great deal from there visits, especially in practical and creative exercises, for example music, dance and CDT.

A large percentage of the children have and use computers at home. These children will have high-quality computer skills as they will be regularly get the change to use their computers. However the children who do not get the opportunity to use computer out side school hours, rely only on the ICT that they perform in school. As there is only one computer in each classroom and one ICT suite in the schools, the children will not get the opportunity to use the computers a great deal. For these children with less confident teachers, they will not receive much ICT at all apart from around two hours per week in the ICT suite.

The school instrumental lessons, taken by a peripatetic teacher from outside the school will start from around Year 3. The pupils are able to take violin, cello, brass, woodwind and percussion for around forty five to an hour and a half a week. It is obvious that these children will a good musical knowledge. Therefore throughout the range of Key Stage Two, there will be great differences in musical knowledge.

The work environment of the users when computer are used, is either of the situations shown in figure 5.1. The picture on the left is an individual computer which is situated in every classroom throughout the school and the picture on the right is the ICT suite in the school. The classroom computer will be used by either an individual or pair of children in lesson time or whenever a teacher is present for example break times or dinner times when it is raining. The ICT suit at this school is a rare resource. Many other primary schools in the area are not do fortunate due to physicality of the school or financial resources. This will be allocated to each class around two hours per week. The ICT suite is also used for extra curricular subject taken after school or in lunch
5.1.2 Current Approach to task

While at ‘Bryn Coch Primary School’, it was possible to attend two music lessons. The first lesson was carried out by the school’s music coordinator and one additional non-specialist music teacher to a class of year four children. This lesson was based on ‘Space Music’ (Figure 5.2). The children were told to close their eyes and listen very carefully to the instruments being played and the tempo while the teacher played a musical piece by a composer called ‘Toto Techamitso’. The issues of tempo and instruments were discussed as a class. The piece was played for a second time, in order for all the children to recognise the alteration in tempo and the change in instruments used. A second musical piece was played, also based on the space theme with a constant tempo, the children this time where able to tap and click their fingers along to the rhythm. The next exercise given to the children was to compose their own composition based on the space theme. The children were divided into groups of threes and given a variety of instruments to use including triangles, drums, xylophone, maracas, tambourines, symbols, keyboards. This lesson was cut short due to the hall being needed by other classes. Therefore the children were told to remember in which group they were in and which instruments they were using for next week’s lesson.

The second musical lesson was carried out on a greater scale of around one hundred children present by three teachers including the music coordinator. This lesson was a singing exercise. Firstly pictures were shown...
to the children of different types of dancing from different cultures from around the world including, Morris
dancing from England, New Zealand stick dancing, Spanish hapanera dancing, capoeira dancing from Africa
and finally Rock and Roll dancing largely from America in the 1960s. It was then explained that they would be
looking at a musical piece from the 1960s that was composed for Rock and Roll dancing, this piece was called
‘The Hop’. The class was divided up into girls and boys and the teachers went through the words to each section
with the children. This lesson was also cut short as the allocated time was up.

The national curriculum for music in Key Stage Two is divided into four main sections; singing,
appraising, composing and performing (National Curriculum Online, 2004). Since the visit to the school, this
confirms what the literature in chapter two suggested. The first lesson seemed to intertwine listening, appraising
and composing elements and the second lesson was singing oriented with aspects of listening and appraising
also. Each lesson seems to have focused one main component of the curriculum but due to the link between
these creative components, the activity cannot be completed without input from another area.

As we can see, the time used for practical music lessons did not seem long enough as the current
activity that was trying to be achieved needed to be left until the next lesson in a week’s time.

Inspection Report
The following are the results of the current inspection completed at the school to comply with The School
Inspection Act 1996. The comments received by the inspectors on the music lessons undertaken in Key Stage
Two will give the indication of how good the music lessons that they undertake are.

- The standards of achievement of music in the schools are good in Key Stage Two (Newman, 2001).
- ‘By KS2, pupils listen well to music. Y3 pupils can identify the sadness in the “Pavane to a Dead
  Infanta” and they can describe their feelings in listening to music, They know that the dance this would
  be played for would be slow and stately and can “walk” their fingers in time to the music’ They recognise
  that the instruments being played is a piano and can use simple subject vocabulary accurately’ (Newman,
  2001).
- ‘By the upper end of KS2, pupils sing with good pitch and tone and have good understanding of tempo.
  Their diction is clear and crisp when singing in two and in three parts. There are good standards of
  discussion when they evaluate their performance and suggest ways of improving it’ (Newman, 2001).
- ‘KS2 pupils can use the major notes to compose a Christmas Carol and have good understanding of
  how to use syllables to represent different beats. Pupils work well together when planning ways to
  varying the rhythm to fit the words. They are ready to listen to other opinions and to appraise their own
- ‘Y6 pupils can define an ostinato and achieve good standards of performance in small groups to
demonstrate their understanding. (Newman, 2001).
These report findings indicate that the national curriculum in Bryn Coch School is being achieved in music. This must be one of the four in ten that are achieving good/excellent achievements in music (QCA, 2004). Therefore there does not seem to be much weaknesses to the current means of doing the task at Bryn Coch Primary School.

5.1.3 Functional Analysis

The purpose of teaching music to the Key Stage Two level is to comply with the national curriculum, which all schools must comply with. The functional aim of the national curriculum in music is to ‘give all pupils the instrumental skills they need for an active and life-long involvement in music’ (QCA, 2004). This is the underlying reason why the task is being performed.

5.1.4 Evolution of User

After numerous conversations with teachers in the school, it became clear that the novice computer users would require extensive help in order to complete a task without assistance from their teacher. The child would easily become distracted, irritated and lose interest in the system if they did not understand exactly what was required to accomplish the task. However as the child becomes a frequent user of the system, this help would not be required. They are easily able to remember the structure of educational product. As the majority of the children have a computer at home, they posses a high-quality computer level and therefore are able to quickly pick up how computer program in the classroom are used. However as not all children can be placed in this category, help should be provided by the system but only at the users request. It was also mentioned by the teachers that shortcuts should be provided to items that would usually take the user many clicks of the mouse to get to.

5.2 Competitive analysis

The completive analysis will be based on software programs currently on the market that target the age range of pupils within Key Stage Two. The main competitive analysis will be complete on products that offer areas within the music national curriculum.

The evaluation criteria for these products will be based on the ten usability heuristics by Neilson (1992) shown in Appendix D, and the ease of navigation. These products will also be empirically tested by a small number of Key Stage Two pupils. None of the product chosen actually covers the whole of the music Key Stage Two syllabus therefore performing content analysis would be of no interest. Each usability criterion will be awarded a maximum of five marks each and a mark out of ten for the navigation. Therefore the overall maximum mark possible for any product will be sixty.
O-Generator

This product is split into various lessons, where the first lesson must be complete before the next lesson can be accessed. The first lesson starts by exploring the concept of rhythms and then giving the children different exercises to experiment making different type of rhythms for various styles of music e.g. Hip Hop, Drum n Bass, and Dance. These lessons continue in the same format exploring a variety of topics for example melody, arranging music and exploring the guitar.

The children who experimented with this system seemed to find it very enjoyable. After following a basic tutorial of what a Hip Hop beat should sound like, they where able to experiment by adding and removing beats and able to hear immediately the alteration this made to the rhythm. The instructions where in the form of a voice speaking to the user and seemed easy to follow as they where divided into smaller instructions. Once the next instruction was ready, the voice would stop the continue button would start flashing. The main pitfall of this program is that not much help was included with this system as it is designed for a class of children therefore any help required could be directed at the teacher.

The heuristic evaluation score received by the O-Generator is a 37/60. This program was very good however scored a zero for many of the heuristics. This included no feedback to the user, no help or documentation or no shortcuts.

Dance e-Jay 4

Dance e-Jay provides the user with samples of various beats and vocals. The user will arrange these beats and vocals in order to compose various songs. There are many additional options available, for example effects studio, drum matrix and voice studio. These options allow the user to create their own beats and voice samples to use in their compositions.

The empirical evaluation of the product found that the user could easily begin composing using the sample beats and voices provided, however the addition options where a little to complex for the age of user. The pupils seemed to enjoy composing on the program as the songs produced did sound fairly professional. However, the major drawback with this product is that it didn’t really introduce many of the musical elements (tempo, pitch etc) to the user.

The heuristic evaluation of this product scored a 34/60. There was nothing outstanding about the interface design, for each heuristic is scored an average of 3/5.

FlexiMusic Kids Composer

This software allowed the user to experiment with composing rhythm and melodies with various instruments. It provided the user with a very simple interface with no navigation required as everything was located on the same page.
The empirical testing found that the no instruction on use was required by the user as there was an instruction bar along the bottom of the page which allowed for instruction to be communicated to the user wherever the user clicked over any of the commands. It enabled the user to start experimenting with composing straight away, however it did not really teach the children about any of the musical concepts connected with the Key Stage Two syllabus.

The heuristic evaluation score for the FlexiMusic Kids Composer is 46/60. The interface was designed well for the target audience. The only bad score received was the lack of feedback to the user.

5.3 Setting usability goals

Each of the five usability attributes mentioned in Chapter 4.3, will be prioritise based on this individual project and set minimum acceptable levels. The attributes are prioritised from highest priority to the lowest below:

<table>
<thead>
<tr>
<th>Priority</th>
<th>Usability Goal</th>
<th>Worst Acceptable Level</th>
<th>Acceptable Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>User’s satisfaction</td>
<td>The user’s feels satisfied with what they have achieved while using the program and are willing to use the program again.</td>
<td>The user’s have enjoyed the system and want to use it again.</td>
</tr>
<tr>
<td>2</td>
<td>Robustness</td>
<td>Errors will not occur frequently however in the circumstance that an error is caused, the user will be directed to the problem immediately.</td>
<td>No errors will occur therefore there is no need for users to correct any errors.</td>
</tr>
<tr>
<td>3</td>
<td>Memorability</td>
<td>Infrequent user may return to the system and be able to use the system effectively quickly.</td>
<td>The system will be self explanatory to the user therefore infrequent user will be able to user the system with no difficulty.</td>
</tr>
<tr>
<td>4</td>
<td>Learnability</td>
<td>After the system has been used for a little while, the user will know what is required of them.</td>
<td>The users will know what the system is asking of them as soon as the instruction is displayed</td>
</tr>
<tr>
<td>5</td>
<td>Effectiveness</td>
<td>After the system has been used for a little while, the level of performance of a novice will be equal to an experienced user.</td>
<td>Performance levels should be constant, if the system is learnt or not.</td>
</tr>
</tbody>
</table>
Strangely enough, the user requirements for the CAL system will not be collected directly from the main users of the system, the children. Alternatively the teachers will provide the requirements. As it is the national curriculum (described in chapter 3) that specifies the elements of music that should be taught to key stage two children, it is the teachers who design effective methods of delivering the national curriculum to the children.

6.1 Interview with key stage two teachers.

The interviews were conducted with the following objectives in mind:

- To determine if there is a need for such a system
- To determine what aspects of the music national curriculum should be included in the system
- To determine the ability of pupil the system should accommodate
- To determine what attributes will enable children learning from the system more effective

In order to determine each of these objectives a set of questions, relevant to each individual objective will be asked to the teachers. These questions, will attempt to confirm what the literature in chapter two and three have suggested.

(1) To determine if there is a need for such a system

The literature in chapter two suggests there is need for additional ICT equipment made available in order to improve the quality of the music education gained by each pupil. With most teachers having little confidence and experience in teaching music, the best ICT solution seems to be a CAL system that will require little teacher input. Such a system will ‘reinforce and extend music learning’ (QCA, 2004) from the classroom as little time is available to do so in the next lesson.

By asking the teachers the following questions, it will determine if the teachers agree with the assumption gathered from the literature. If the literature and the answer to the interview questions agree, it seems that there is definitely a place for such a program

- Have you any experience in teaching music?
- Do you have any ICT for aiding the learning of pupils in music?
- Do you feel that there is a place for a CAL program?
(2) To determine what aspects of music should be included in the system

As the literature from chapter two states that the national curriculum is overcrowded at present and that music ‘is still a lottery in the primary phase’ (Ofted, 2003 in QCA, 2004), it seems unlikely that material that will be contained in the CAL will extend beyond the content of the music curriculum.

The first question in this section will determine if the system should take the child’s learning further that the current national curriculum. The subsequent questions in this section are enquiring what part of the curriculum the pupils find more difficult and is it these areas that the program should focus on.

- Do you think children could be taught music in the classroom that goes further than the current national curriculum?
- What area(s) of the national curriculum in music do you find children have the most difficulties with?
- What specific features would you like to see the computer program contain?

(3) To determine the ability of pupil the system should accommodate

The literature states that the content of the curriculum at present does not seem to be met (QCA, 2004). The curriculum standards should be obtained by ‘pupils of different abilities and maturities’ (Education Act, 1996). In the musical lessons attended at Bryn Coch Primary School, each ability of child attended the same lesson therefore it seems likely that the system should accommodate for all ability of pupil, as all pupils will need to ‘reinforce and extend music learning’ (QCA, 2004). However does the lower ability of children require additional musical help but the national curriculum timetable does not allow for this? In order to determine this system requirement, the following question will be asked.

- Do you find it hard to teach children of different abilities music at the same time?

(4) To determine what attributes will enable children learning from the system more effective

As the fundamental aim of the music curriculum is to ‘give all children the instrumental skills they need for an active and life-long involvement in music’ (QCA, 2004). If the child already possesses some instrumental skills outside of school, does this attribute assist in the classroom musical education? In the composition lesson that was attended in Bryn Coch Primary School, collaborate working was used. Does allowing the pupils to compose in this way enable more effective learning that individual music composition? The following questions will be asked to determine there issues.

- Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?
- Do you feel that children will improve their learning in such a system if they work together (collaborate
6.2 Results

Section 1

A large percentage of the teachers did have some kind of teaching experience, even if it was not a professional music qualification. All of the teachers that were interviewed agreed that there was a need for a CAL program that aided music. One teacher stated, ‘ICT should be integral to all subjects within the national curriculum’. This opinion was expressed by the majority of the teachers. The teachers used various ICT for example keyboards, tape recorders, CD players however none of the teacher used any computer programs. Many opinions where suggested why ICT should be used including; allowing a higher percentage of children of low ability to become more interested in music, permit interaction at their own pace, children enjoy using such educational software as they see it as a reward to be allowed to go and ‘play’ on the computer.

The music coordinator in one of the schools acknowledged that he had ‘looked into many computer programs but as of yet there are no programs that really helps the children.’ Being in control of music for a school and not being able to find a suitable program suggests that there is an undoubtedly a place for such a system. This may be the reason why another teacher stated ‘I’m sure I should be using it more and I would welcome that.’ If software, which actually supported the national curriculum, was available, it seems likely that a higher percentage of the teacher would be eager to use it.

Section 2

‘The national curriculum provides levels and low ability children would not be able to go beyond these levels.’ It may be possible for higher ability children to exceed the level set by the national curriculum, however due to the limited time aspect given to music this is not incorporated into the classroom music lessons. ‘Children who want to take music further get the opportunity to take up playing a musical instrument.’

Appraising, listening and composing where all mentioned as the most difficult part of the curriculum. It seems that children have difficulties with most areas of the curriculum.

The system should be designed in an interactive fashion, this will facilitate the child to gain help on areas of the activities he/she is having most difficulty with. The appraising aspect should allow the child to have the ‘opportunity to see and hear the musical instruments used within an orchestra and from different cultures around the world’. On the other hand, the composition aspect should allow the child to ‘feel that they have composed a piece of music for themselves’. It should contain facilities to play back the child’s composition are make alterations if necessary.
Section 3

These teachers did not find it hard to teach a class of diverse abilities children at once. The ability of the child was said not to contribute towards the learning of music. ‘Music is one of the subjects that children with difficulties can access quite readily’.

Section 4

The music coordinator suggested that pupils who play musical instruments do just as well in the creative aspect of music as the other children. The ‘composition skills tend to be on a similar level to those children who don’t play an instrument’. Apart from the creative element of composition, the pupils did have considerable differences. ‘There concentration, memory skills, coordination generally is certainly better’, they are able to ‘listen to tone, listen to pitch and loudness and softness’ and ‘more interested’ in music generally. The ability to play a musical instrument is definitely an advantage on the whole to the elements of the music curriculum.

It was suggested that collaborate working could be used so that a ‘poorer ability children … can see how the better ability children perform and are able to pick that up’. Collaborate working of this kind was suggested to be an important aspect of teaching music. The children could ‘discuss their ideas with peer at a level that they understand themselves’.

6.3 Conclusion to requirement collection

As it has already been concluded that only a prototype of the system should be designed, as some teachers specify that the system should accommodate for the whole national curriculum, this will not be achievable. Only a prototype containing the area in which all abilities of children are able to complete to the same standard, whether a musical instrument is played is played or not will be chosen. Therefore composition has been chosen as the main element of the system. As mentioned in Chapter two, all the elements of the curriculum are intertwined therefore the system will also contain aspects of listening, performing and appraising.

As the fundamental objective of curricular music is to ‘give all pupils the instrumental skills they need for an active and life-long involvement in music’ (QCA, 2004) and that year three is the year in which many of the pupils start playing instruments, it seems clear that the aspect of providing users the ‘instrumental skills’ (QCA, 2004) should be incorporated into the program through the use of a keyboard.

Another key issue was that discussed in the interviews was the pupils being able to work together so ideas can be shared while composing. This was seen in the musical lesson at Bryn Coch Primary School, pupils worked in small groups to compose. Therefore the system should also be able to manage a pair of pupils working together. This view was also suggested by Druin & Solomon (1996) as one of the most important
aspects of a CAL program for children.

6.4 System Requirements

Subsequent to the teacher’s interviews, the pre-design stage undertaken in chapter four and the literature researched in chapter two and three, the following system requirements have been defined:

(a) Functional requirements

Core functional requirements:

- **Collaborate working**: The system will be designed to accommodate for children working together at the same computer in order for sharing of ideas.
- **Users**: Any ability of child in key stage two may use the system
- **Musical instrument playing**: The system will allow for teaching the basics of a percussion musical instrument, through composition using the keyboard.
- **Content**: The system will be designed to reinforce only the music that is taught in the classroom, it should not try to go any further that the national curriculum for key stage two.

Additional functional requirements:

- **Exercises**: Help the user to understand components of the curriculum through basic exercises
- **Composition**: Ability to save and playback compositions.
- **User support**: Allows the user to receive help on any part of the system that they are having difficulties with. This will not only include help on navigations but also help with ideas when composing.
- **Log In facilities**: Enables personalization of system and ability to load compositions and see which exercises have been completed.

(b) Non-functional requirements

- **Administrative tools**: Allow the teacher to set up the midi devices and provide feedback to the user on compositions.
- **Layout**: It is important that the layout of each component of the system is consistent. Also the issues of visual logic, clutter and focus should be considered.
- **Portability**: Ensure that the system can manage a range of midi input and output devices and a range of operating systems
- **Security**: the administration section of the application should be password protected.
Chapter 6 – Design Issues.
This section is divided up into interface design and content design. These two issues are discussed below:

6.1 Interface Design

The goal of interface design is to reduce visual work, intellectual work, memory work, motor work and eliminate the burden imposed by technology (Dix & Finley & Abowd & Beale, 1998). The result of which is to produce an interface which will improve productivity and satisfaction of the user. As the interface designed for this system will be primarily based on the principles related to HCI, it is important that the elements of this subject are examined. The research in this area will uncover a number of crucial issues that will need to be addressed in the design of the interface.

6.1.1 Human-Computer Interaction (HCI)

Human computer interaction is one of the most important characteristics of a computer based learning system. It is essential these days that humans spend less time mastering the software and more time learning. This procedure is very important; one example of this is IBM. They gained 400% increase in their online sales once they redesigned the site, making it more user-friendly (Karat & Karat, 2003). The area of HCI will be examined separately, firstly we will look at the human then the user, then finally at the interaction process between the two.

6.1.1.1 Human Characteristics

We have previously examined the user at their place of work in the pre-design stage and identified the individual characteristic that will need considering. Now it is essential that human psychology is examined in order to ‘understand the capabilities and limitations of that person’ (Dix & Finley & Abowd & Beale, 1998). The main aspect of human psychology that will need to be examined is ‘how they (humans) store and process information’ (Dix & Finley & Abowd & Beale, 1998).

Human as processor of information.

The information processing theories articulate that the human mind works in an identical way to a computer (Shaffer, 2002). One significant factor to this theory is that ‘both the human mind and a computer have limited capacity for processing information’ (Shaffer, 2002). This limited capacity information system will require strategies in order to process the information provided successfully.

There are three types of memory, sensory store, short-term memory and long-term memory. The sensory memory receives input from the various stimuli from the senses; visual, aural and touch (Dix & Finley & Abowd & Beale, 1998). This information is passed to the short-term memory by means of attention, ‘thereby
filtering the stimuli to only those which are of interest at a given time’ (Dix & Finley & Abowd & Beale, 1998). If the knowledge kept in the short-term memory must be passed to the long-term memory by rehearsal techniques otherwise the information will be lost. (Dix & Finley & Abowd & Beale, 1998).

This procedure will determine the success of the CAL system. As the main objective of the CAL system is to enable the users to learn, this phrase ‘learn’ will be taken to mean being able to store the information in the long-term memory. The rehearsal technique is where the information is repeated until it is remember (Shaffer, 2002). The easiest way in which the CAL program will be capable of achieving this permanent memory store is by means of tests or quizzes. At the end of each of the exercises, a quiz will be give to the child on the musical concepts relating to that specific exercise.

If the user receives a high score in the test, it is obvious that the information has been remembered in at least the short term. Where as if a low score is achieved, the information should be repeated as the information has been lost in the transition between the sensory store and the short term memory. Subsequently the exercise will need to be repeated. However, in order to be confidence that the information is permanently remembered in the long term memory, the test should also be repeated the next time the system is used except without giving the user the information required prior to the quiz. This additional requirement will be added to the system requirements defined in Chapter six.

The next issue that will need to be inspected is how exactly the computer will interact will the user. An ‘interactive system is to aid the user in accomplishing goals from some application domain.’ (Dix & Finley & Abowd & Beale, 1998). Therefore the central task the ability to move this information from the computer to the user in order for processing to be accomplished. By enabling this activity, the user will be able to accomplish their goals.

6.1.1.2 Computer Characteristics

The visual stimuli provided to the users short-term memory will be in the form of the graphical interface shown on the computer screen. The only aural stimuli that will be provided by the system to the user is through the user of sound, which will be an important characteristic as it music based. The issues related to communicating these stimuli to the users are described below:

Interaction Techniques

When designing software for children, the use of graphics should be used whenever possible. ‘Graphics provide the most natural means of communicating with a computer’ (Foley & van Dam & Feiner & Hughes, 1997). The ancient Chinese proverb ‘a picture is worth ten thousand words’ will give us an indication of why exactly this is. However, in this day and age, a combination of all different mediums can be used to obtain the
most efficient and effective way of communicate the information to the user; this is defined as multimedia. For this CAL system the following mediums will be used:

- Text
- Sound / Audio
- Images / Graphics
- Animation

As text will be used throughout the system to communicate the instructions on each exercise to the user, it is important that the user is able to understand all that is being communicated. Due to the young age of the users, not only is it required to eliminate the use of computer jargon but it is essential that vocabulary that they have not yet come across is used. If these goals are not met, it is unlikely that the user will learning anything from the system.

**Interface Language**

The language used for the system will be kept fairly simple due to the young age of the target audience. Therefore while designing the system; this will be taken into considered however the real test will be completed in the first prototype iteration. A pair of year three teachers will evaluate primarily the language of the system, making any suggesting as they proceed.

The visual stimuli that are required to the user must be easily recognisable; otherwise it will be unclear which of the visual aspects of the system are the most significant. For these young target users, this will be achieve by the effective use of colour. In order for the optimum effect to be produced to the visual stimuli, the aspect of colour must be examined.

**Colour**

Colour must be considered when designing the text, graphics and animation. The use of colour can be used to establish a tone or mood, for realism and to highlight (Foley & van Dam & Feiner & Hughes, 1997). ‘Careless use of colour can make the display less useful or less attractive that a corresponding monochrome presentation’ (Foley & van Dam & Feiner & Hughes, 1997). ‘Poorly designed products will simply become colourful poorly designed products’ (Galitz, 2002). Galitz (2002) has specified several key colour issues that should be taken into account to optimize the user of colour.

- ‘Select no more that four or five colours widely spaced on the colour spectrum’ (Galitz, 2002).
- ‘To draw attention or emphasize elements, use bright highlighted colours’ (Galitz, 2002).
- For background colour, cool colour such as blue, green, violet draws away the user’s attention.
Galitz, 2002).

- For foreground colours, the use of ‘warmer more attractive colours’ (Galitz, 2002) that ‘highly contrast with background colour’ (Galitz, 2002).

- If colour is used for text, the use of larger font size and the width between the lines should be doubled (Galitz, 2002).

Taking all this advice about colour into account, the use of a dark blue has been chosen for the background and a bright yellow for the foreground text. By choosing this combination of colours, the small percentage of population with colour blindness has also been taken into account. As we can see from in Figure 6.1 adapted from Galitz (2002), these colours will remain fairly constant.

<table>
<thead>
<tr>
<th>Actual Colour</th>
<th>Red-viewing Deficiency</th>
<th>Green-viewing Deficiency</th>
<th>Blue-viewing Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Greenish-Yellow</td>
<td>Orange</td>
<td>Deeper Yellow</td>
</tr>
<tr>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
<td>Green</td>
</tr>
</tbody>
</table>

Figure 6.1

Now both the individual elements of the human-computer interaction process have been examined; the human and the computer, it is time to consider how these elements will interact with each other. This will be achieved through interaction techniques.

6.1.1.3 Interaction Techniques

The interaction techniques used will be the input and output devices related to the computer. There will be examined below.

Input and Output devices

As the system requirement in chapter six specify that basic instrumental skills should be developed, this will be achieved by using a musical keyboard. A device must be used in order to translate the key presses on the musical keyboard into midi signals that the computer can recognize. This can be achieved through using various different devices. Due to this requirement, the setup shown in Figure 6.2 of input and output devices has been decided upon:
**Input Device Techniques**

The input devices (i.e. mouse and musical keyboard) and output devices (i.e. monitor and speakers) techniques are described below. The mouse will be used for selection purposes on the interface; this means that the mouse will simply send a discrete parameter to the system, reporting the users selected option on the interface. By selecting various options with the mouse (main menu -> Rhythm -> Exercise 1), the musical keyboard will be enabled; hence the user is able to input data to the system. This has been designed in this manner to prevent the users from playing around on the keyboard all the time. The musical keyboard will also only send discrete parameters in the form of MIDI messages, informing the system of the key pressed and the estimated duration of the key press.

**Output Device Techniques**

The monitor will be the only visual output to the user. The techniques used to output the information to the user will be windows and animations. The computer speakers or the musical keyboard can be used to output
the sounds created from the keyboard. The technique used to output the sound created by the user on the keyboard is to send the midi out signals to the speakers or the musical keyboard.

Ergonomics

The relationship between the physical characteristics of a human and the environment parameters is defined as the ergonomics. Britannia (2005) gives a definition of ergonomics as being, ‘profession of designing machines, tools, and work environments to best accommodate human performance and behaviour.’ This definition states that the placement of devices used by the CAL should be checked for optimal performance and behaviour.

Before now, each individual school will have looked carefully at their strategy of workspace design for providing safe and comfortable working conditions when using computers, either a stand alone computer in a classroom or a set of networked computers in an ICT suite. Therefore, all that is required to examine is the placement of the new devices (i.e. the musical keyboard) into the existing workspace.

There does not seem to be a problem of adding the musical keyboard into the workstations. As the computer keyboard will only be used for administration duties it can be substituted with the musical keyboard and the mouse can be moved along to the end of the desk. The monitor will not need to be moved as it is already set up to accommodate for children working in pairs, however the seating used may need to be raise a little to accommodate for the additional height of the musical keyboard against the computer keyboard. This can be achieved by using two computer chairs, as seen in the diagram. This new workstation arrangement is shown in Figure 6.3 below.

Taking all of these issues into consideration including the heuristics set by Neilson and Shneiderman in Appendix D, a simplistic design of the forms used in this CAL is shown in Appendix F.
4.3 Conceptual Design

The conceptual design is required in order to translate the functional requirements collected in chapter six into the user interface design. There are two different conceptual design issues that will need to be inspected; content and navigation design.

4.3.1 Content Design

As it has been decided that vertical prototyping should be used, it has been decided that only the composition elements will be included. Due to this only the educational content of this element that will be considered at present. The composition component should be the main element the exercise should try to achieve, however as the components of the national curriculum are intertwined, this will also be the format of the exercises in the CAL program.

The composition content can be divided neatly into two main sections, see Appendix C section (2)(a); starting with the basics of composing a basic rhythm and the composition of basic melodies. Below, the actual content, the musical elements and elements of the national curriculum trying to be achieved by of each of these exercises will be described. The elements of the Key Stage Two national curriculum for music achieved will be referenced from Appendix C.

Rhythm exercises content

- **Exercise 1:**
  (a) It will first require the user to play basic rhythms on the midi keyboard from a sequence of rhythms that will be shown on the screen. The rhythms shown will all be of time signatures (1/4, 2/4 and 3/4).
  (b) As soon as the user is able to carry out this task, they will be asked to use the different rhythms that where shown to compose their own sequence.
  (c) Once they are happy with their rhythm, they will be asked to record it using the keyboard.

  Musical elements achieved: *tempo (2/4)*
  Section of national curriculum being accomplished: 2(a), (2)(b)

- **Exercise 2:**
  (a) A simple song will be played that will have a structure of ABA. The teacher will ask the user if they are able to hear where the different in structures begins.
  (b) If the user is able to hear this, the teacher will explain that this is caused by a change in the tempo, from a time signature of 3/4 (A) to 2/4 (B) back to 3/4 (A). The Italian terms of *Rallentando* (getting slower) and *Accelerando* (getting faster) will be introduced.
  (c) Now the user will be asked to compose such a sequence. If they are having trouble with this, basic
rhythms may be given to the user to use (like exercise 1).

(d) The user will be asked to record their composition using the keyboard.

Musical elements: \textit{rallentando, accelerando, structure and tempo}.

Section of national curriculum being accomplished: 2(a), (2)(b), (4)(b)

- **Exercise 3:**
  (a) A basic melody will be played to the user.
  (b) The user will be asked to create a rhythm that will accompany this melody. If the user is having difficulties with this exercise (e.g. unable to identify the tempo) the teacher will tell the user the time signature. If a user is still having difficulties composing a rhythm, basic rhythms will be shown to the user as guidance (as in both exercise one and two).
  (c) The user will be asked to record their rhythm on top of the melody using the keyboard.

Musical elements: \textit{tempo}

Section of national curriculum being accomplished: 2(a), (2)(b)

**Melody exercises content**

- **Exercise 1:**
  (a) Play a piece of music that has a continuous ‘drone’ as an accompaniment. Ask the user if they can hear this.
  (b) If they are able to, ask them to try to compose a simple melody on top of a D drone provided using the notes D,E,F,G and A on the keyboard.
  (c) The user will be asked to record their melody, on top of the drone provided using the keyboard.

Musical elements: \textit{pitch}

Section of national curriculum being accomplished: 2(a), (3)(a)

- **Exercise 2:**
  (a) Ask the users to compose a simple question answer melody to the words of a two line poem using the notes C, D, G, A, B
  (b) Allow the user to record their composition against the poem using the keyboard.

Musical elements: \textit{pitch, structure}

Section of national curriculum being accomplished: 2(a), (3)(a)

- **Exercise 3:**
  (a) Introduce the concept of notation to the user. If the user is having difficulties using this notation, allow them to carry on just writing down the letters of the notes they use.
  (b) Ask the user to try to compose a melody in the time signature of 3/4 with a rhythm provided. Explain that this 3/4 time signature is a type of waltz.
  (c) Ask the user to record their composition using the keyboard.
Musical elements: notation, tempo (waltz - 3/4)
Section of national curriculum being accomplished: 2(a)

The following two exercises in the melody exercises are types of composition using cultural instruments.

- **Exercise 4:**
  (a) Play a piece of Chinese origin that will contain a traditional Chinese stringed instrument called the *erhu*.
  (b) Ask the user to compose a melody using the notes D, E, F sharp, A and B to a poem about the Chinese New Year.
  (c) Ask the users to record their composition against the poem using the keyboard.
Musical elements: *pitch*
Musical instrument: *erhu*
Section of national curriculum being accomplished: 2(a)

- **Exercise 5:**
  (a) Play a piece of traditional Indian music that will contain a traditional Indian instrument called the *Wajahat Khan* that using the rāg (Indian scale) and the tāg rhythm pattern.
  (b) Ask the users to compose a melody for the *Wajahat Khan* using the rāg scale against a tāg provided.
  (c) Ask the user to record their compositions against the tāg provided.
Musical elements: *rāg*, *tāg* and *Tempo*
Musical instrument: *Wajahat Khan*
Section of national curriculum being accomplished: 2(a)

These rhythm and melody exercises will combine the components of the national curriculum, similar to the way the musical lessons in Bryn Coch Primary School achieve. Each exercise requires users to perform their composition using the keyboard. Also the majority of the exercises require some listening and appraising skills to examples of music pieces before the composition may begin.

### 4.3.2 Navigation Design

It is important that the multimedia application exploits the potential of current technology as ‘most current multimedia is non-interactive and linear’ (Feifer & Tazbaz, 1997). If the CAL program exploits this potential, the multimedia will be interactive and non-linear.

The requirements of a non-linear and interactive system are as follows:

- To provide meaningful choices to the user (Feifer & Tazbaz, 1997). This requirement will essentially put the user in control of the system. In order to make the choices meaningful, the user must be given
a context in which the choices matter and permit sufficient input (Feifer & Tazbaz, 1997).

- The result from each meaningful choice must be ‘bite-sized’ information (Feifer & Tazbaz, 1997). This ‘bit-sized’ information represents a single idea or concept (Feifer & Tazbaz, 1997). ‘After viewing that information, the user should be able to make new and meaningful choices’ (Feifer & Tazbaz, 1997).

As the CAL will be divided into exercises and the previous exercise must be completed before the next can be started. Due to this characteristic, the CAL will only be semi-linear and only semi-interactive. However due to the young age of the users, it quality of the system is useful as the user will not become lost and unable to decide what should be done next. The only choice the user will have is the type of lesson they wish to study (rhythm or melody). Therefore a hierarchical navigation system will be used. This navigation structure is seen in Appendix G.

5.3 Tools

This section will be divided into two sections. First, commercial programming language that will be used to actually design the interface and the coding behind the features will be examined. Subsequently, various database will be examined in order for the data received from the program to be saved.

5.3.1 Programming Languages

As the graphical user interface (GUI) will be an essential feature of making the product usable. It may require many alteration therefore it is vital that the tool used to design the product is able to construct simple and effective GUI interfaces quickly. One other important feature is that the language will need to be able to receive MIDI signals. This procedure is enabled by calling the ‘winmm.dll’ file. These are the two basic requirements for such a system. The programming language decided upon will be one of the following, Java, C++ or Visual Basic. These three have been decided upon due to prior knowledge through use in programming modules in the university and previous programming courses outside the university.

Java / C++

Java and C++ are both object-oriented languages and have a very close relationship, the coding required by both programs have very similar syntax. Such object-oriented languages allow for effective reuse of code. However on major advantage of Java over C++ is that it is not implementation dependent, therefore Java is able to run on any platform. The huge java libraries available will enable ensure that the midi element of the implementation can be achieved.
Visual Basic 6.0

This programming language, developed by Microsoft is relatively easy to learn as it uses English language terms strung together to tell the computer what to do (Courter & Marquis, 2001). The interface design is created by attaching different objects to a standard form. Therefore, in designing the interface, there will be not code needed. Together with the ability to import various DLLs, this language satisfies all requirements.

Due to the ease of GUI interface and easy of programming code, it has been decided that Visual Basic should be used to implement the program. By using this language, the interface design can be altered extremely easy to accommodate for any alterations required in the prototyping process.

5.3.2 Database

As mentioned in the user requirement section, the users quiz scores, composition scores, teacher’s comments and current exercises completed. This will not require a complex database structure to be implemented. No joining of tables will be necessary. The only requirement is that is must be able to perform queries on the data.

Microsoft Excel

This is not technically a database application, it is a spreadsheet application. However, as it is compatible with the chose programming language, it must be considered. The ability to search the database can be made in the visual basic program therefore all it requires is to open the database.

MySQL

MySQL database server is the worlds most popular open source database (MySQL.com, 2005). This system will be able to perform all the queries required by using the SQL syntax. This tool has won award for its speed, scalability and reliability (MySQL.com).

Due to the compatibility of Excel with the chosen programming language, it will be this that will be used to hold all of the required data for the system.
Chapter 8 – Iterative Design

This chapter is concerned with all issues relating to the iterative design stage of the prototype described in the usability engineering methodology (Neilson, 1992) in Chapter 4.3. The prototype designed at successive iteration of the design process is described below.

8.1 Iterative Design

As a ‘vertical prototyping’ (Neilson, 1993) method was being implemented; only the first exercise in rhythm and melody and the administration area would be currently contained in the prototype. This will hopefully produce a fully functional system for these areas and would assist when the subsequent exercises for composition and listening, playing and appraising elements of the national curriculum were added.

The iterative design process of the CAL system ended up comprising of two iterations. Described below are the iterations which included a heuristic evaluation and real-user testing. The prioritised problems that are establish from both the iterative methods as shown in section

8.1.1 Heuristic Analysis

Each of the four iterations included a heuristic evaluation completed by three students studying computing at the University of Leeds. These students have completed modules in Human-Computer Interaction and People-centred methodologies. This evaluation process should have been completed by professionals in these fields however due to lack of connections, this procedure was not possible. Therefore in order to compensate for this, a thorough list of heuristics was constructed from previous heuristic evaluations carried out in similar areas and is documented in Appendix I. The priority of each problem encountered was also asked to be defined by the evaluators. The summaries of the problems described below have been ordered in the priorities defined by the evaluators.

First Iteration

This first iteration was carried out early in the design process in order to attempt to decrease the amount of alterations to the prototypes. The iteration will hopefully significantly reduce the time and cost elements of the design process.

8.1.2 Participatory design

The two design iterations also included real-user testing. However due to the young age of the actual
users of the system, they were absent from the design iterations and only used to evaluate the final prototype. Therefore the users that were tested in the design iterations were the teachers. If the problems found with the system were mentioned by all of the teachers, this would be given a high priority due to the principle of converging operations as described in Chapter 4.3. For each iteration, the user was asked to describe any instances when they were having problems and it was observed when operations should have been completed but were not.

First iteration

The first iteration was only brief user testing, a pair of year three teacher who were novice computer and music users tested the system. The main objective of this testing was to ensure the standard of language wasn’t above the child’s level. The administration area was also examined for any terms or jargon that was not understood. The full results from this first iteration are shown in Appendix J.

As the teachers used were not computer literate and music was not their main subject, these would provide guidance for the novice child users of the system. The users of the system would hopefully be beginning Key Stage Two (Year 3). Therefore the suggestions from these teachers would be vital in order to make the language recognisable to the youngest users.

Second Iteration

The main objective of this real user testing was to analyse the functionality of the system. One music coordinator and one intermediate computer skilled teacher with no musical knowledge were used as test examples as from the previous iteration. The music coordinator was used as the non-specialist teachers from the previous iteration could not comment on the functionality of the system, especially the musical components. They took it for granted that the musical elements associated with the exercises were satisfactory. The full results from this iteration are shown in Appendix L and are summarised below:

8.2 Prioritise Problems

The problems that were established in both the heuristic evaluation and user-testing must be given the highest priority due to the principle of converging operations described in Chapter 4.3. The problems discovered by the principle of converging operations at each iteration are highlighted in bold font in the subsequent tables.

8.2.1 First Iteration
As the prototype was in its early design stage, all of the problems raised from the heuristic evaluation and user testing have been implemented. Below is a prioritised list of the problems that have been solved. The highest priority problems discovered by the principle of converging operations are the problems that the empirical and analytical evaluation procedures found. The means in which the interface design has been altered to solve these usability problems are shown in Appendix K.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove heavy use of upper-case letters</td>
</tr>
<tr>
<td>2</td>
<td>Need for more emphasis on important data on Rhythm page 4 and Melody page 4.</td>
</tr>
<tr>
<td>3</td>
<td>Menu choices are not logically ordered.</td>
</tr>
<tr>
<td>4</td>
<td>No back button to see previous set of instructions</td>
</tr>
<tr>
<td>5</td>
<td>No clear title at top of page when menu choices are made</td>
</tr>
<tr>
<td>6</td>
<td>All Terminology is not familiar to user (MIDI in and out)</td>
</tr>
<tr>
<td>7</td>
<td>Remove all possibility of user making error - by removing the close window button</td>
</tr>
<tr>
<td>8</td>
<td>The exit menu choice is not at the bottom of the list</td>
</tr>
<tr>
<td>9</td>
<td>Menu options are not either left or centrally aligned</td>
</tr>
<tr>
<td>10</td>
<td>Data entry screens (admin) does not provide defaults for the MIDI devices</td>
</tr>
<tr>
<td>11</td>
<td>Musical note help on melody exercise one, page 2 of 6 was too quick</td>
</tr>
<tr>
<td>12</td>
<td>No help button on main menu for guidance</td>
</tr>
<tr>
<td>13</td>
<td>Slow the view button down that shows each pitch in the musical score</td>
</tr>
<tr>
<td>14</td>
<td>Insert more instructions on how to use admin</td>
</tr>
<tr>
<td>15</td>
<td>Playback of composed rhythm, inset device so child knows which rhythm is being played</td>
</tr>
<tr>
<td>16</td>
<td>Admin titles no clear (‘Add user’ and ‘Delete user’)</td>
</tr>
<tr>
<td>17</td>
<td>Make it possible to see all comments on composition in the box at the same time</td>
</tr>
<tr>
<td>18</td>
<td>Quiz and composition scores not in schools standard of grades</td>
</tr>
<tr>
<td>19</td>
<td>Cannot see all of answer in the boxes for question seven and eight of melody quiz</td>
</tr>
<tr>
<td>20</td>
<td>The question three and six boxes in the melody quiz move different way to the others</td>
</tr>
<tr>
<td>21</td>
<td>Do not know where melody piece starts and ends</td>
</tr>
<tr>
<td>22</td>
<td>No white space between each quiz question.</td>
</tr>
<tr>
<td>23</td>
<td>No sound used for MIDI error messages</td>
</tr>
</tbody>
</table>

8.2.2 Second Iteration
In consecutive iterations, merely the highest priority problems should be altered due to the time consumption of trying to vary the design in the heart of the design process. Conversely, due to the importance of each of the problems defined by the teachers to enable the program to be as usable as possible, it seemed necessary to alter of the following problems. The highest priority problems (highlighted in red) are the problems point out by both the teachers.
The alterations made to the interface to solve the usability problems raised in this iteration are documented in Appendix M.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Did not know what to do next when tutorial was finished. Need more instructions</td>
</tr>
<tr>
<td>2</td>
<td>Help was not used to its full potential. Need to make it clearer that it can be used.</td>
</tr>
<tr>
<td>3</td>
<td>Change the rhythm composing technique and quiz answering technique to click and drag of objects</td>
</tr>
<tr>
<td>4</td>
<td>Instructions not clear when next should be clicked</td>
</tr>
<tr>
<td>5</td>
<td>Arrows not used to insert the name when logging onto the system</td>
</tr>
<tr>
<td>6</td>
<td>Enable all notes to be used when playing the rhythm</td>
</tr>
<tr>
<td>7</td>
<td>Need more instructions once a menu button has been selected</td>
</tr>
<tr>
<td>8</td>
<td>No musical extract of fast and slow tempos.</td>
</tr>
<tr>
<td>9</td>
<td>User distracted by other writing apart from instruction</td>
</tr>
<tr>
<td>10</td>
<td>Contradiction names of buttons (Melody exercise page 3 of 5: STOP and END)</td>
</tr>
<tr>
<td>11</td>
<td>Various instructions not clear on what is required</td>
</tr>
<tr>
<td>12</td>
<td>The system command buttons (e.g. NEXT + START) are not located in the same place. Therefore not too sure where to look</td>
</tr>
<tr>
<td>13</td>
<td>Musical notation and time signatures are too complex for the first exercise. Remove from here and inset into a later exercise.</td>
</tr>
<tr>
<td>14</td>
<td>Definition of tempo is too complex for the children</td>
</tr>
<tr>
<td>15</td>
<td>Piano keys not shown to user all the time</td>
</tr>
<tr>
<td>16</td>
<td>Example in site navigation in tutorial was distracted by the written instructions</td>
</tr>
<tr>
<td>17</td>
<td>Arrows not used when selecting class and year of a new user</td>
</tr>
<tr>
<td>18</td>
<td>Did not understand the terms in the MIDI lists</td>
</tr>
<tr>
<td>19</td>
<td>Print of shortcut and marking on main menu too small</td>
</tr>
<tr>
<td>20</td>
<td>Need more explanation of how to add comments to a users compositions</td>
</tr>
<tr>
<td>21</td>
<td>Administration page contains too much information on one page</td>
</tr>
</tbody>
</table>

8.3 Evaluation of final prototype.

The main objective of the evaluation procedure is to identify if the system requirements specified in chapter 5.3 and chapter 6.3. As requirement where specified for both the administrators and the learners of the system, it was essential that both elements where tested. Both the evaluation procedures would take place in Bryn Coch Primary School, where the pre-design stage took place.
8.3.1 Evaluation of children

This evaluation of the final prototype is the first time the direct users (children) of the system are used. In previous iterations, system administrators (teachers) have been utilized due to the young age of the children. In order for evaluation to take place on children so young, consent form sent out to the parents of the Key Stage Two children in the school. An immense response of consent forms where received, eighty nine in total. In view of this fact, it was possible to evaluate the system with numerous participants of all ages in Key Stage Two. The class teacher gave indication of the musical experience and computer experience of each child in order for the pupils to be paired based on their computer and musical experience. With this prior knowledge of the experience of the pupils, it was possible to evaluate virtually every possible combination of users that would use the system. However due to limited time allocation for the evaluation process, it was not possible to evaluate each of the above situations for each year in key stage two. At least one of each of the following situations would be evaluated:

- Two children with excellent computer experience and musical knowledge.
- Two children with high-quality computer experience and limited musical knowledge.
- Two children with limited computer experience and high-quality musical knowledge.
- Two children with both limited computer experience and musical knowledge.
- One child with high quality computer experience and the other with some musical knowledge.
- One child with good musical knowledge and the other with good computer knowledge.
- Both children with limited computer and musical knowledge.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Criteria needed to evaluate</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Requirements:</td>
<td></td>
</tr>
<tr>
<td>Collaborate working</td>
<td>Are pairs of children able to use the system?</td>
</tr>
<tr>
<td>Users</td>
<td>Is any ability of child in Key Stage Two able to use the system?</td>
</tr>
<tr>
<td>Musical instrument playing</td>
<td>Are the pupils able to compose using the midi keyboard?</td>
</tr>
<tr>
<td>Content</td>
<td>Does the system address issues relating to the Key Stage Two music curriculum?</td>
</tr>
<tr>
<td>Exercises</td>
<td>Are exercises used to enable the users to learn the components?</td>
</tr>
<tr>
<td>Composition</td>
<td>Are the users able to play and save compositions?</td>
</tr>
<tr>
<td>User support</td>
<td>Is the user able to receive help on parts of the system they don't understand?</td>
</tr>
<tr>
<td>Log In facilities</td>
<td>Can the users log in using their names?</td>
</tr>
</tbody>
</table>
Below are the system requirements that require testing in this part of the evaluation:

A checklist was constructed that would test each of these requirements. The checklist was divided into sections relating to the various components of the system. This would enable the various requirements to be assessed throughout the program and not simply given a yes or no answer. This checklist, including the results from the evaluation is documented in Appendix N.

**Collaborate working** – Yes, the system does allow for pairs of pupils to log into the system.

**Users** – In one case where grouping children who both had poor ability took place, in evaluation number four, the system was not used to its full potential. The children who able to play around together rather that using the program. However, evaluation number seven, two children with poor abilities where grouped together and achieved good results. With poor ability children being paired with higher ability children, this did help, as suggested by the teacher is the requirement analysis. Therefore the system does accommodate for varying ability of children, however selection of pairs of children should be chosen carefully.

**Musical instrument playing** – In both the rhythm and melody exercise, every pairing of child where able to perform their compositions using the keyboard. This was a part of the system that the children enjoyed a great deal. They became more interested in the program once added more practical aspect where involved.

**Content** – The content of the prototype contains basic elements of the national curriculum. At present the elements (2)(a), (2)(b), (3)(a), (4)(c) are contained within the first two exercises implemented in the prototype. See Appendix B for actual curriculum objective. These will be reinforce and extended with subsequent exercises.

**Exercises** – The system is split into exercises based on the elements of composition. This way of organising the system will give the user certain freedom of which exercise can be chosen, however once an exercise is chosen, the user must follow the specified path through the exercise.

**Composition** – Each pair of pupils evaluated where able to record, play and save their compositions successfully.

**User support** – For most of the exercises, user did not require much support as the instructions are self explanatory and tell the user all that is required. The only point of the system that help was actually utilised was

<table>
<thead>
<tr>
<th>Layout</th>
<th>Are the users able to find what they are looking for on each page?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usability Requirements:</strong></td>
<td></td>
</tr>
<tr>
<td>User’s satisfaction</td>
<td>How much did the child enjoy the system?</td>
</tr>
<tr>
<td>Robustness</td>
<td>Did the child encounter any errors while navigating the system?</td>
</tr>
<tr>
<td>Memorability</td>
<td>Are infrequent pupils to the system able to use the system?</td>
</tr>
<tr>
<td>Learnability</td>
<td>Does the user know what is required of them at each stage?</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>What are the performance levels of the pupils?</td>
</tr>
</tbody>
</table>
where this instructions stated that help was available is the keyboard notes where not known. The musicians who used the system did not require any help with the system.

**Log In facilities** – Each pair of pupils successfully logged in using their names.

**Layout** – As the required command that must be clicked to continue with the exercise or perform certain functions are flashing when the user is required to use them, the user is automatically drawn to the correct screen location. The melody exercise was completed generally much quicker that the rhythm exercise; this shows that the users are already beginning to learn the layout of system.

**User’s satisfaction** – Every pupil except the only pair of pupils, who did not manage to use the system without assistance, stated that they enjoyed the system and would be willing to try it out again. This indicates that there is a high level of satisfaction for the children.

**Robustness** – No errors where encountered by the children while evaluating the system. The system makes sure that it will take the blame for any problems that do occur, however this is very infrequent.

**Memorability** – As all of the pupils at present are infrequent users. The system was learnt quickly at their first attempt therefore it is likely that this time taken to learn the system each time each time it is used will continue to reduce.

**Learnability** – As it can be seen from the result, all of the pupils completed the activities that were set to them in each exercise. Therefore due to this, the users are aware of what is required of them at each phase.

**Effectiveness** – The composition elements of the each pair of the student were very good. The compositions produced by the high ability pupils were equal to the low ability. The only performance difference is that the high ability pupils where able to complete the quiz’s at the end of the exercises much quicker that the lower ability children. The lower ability children would discuss what they thought the answer was, then the clip was played for a second time for conformation. The high ability children recognised straight away what the answers were. However, there where no differences in the quiz scores, the CAL system enables the user to learn at their own pace, which demonstrates that this technique does aide the learning of children.

### 8.3.2 Evaluation of teachers.

Similar to the evaluation procedure undertaken for the pupils, a checklist will be produced in order to observe the actions of the teachers to determine if the requirements related to the administrators have been met. The checklist and set of questions can be seen in Appendix N. The checklist will divide the requirements into the relevant components of the system.

Below, are the system requirements that must be tested with respect to the teachers:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Method of evaluating</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Requirements:</td>
<td></td>
</tr>
<tr>
<td>Administrative tools</td>
<td>Is feedback (comments and marks) able to be provided to users?</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Layout</td>
<td>Could the administrator find the various commands that are required?</td>
</tr>
<tr>
<td>Portability</td>
<td>Are midi devices able to be altered and are various operating systems able to be used?</td>
</tr>
<tr>
<td>Security</td>
<td>Are administrators able to log in using a password?</td>
</tr>
<tr>
<td>User support</td>
<td>Does the system provide help to the administrator on each activity?</td>
</tr>
</tbody>
</table>

**Usability Requirements:**

<table>
<thead>
<tr>
<th>Robustness</th>
<th>Can user recover from error easily and quickly?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorability</td>
<td>Are infrequent administrators able to use the system effectively?</td>
</tr>
<tr>
<td>Learnability</td>
<td>Does the administrator know what the system requires of them?</td>
</tr>
</tbody>
</table>

The results of the administration part of the system was an outstanding success, six Key Stage Two teachers with a range of computer experience where evaluated. The checklist answers corresponding to their relevant system requirement where collected and the outcomes are described below.

**Administrative tools:** The entire set of teacher evaluated where able to provide feedback to users with the help provided by the system.

**Layout:** All sections (select MIDI, add user, delete user and feedback) where navigated to and the required commands fulfilled for each section successfully by all the teachers.

**Portability:** Every teacher was able to select the MIDI devices that were asked of them and able to test them, however a number of the teacher tested the devices without being asked to do so as the test section was grouped with the selection process. Various editions of the Windows operation systems were used while testing the system, varying from Windows 95 to Windows XP.

**Security:** Each teacher was able to enter the username and password to enter the administration section of the system successfully. Some required help, as they had entered the username or password incorrectly or with caps lock on.

**Learnability:** As every one of the teachers hand no prior knowledge of the system, each activity was completed fairly quickly, therefore it can be assumed that the system is easily learnt.

**Robustness:** When entering a new user or deleting a current user, if invalid class or year was entered, the error messages suggested to the user which field had been entered incorrectly and suggested to the user how this was fixed. The users, who obtained this error, went on to correct this error straight away then carry on with the activity in hand.

**Memorability:** This requirement is difficult to judge. As all of the users have no prior knowledge of the system, this attribute cannot be tested. It can be assumed since the Learnability requirement was met, that this requirement will also be met.
8.3.3 Final Heuristic Evaluation.

As all of the problems discovered from the heuristic checklist used in the iteration stage of the prototyping have been corrected, it would be unlikely that the same evaluators would find any additional problems. Therefore, the final heuristic evaluation will be based on the ten general heuristic specified by Neilson (1992). By conducting this evaluation and marking each element out of a maximum five marks, an evaluation against the competitors can be completed. The interface design evaluation will be the only competitor evaluation that can be conducted as the content of each of the competitors not containing an equal content.

(1) Simple and natural dialogue
Perhaps the dialogue was a little too easy from the high ability children, they were able to complete the exercises quite quickly. However, this exercise was based for the beginning of Key Stage Two therefore as further exercises would be added; it would be a good idea for the dialogue to develop with the skills of the users. Mark: 4/5

(2) Speak the user’s language
The first empirical evaluation that was done with Year three teachers, the language of the interface was checked. Therefore all of the language on the interface the user will understand. Mark: 5/5

(3) Minimise the user’s memory load
This is tried to be accomplished by only providing the user with the essential information required at each part of the exercise. Rather than provide the user with a list of all the instructions for a current exercise on one screen, the next button is used whenever the user has understood the current instruction and the next instruction is required. Mark: 4/5

(4) Consistency
Throughout the prototype the layout of the interface has remained constant.
- The menu bar is always located on the left hand side
- The control button required for system interaction are located at the bottom of the screen
- The instructions always appear in the middle of the screen in the speech bubble.
- The help button appears by the side of the music teacher whenever help is available.
Mark: 4/5

(5) Feedback
There is feedback to the user, in the form of new instructions displayed on the after every action completed by the user.
Mark: 4/5

(6) Clearly marked exists
On each page, the exit appears on the bottom of the menu bar except on the log in screen, where it is still in the bottom left however there is no menu bar therefore it is just a button. Mark: 5/5

(7) Shortcuts
At present, due to only a very small fully functional section of the system being built, there did not seem need for shortcuts to be implemented. On the bottom of the main menu, there is room for shortcuts to the next exercise that should be completed by the user to be shown. This will prevent the user from having to navigate through the menu bar to find the next exercise. Mark: 0/5

(8) Good error messages
Error messages only appear in the administration section, it is not possible for the child to make any errors in the program itself. The error messages that appear to the teachers will indicate the origin of the problem and how exactly to fix the problem. Mark: 5/5

(9) Prevent errors
Error prevention is accomplished in the main part of the system for the pupils by disabling any command button that when pressed may cause errors. Mark: 5/5

(10) Help and Documentation
Help is provided in all aspects of the system. Starting by giving new users the chance to learn the basics required to operate the system through the tutorial provided on the main menu. There is help given when any instruction of an exercise are not understood. Also help is provided when the mouse is left over any of the command buttons or functions in the program so users know what will happen once they have click on them. Mark: 5/5

Additional criteria: Navigation
The navigation of the site is fairly simple and easy for the children to find their way around. However the only criticism is that when a greater deal more of the prototype will be contained into the system, where eventually the whole of the music national curriculum is contained, the navigation bar on the left hand site may become overcrowded and confusing to the user. However at present the navigation of the program works well, however for this possible future problem, the navigation will be awarded a mark of 6/10.

Therefore the overall mark for ‘The Music Teacher’ software is 47/60. This was higher than the entire competitors that where examined. However, there is still much improvement that can be made to the product in order for it to receive the maximum score.
Chapter 9 – Evaluation

9.1 Against Minimum Requirements.

- **Research on literature regarding learning techniques and the teaching of music.**
  The literature research was conducted from a number of sources including books, journals and websites. The advantages of teaching music to children were first looked at and the government's perspective of its importance. The specific Key Stage Two national curriculum was then examined, which also included examining the music teacher and the learning theories used to teach in the traditional classroom. Subsequently, the use of ICT with music in the classroom was examined. One area of ICT that can be used to aid children is CAL. This method of learning was examined with identification of the learning theory that is used. Finally, why the CAL system used for aiding classroom teaching should be based on the principle of usability.

- **Investigation of three existing computer-based learning applications.**
  This section includes only computer-based learning systems which were focused on musical aspects. All of these systems were evaluated through means of heuristic evaluation and empirical evaluation, as described by the usability engineering methodology.

- **Design the computer-aided learning systems.**
  The design components of the system; interface design, content design and navigation design needed to be researched in detail. The issues relating to human-computer interaction where examined for interface design, while the content was decided upon by making sure each element included in the system would correspond to the needs of the national curriculum. All of these aspects relating to the interface design, if implemented correctly, would produce a usable system.

- **Develop a basic prototype of the system.**
  Four prototypes of the system where produced in an iterative fashion. The first prototype was a paper version as seen in Appendix F. This was developed into a basic functional prototype of moderate quality. The proceeding prototype iteration involved users in order to discover usability problems. By enabling this, the system would become much more usable to the end users.

- **Evaluate the system.**
  The main area that would require evaluating is the usability of the system. As there were two types of end user, the teacher and the child, both where evaluated independently. The criteria that needed to be tested were the system requirement.
9.2 Possible Extensions

The prototyping stage would first require more iterations, as the children did not take part in this stage of the design process. Once the teachers had evaluated the system, it would be time to ask the children to do so. By achieving this, additional usability problems can be defined. Once iterations have been completed with the children, these sections will be fully functional and therefore the process of horizontal prototyping can take place. This is where the additional exercises under the composition heading of rhythm and melody can be implemented.

There are also many additional features that can be incorporated into the system in order for it to attract a larger user base. For example, deafness and blindness could be considered. For the hearing impaired, the instructions can be communicated successfully but it will be difficult for them to hear their compositions. With the visually impaired, speech can be incorporated into the program, when the instructions appear on the screen, the music teacher will communicate these instructions to the user through speech. For the keyboard element of the system, Braille could be placed on the keys in order for them to know which key they were pressing. If the user is not fully impaired, the volume of the output and the size of the elements on the screen can be enlarged. There are many different possibilities that could be included for this aspect.

As the school has contact with two Disabled schools in the area, making the system usable for a range of disabled users would be very advantageous. As these children who visit the school perform well in the creative exercises, the CAL program may significantly help their music development.

9.3 Problems Encountered

The only major problem that was discovered was at the final stage of the project, when the coding was made executable by Visual Basic. In my previous experience with Visual Basic, if the coding is working fine while being run in Visual Basic there should be no errors when an executable is created. However, this was not the case. Once made into an executable file, the program would start up fine however when the program required MIDI data from the music keyboard, the program crashed. Unfortunately, this problem was not fixed.
References


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Nfer (2001). Annual Survey of Trends in Education


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Appendix A – Personal reflection of project experiences.

The CAL project that was undertaken was very enjoyable however it was the most challenging piece of work that I have ever had to complete. It required a great deal of knowledge into many different aspect of the computing, some of which had not actually been studied in the university due to the joint honours programme of study and some subject choices that had been made in the second year.

The background research that was done toward the project, including the research on music, CAL and methodologies helped out a great deal with the project. Especially the extensive research completed on the chosen methodology really help in the pre-design stage.

One aspect of the project that I should have given a little more consideration was the scheduling. As the initial schedule was being developed, it seemed that there was plenty if time allocated to complete each activity. However, after the January exams, the initial schedule was not really working any more. As the deadlines set where fairly close together, many of the task where being complete simultaneously. This made it difficult for my full concentration to be spent on each task individually. With a little more time spent on time management before beginning the project, this problem could have been overcome fairly easily.

Before the project was started, the scheduling for the implementation for the prototype was give a month. This was decided upon from the module in Software Project Management (SE22) that was taken in the second year. This seemed like a sufficient amount of development time; however a few major problems come about while the implementation was taking place that was not previously scheduled for. For example, problems begin to come about when the MIDI messages from the keyboard where transmitted to the program. I did not know how to solve the problem, therefore the implementation needed to be put on hold while this problem was solved.

In addition to the time the scheduling was made, it was not known which methodology that was going to be implemented. As I chose the Usability Engineering method, this was very time consuming as much user input was required. The main time consuming areas of this methodology are:

1. The pre-design stage required me analyse the users and their environment in a great deal of detail. Informal discussions needed to be had with a range of Key Stage Two teachers and observation in the way in which the current task was complete.

2. The creation of many iterations of the prototype with user input before the next iteration could begin. As the program was needed to be tested against a selection of real users, this required me to arrange time to visit schools in order for teachers to give me feedback on the prototype. This procedure was time consuming as teacher did not have much spare time in their busy schedule. It was possible for me to see the teachers before school started, which gave me around half an hour and at break times. Each day it was possible for the teacher to actually experiment with the system for around an hour. Due to this face, it required me to
make numerous journeys to the schools to gain feedback at each iteration.

The busy schedule of the teachers also made it time consuming and difficult to gather the user requirement. This procedure was much quicker that the empirical testing as it was possible to record the teachers’ comments using a tape recorder and analyse their responses at a later date. However, I was very pleased with the user requirement technique selected. The interviews gave very detailed responses. If the requirement would have been gathered by using a questionnaire technique, like previously suggested the information gathered would not be half as detailed. The face to face communications with the teachers really help me to find out all that I needed to know.

The heuristic evaluation that was completed at the first iteration of the prototyping stage by three computing students with knowledge of the subject did not provide the greatest results. They only noticed the basic interface design issues that had been implemented incorrectly. Professional heuristic evaluators would have given much better results.

The overall project was very enjoyable, however to began to become very stressful towards the completion date. However for a student attempting this or a similar project many alterations would be suggested:

- If an external user is needed to be consulted as part of the system, remember that they are very busy and you must fit into their schedule and not the other way round.
- The scheduling is extremely important to the overall success of the project. Before attempting to construct the schedule have a good idea of what each section will contain.
- The implementation stage, whatever amount of time you believe that you need for this stage, double it!
- Do not rely on the heuristic evaluation procedure to evaluate the software; user testing seems to give much better and precise results.
- However, do not attempt do start any of the implementation until you have fully completed the pre-design stages of the project. This will reduce the amount of re-coding required in the implementation stage.
- Do not leave the compiling of the project until the last minute.
Appendix B – Gantt Schedule Chart

<table>
<thead>
<tr>
<th>Task Number</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<td>16</td>
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</tbody>
</table>
Appendix C – Music National Curriculum (National Curriculum Online, 2005)

Knowledge, skills and understanding

Controlling sounds through singing and playing
(1.) Pupils should be taught how to:
(a.) sing songs, in unison and two parts, with clear distinction, control of pitch, a sense of phrase and musical expression
(b.) play tuned and un-tuned instruments with control and rhythmic accuracy
(c.) practice, rehearse and present performances with an awareness of the audience

Creating and developing musical ideas – composing skills
(2.) Pupils should be taught how to:
(a.) improvise, developing rhythmic and melodic material when performing
(b.) explore, choose, combine and organise musical ideas within musical structures

Responding and reviewing – appraising skills
(3.) Pupils should be taught how to:
(a.) analyse and compare sounds
(b.) explore and explain their ideas and feelings about music using movement, dance, expressive language and musical vocabulary
(c.) improve their own and others’ work in relation to its intended effect

Listen, and applying knowledge and understanding
(4.) Pupils should be taught:
(a.) to listen with attention to detail and to internalise and recall sounds with increasing aural memory
(b.) how the combined musical elements of pitch, duration, dynamics, tempo, timbre and silence can be organised within musical structures (for example, ostinato) and used to communicate different moods and effects
(c.) how music is produced in different ways (for example, through the use of different resources, including ICT) and describe through relevant established and invented notations
(d.) how time and place can influence the way music is created, performed and heard (for example, the effect of occasion and venue.)

Breadth of study
(5) During the key stage, pupils should be taught the knowledge, skills and understanding through:
(a.) a range of musical activities that integrate performing, composing and appraising
(b.) responding to a range of musical and non-musical starting points
(c.) working on their own, in groups of different sizes and as a class
(d.) using ICT to capture, change and combine sounds
(e.) a range of live and recorded music from different times and cultures (for example, from the British
Appendix D – Usability Heuristics

Jakob Neilson’s set of ten usability heuristics:

- Simple and natural dialogue
- Speak the user’s language
- Minimise the user’s memory load
- Consistency
- Feedback
- Clearly marked exists
- Shortcuts
- Good error messages
- Prevent errors
- Help and Documentation

Shneiderman (2002) has defined eight rules of interface design that should be followed in order to accommodate
for the range of computer ability users and design a high-quality user interface.

1. **Consistency** – Throughout the system a ‘consistency in colour, layout, capitalization, fonts, and so on
should be employed’ (Shneiderman, 2002).

2. **Enable frequent user to use shortcuts** – This allows increase in pace of interactions and reduce the
number of interactions. This can be achieved by using special keys and hidden commands (Shneiderman,
2002).

3. **Offer informative feedback** – ‘For every user action, there should be system feedback. For frequent
and minor actions, the response can be modest, whereas in infrequent and major actions, the response
should be more substantial’ (Shneiderman, 2002).

4. **Design dialogues to yield closure** – ‘Sequences if actions should be organized into groups with
beginning, middle and end’ (Shneiderman, 2002). This will give user the satisfaction of accomplishment
and the ability to prepare for the next set of actions (Shneiderman, 2002).

5. **Offer error prevention and simple error handling** – This will restrain the user from creating serious
system errors, which may cause the system to close and lose all current work.

6. **Permit easy reversal of action** – This will encourage users to explore the system more thoroughly as
they know the action are reversible is it causes an error (Shneiderman, 2002).

7. **Support internal locus of control** - Decreases dissatisfaction and anxiety as the user will be in charge
of the system and the system will respond to their actions (Shneiderman, 2002).

8. **Reduce short-term memory load** – This ‘required displays to be kept simple, multiple page displays
Appendix E – Requirements collection

Interviews with teachers in key stage two.

(1) Interview with Adrian Dilks – Key Stage 2, Year 3 Teacher.

Have you any experience in teaching music?
Yes I do, I have two degrees in music and I have taught music for sixteen years both within a school and a county level. I am the music coordinator within my school.

Do you find it hard to teach children of different abilities music at the same time?
Sometime it can be difficult, but generally most of the music we do is by outcome so children can produce things at different levels.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?
Again, it all depends on the ability of the child; we have children in the school who are very musically able who are able to take music instrumental lessons within the school so they are able to take their music further. The national curriculum provides levels and if low ability children they would not be able to go beyond these levels.

What area(s) of the national curriculum in music do you find children have the most difficulties with?
For many children it is singing to be honest. I find that even by the time children reach year six even though they have previous experience with music, quite a number of them are still unable to sing in tune. Lots of singing games and lots of listening activities and getting them to pitch notes correctly and making sure that the songs that are being chosen are appropriate for their voice range.

Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?
Sometime yes but sometimes you’ll find that a child is competent playing a violin for examples and been practicing a piece for say six months, so they can play that piece very well but when it comes to more creative music in the classroom a lot of them do just as well as the other children and have very good ideas that are just as valid as those who don’t play musical instruments.

Do you have any ICT for aiding the learning of pupils in music?
We have keyboards available but not connected to any of the schools PCs. As I am the music coordinator, I have looked into many computer programs but as of yet there are no programs that really helps the children. We follow a curriculum scheme called ‘Sounds of Music’ which is very practical based so we do a lot of practical music with the instruments.

Do you feel that there is a place for a CAL program?
I think it would be a good idea, if it was used in a computer suite with headphones so it did not disturbed the rest of the class.

If so, what specific features would you like to see the computer program contain?
Elements of creativity but taking into account that the children possibly cannot read music. Some features like being able to select sounds and examples of sounds and to combine those to produce a piece music that interests them.

*Will such a system reinforce and extend the child’s learning from the classroom music lesson?*

I would hope so yes that would be the main objective of such a system. At the moment being able to allow every child in the class to use a computer program to support the learning would take a great deal of time. We have to be very careful of time as to make sure that it will not take time away from other subjects.

*Do you feel that children will improve their learning in such a system if they work together (collaborate working)?*

I would think so yes, there is always something to be said about children working together with the discussion of cooperation and sharing of ideas. I to believe there is a case for children working in a small group, working in pairs and individual working. When you are teaching a class generally, you try to incorporate all those different things into your teaching, individual, pair and group work. It all has a valid place really, depending on what activity is done.

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(2) Interview with Gwen Jones – Key Stage 2, Year 3 Teacher.

*Have you any experience in teaching music?*

Yes, I have taught music to pupils from year two up to year six therefore the whole range of a primary school. I am quite confident and very much enjoy teaching music to a class too.

*Do you find it hard to teach children of different abilities music at the same time?*

It can be challenging but you can quickly work out who can and who can’t. Therefore all that is required is to find a suitable activity for them to do. The activity will be split up into the different ability of children or I will put a let able child with a more able child. This split can be done in a number of different ways.

*Do you think children could be taught music in the classroom that goes further than the current national curriculum?*

Yes, I think that music should play a much bigger part that we are allowed to do.

*What area(s) of the national curriculum in music do you find children have the most difficulties with?*

Probably younger children who don’t have the skills to compose, they like the change to get to do so but don’t have the skills. They need the time to be shown how to do so and given the opportunity to do so. I think that they could come up with a lot more than we give them time to do.

*Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?*

Yes, there concentration, memory skills, coordination generally is certainly better. I also think that socially it helps the child. I can only see advantages.

*Do you have any ICT for aiding the learning of pupils in music?*

Not in terms of computers, tape recorders and CD players are used in order to playing music for them to
appraise, music for them to listen to and to tape their own compositions. But in terms of computers, no I haven’t actually used any.

**Do you feel that there is a place for a CAL program?**

Most probably, there is a play for computers in most aspects of the curriculum.

**If so, what specific features would you like to see the computer program contain?**

Something to aid children with composition, in a simplistic way, they feel that they have composed a piece of music for themselves with the aid of the computer. A lot of music there days is going in that direction anyway. The program should include interactive help in order to help the child while they compose. This help should direct the child in what sounds good together.

**Will such a system reinforce and extend the child’s learning from the classroom music lesson?**

I would hope it would be linked to the music taught in the classroom.

**Do you feel that children will improve their learning in such a system if they work together (collaborate working)?**

Yes, I think again that there are more able children in music who can help the less able. Collaborate working is very valuable. I think there is a place for a child working independently on a program and in a small group.

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**Interview with Lynn Jones – Key Stage 2, Year 4 Teacher.**

*Have you any experience in teaching music?*

I have. I was curriculum post holder in music in a previous school and in this school I teach my own class music.

*Do you find it hard to teach children of different abilities music at the same time?*

Id say not, I think every pupil can excel in different areas of music at different times.

*Do you think children could be taught music in the classroom that goes further than the current national curriculum?*

Currently no as the national curriculum is packed full anyway and as music only receives a small percentage of that, it just would not be reasonable to add more into it. I think in this school, the children all ready get a wide variety of opportunities, the children who want to take music further get the opportunity to take up playing a musical instruments.

*What area(s) of the national curriculum in music do you find children have the most difficulties with?*

It is the appraising aspect that most children find most difficult. They find it quite enjoyable and relatively easy to compose musical pieces.

*Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?*

Yes, their musical knowledge is better for example they are able use and understand musical terminology. In my opinion that is the only aspect that is improved, their composition skills tend to be on a similar level to those children who don’t play an instrument.
Do you have any ICT for aiding the learning of pupils in music?

Not at present but I have used ICT programs in previous schools. The program that I have had the opportunity to use is ‘Musical Instruments in the Orchestra’.

What advantages / disadvantages are there to this ICT program?

As there is not an opportunity to have all musical instruments within a school, the program will enable the child to see and hear what each instrument in the orchestra will sound and look like.

Do you feel that there is a place for a CAL program?

Yes, I think ICT should be integral to all subjects within the national curriculum.

If so, what specific features would you like to see the computer program contain?

A said previously, I think it is important that a child will be able to get the opportunity to see and hear the musical instruments used within an orchestra and from different cultures around the world. Also I think that composing will be made easier if a computer program will be used. The child will be able to play back their composition and alter parts of it as they wish.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

Yes I believe it will extend and reinforce their learning from the classroom.

Do you feel that children will improve their learning in such a system if they work together (collaborate working)?

Yes, I’d say the maximum number of children that should be allowed to work together is two. If more than two children are allowed to work together in a group they tend to start arguing and each member of the group will want the mouse and they will all fall out. If just one child that was not confident on a computer or music and was told to go and use the program they would end up just sitting there. Therefore I would pair the children up, one who was good at music or on the computer with one who was less confident.

(4) Interview with Andrew Williams – Key Stage 2, Year 4 Teacher.

Have you any experience in teaching music?

Yes, quite a bit but what happened now is because I am P.E mains and ICT mains, I take another class for P.E. while the specialist music teacher takes my class for music.

Do you find it hard to teach children of different abilities music at the same time?

From my experience no, music is one of the subjects that children with difficulties can access quite readily. Whether it being playing instruments or clapping out beats of songs, all children whatever ability can access.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?

Yes, I support there is scope for that. Be nice to have extra things whether being new music of different cultures or an extension in another area, there is definitely a possibility to extend on the current curriculum.
What area(s) of the national curriculum in music do you find children have the most difficulties with?

Listening and appreciating music, quite a lot of children this area find quite hard. Many children are quite happy to tap out the beat on their instruments but find it tough to actually just complete the listening or appreciating activity without doing anything else. This activity for a child of age seven to eight is quite a skill.

Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?

Definitely, there is further interest, more concentration and you can just tell they have more interest in the subject as a hole. From the previous question, the pupils who have additional music lessons tend to be able to listen and appreciate music to a higher level to those who haven’t.

Do you have any ICT for aiding the learning of pupils in music?

There are some programs that I have heard of that are currently on the market and we are currently looking at purchasing one. However at the moment the music coordinator for the school uses a program to aid in music, but at present I do not use any programs.

Do you feel that there is a place for a CAL program?

Yes definitely, as ICT such an important subject at the moment with technology, it would be nice to be able to get it into every area of the national curriculum.

If so, what specific features would you like to see the computer program contain?

Probably some composing activities, listening and appreciation would have to be a key feature with speakers on the computer so they would be able to listen in and following a music sequence with the keyboard are the main area I can think of at present.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

I think so; ICT is one thing that the majority of children in my class are super keen on. The system should increase their interest in the subject, music or otherwise and also increase their music skills in general.

Do you feel that children will improve their learning in such a system if they work together (collaborate working)?

Yes, group working does help, especially for the poorer ability children they can see how the better ability children perform and are able to pick that up. Two better ability children would be able to work together as they will bounce ideas of each other but for a poorer child to watch someone with a little more knowledge would be the main advantage of collaborate working. This extends to all subjects across the board.

(5) Interview with Sian Hilton an Estyn Team inspector – Key Stage 2, Year 5 Teacher.

Have you any experience in teaching music?

I am a non-specialist, I have not been trained to teach music but I have taken responsibility for music in past schools and I do help out with music in Year 5. I think teaching singing and teaching music are
two different things. Teaching music the creative side of that is quite challenging. Lots of teachers avoid it as much as possible, getting the musical instruments out and allowing the children to experiment and then appraise each other is quite difficult, but it is very good in developing listening skills.

Do you find it hard to teach children of different abilities music at the same time?

I do, I think it is difficult to do so as I said earlier it is the listening skills, the maturity. I think the creative side of the curriculum is very important to the children, especially children who are special needs or have behavioral difficulties. The biggest problem for myself it a large group of children, different ability is a problem but different abilities in a large group is a big problem.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?

I have a lot of music in my classroom; I have music on in the morning, during art and reading. I believe it has a calming influence, I think research has shown that. It does not have to be necessarily being classical music. I enjoy music and children enjoy music, it is part of their culture so possibility it could go a bit further, yes.

What area(s) of the national curriculum in music do you find children have the most difficulties with?

It is appraising each others performances, they believe that their own compositions are wonderful so they are not into redoing or listening to criticism, the children find that very difficult. However I think that is quite an advanced skill in itself.

Do you notice the difference in pupil’s musical ability of those who play musical instruments outside of school and those who don’t?

Definitely, they don’t have to be able to read music to do well in music at this level. It is the listening, listening to tone, listening to pitch and loudness and softness. They certainly have a head start.

Musicians are more disciplined as music is not a free for all, like many of the other children may think.

Do you have any ICT for aiding the learning of pupils in music?

I don’t here even though I know there are some good software packages.

Do you feel that there is a place for a CAL program?

Yes definitely, the ICT equips children with many things. You don’t have to be good at music to succeed in it, to produce something of quality I wouldn’t say it the most important thing. I’m sure I should be using it more and I would welcome that.

If so, what specific features would you like to see the computer program contain?

An interactive element so children could learn about things like pitch, about different types of music and access to music from different cultures. I know we can do that by using CDs and the past have done using tapes and videos. Also it would be nice if they children could play around with different contrasting musical instruments for example harp, saxophone that they would not get the chance to be able to see what they sounded like in the classroom. Children respond well to interactive stories so I think the main aspect would be the interactive part.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

Yes because they are able to do so in small groups. The learning of language and listening will be aided by working together in pairs or small groups. They are able to consolidate what they have learnt in the
large group.

Do you feel that children will improve their learning in such a system if they work together (collaborate working)?

Collaborate working is very important; all music is like that I believe. Even though there are wonderful individuals and soloists they are still part of the larger group even if it is just accompaniment. Most of the pleasure they get is playing together.

(6) Interview with Lynn Roberts – Key Stage 2, Year 5 Teacher.

Have you any experience in teaching music?

Only the run of the mill weekly composition lessons in the classroom and singing lessons in the hall.

Do you find it hard to teach children of different abilities music at the same time?

Sometimes there is need to pair the children up, one more able child and one less able child. Also some children are unable to use both hands at the same time to play an instrument and therefore there may be need to pair children up for that reason. All children are different; it all depends on their disability primarily.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?

I think they could if they had the right person teaching them. I do not believe that I would be that person. It would require a teacher who was confident in teaching music.

Do you notice the difference in pupil’s musical ability of those who play musical instruments outside of school and those who don’t?

Yes, they are more interested and are more willing to listen carefully. If you focus on a particular aspect of a piece of music, the children who have had musical lessons outside school are more able to identify with it more readily.

Do you have any ICT for aiding the learning of pupils in music?

I personally have not; I think there are a few different CDs within the school that we are able to use. We where looking at some CDs ROMs but have not bought anything as of yet. The children in my class do not get any support through the use of computers but they do get to use music tapes and CDs.

Do you feel that there is a place for a CAL program?

Yes I do. I think that by using computer aided learning programs there will be a higher percentage of children of low ability becoming more interested in music. This will be because they will be able to interact with the computer at their own pace.

If so, what specific features would you like to see the computer program contain?

Interactive aspects where the children can use their own ideas to change/alter and compose their own music and being able to see what they have composed and have the option of playing their piece back to themselves.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

I think it will make them more interested and keep to learn and being able to take on new ideas.
Do you feel that children will improve their learning in such a system if they work together (collaborate working)?

Yes as they will be able to discuss their ideas with peer at a level that they understand themselves.

(7) Interview with Kath Williams – Key Stage 2, Year 6 Teacher.

Have you any experience in teaching music?

Yes I have. I teach music to my class and have done for many years but it is not my main subject of expertise.

Do you find it hard to teach children of different abilities music at the same time?

Not at this level, if I was a secondary school teacher I think that it would become a great deal harder.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?

Not with the class sizes that we have. There would be possibilities if we had support from teachers who had expertise in music that could split the large class into smaller, more manageable sizes.

What area(s) of the national curriculum in music do you find children have the most difficulties with?

Terminology mainly.

Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?

Yes, if they play a musical instrument outside of school they know a lot of the terminology and most of the time they are able to help me! They find it easier and understand the ideas of beats, rhythms, layering. Depending on their level of expertise, every part of music seems to be improved.

Do you have any ICT for aiding the learning of pupils in music?

I do not have any.

Do you feel that there is a place for a CAL program?

Yes, there is always room for another resource especially if it is ICT based as the children enjoy using programs for aiding their learning on the computer. Allowing the children to go and ‘play’ on the computer is seen as a reward.

If so, what specific features would you like to see the computer program contain?

I think it would have to be linked in to individual schemes for each child which would be difficult but most schools adopting the scheme where the computer program they use are being used in conjunction with ‘sounds of music’, the curriculum used for our school.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

If it was a good quality music program then without a doubt it would.

Do you feel that children will improve their learning in such a system if they work together (collaborate working)?
Yes, they like supporting peers because even today not all children are computer literature.

(8) Interview with Lee Comber – Key Stage 2, Year 6 Teacher.

Have you any experience in teaching music?

No formal experience in teaching music, only what I have done when beginning teaching at this school. Therefore I have no confidence in the slightest when teaching music.

Do you find it hard to teach children of different abilities music at the same time?

Yes, a lot of children in the class if they play an instrument like piano, clarinet or any musical instrument there music ability are better than mine and so they are ahead of me. For children who may be special needs, they tend to do as well or even better than the higher ability kids. Therefore I have not found any real difficulty when teaching children of different abilities.

Do you think children could be taught music in the classroom that goes further than the current national curriculum?

Yes they have a potential to do so but as a school, I do not believe we have the scope or the time in the curriculum to do so.

What area(s) of the national curriculum in music do you find children have the most difficulties with?

Depends on the child really, I think it’s unfair to say that all children find the same aspect of the music curriculum.

Do you notice the difference in pupil’s musical ability of those who play musical instruments out side of school and those who don’t?

Yes with out a shadow of a doubt.

Do you have any ICT for aiding the learning of pupils in music?

Other than CD playing no, I do not use any computer packaging.

Do you feel that there is a place for a CAL program?

There is if it would be a classroom resource, I think if it was a stand alone package that the child went to the corner and used it on the computer by themselves I don’t think the teachers would be inclined to use it. This would be partially because there are many other packages that reinforce writing, reinforce maths and it would just become another resource. But if it was a class resource then it could be used with an electronic white board or they could even use on a PC to take the lesson for you then that would definitely by an advantage.

If so, what specific features would you like to see the computer program contain?

I don’t really know a lot about music, I just follow the music package that the schools have chosen. If it was split down into lesson plans that takes the teacher through it.

Will such a system reinforce and extend the child’s learning from the classroom music lesson?

I think it will because it will make the teaching of music easier. Because a lot of the problem about music for myself is the confidence in teaching music.
Do you feel that children will improve their learning in such a system if they work together (collaborate working)?

I think when you teach music, it is all about working in pairs or small groups. So whatever is being taught would have to have that focus. I don’t think that individual learning would work. The biggest problem is finding the time to send children away to use such a system as music does not appear a great deal at present in the national curriculum.
(4). Main Menu Form(3)

MAIN MENU

QUIT ➔ MAIN MENU ➔ Composition ➔ Exercises

QUIT ➔ MAIN MENU ➔ Composition ➔ Exercises

Help
Next

(5). Main Menu Form(4)

MAIN MENU

QUIT ➔ MAIN MENU ➔ Composition ➔ Exercises

QUIT ➔ MAIN MENU ➔ Composition ➔ Exercises

Rhythm
Melody

Help
Next

This form will be the same for all of the exercise types, rhythm and melody.

(6). Rhythm Exercise 1 Form

EXERCISES 1

QUIT ➔ MAIN MENU ➔ Composition ➔ Exercises

Help
Next

Exercises: In order for exercise2 to be displayed, exercise1 must be completed.

(7). Administration Form

ADMIN

MIDI: Allows the administration to select the midi in and out options

Adding Users: Allows users to be added to the system.

Delete user: Allows user to be deleted from the system

Comment on user work: Allows the administrator to comment on the users compositions.
Appendix G – Navigation design
Appendix H – Initial Interface Design

Log On Form

Main Menu Form

Melody Exercise 1 Form

Rhythm Exercise 1 Form

Administration Form

Quit Form

Admin Password Form

Log Off Form
Appendix I - Heuristic Checklist. (Adapted from Pierotti & Comporation, YEAR))

(1) Visibility of system status
Does each form display a clear title that describes screen content?
Is there consistent icon design scheme and stylistic treatment across the system?
Is selected icon clearly visible around unselected icons?
Do menu instructions and error messages appear in the same place on each menu?
In multi-screen, is it visible the relation between them?
In pop-up error messages, is the error field visible?
After user completes an action(s), does the feedback to user specify the next action can be started?
Is there visual feedback indicating which menu options can be selected?
Is there feedback when function keys are presses?
Are there observable delays in systems responses?
Is menu-naming terminology consistent with users task domain?
Is selected objects made obvious?
Is de-selection of objects made possible?

(2) Match between system and real world
Are menu choices ordered in the most logical manner?
Do selected colours correspond to common expectations about colour codes?
When instructions imply an action, are the words in the message consistent with this action?
In data entry screens, is the terminology familiar to the user?
In questions, is the questions stated clearly and in simple language?
Are function keys labelled clearly and distinctively?
Are the words, concepts and phrases in the system familiar to the user?
Does the system cater for user who have no prior experience of electronic devices?

(3) User control and freedom
When a user’s task is complete, does the system wait for a signal from the user before proceeding?
Can users type ahead in systems with many nested menus?
Are users prompted to confirm commands which may have drastic circumstances?
Is there and ‘undo’ button and redo buttons?
Do users have the option of using keyboard shortcuts instead of using the mouse?
Are menus broad (many items on single menu) rather than deep (many menus levels)?
If deep menus are used, can the user go back to previous menu?
If deep menus are used, can the user change their option on the previous menu?
Can user easily reverse their actions?
If the system uses question and answer interface, can the user return to the previous question or skip forward to later questions?
Are there clearly marked exits?

(4) Consistency and standards
Have a heavy use of upper case letters been avoided on screen at once?
Are icons labelled?
Does each window have a title?
Are menu choices listed vertically?
If “exit” is a menu choice, does it always appear at the bottom of the list?
Are menu titles either left or centred aligned?
Do on-line instructions appear in a consistent position on the screen?
Are field labels consistent from one data entry screen to another?
Do field labels appear to the left of the field?
Are attention-getting techniques used with care?
Are only four font sizes used?
Are only three different fonts used?
Are only 4 to 7 different colours used that are far away in the visible spectrum?
Have pairings of high-chroma or spectrally extreme colours been avoided?
Are high value / high chroma colours used to attract attention?
Is the most important information been placed at the beginning of the prompt?
Are user actions and system objects named consistently across all forms?
For question and answer interfaces, are there valid inputs for a question list?
Are menu options names consistently across the system?
Does the structure of menu choices match their corresponding menu titles?
Are commands used the same way and do they mean the same thing across the system?
Does command language have a consistent, natural language?
Is the structure of the data entry techniques consistent from screen to screen?
Is the method of moving the cursor to the next/previous field consistent across the system?

(5) Error prevention
In the menu choice name, does the higher-level menu name appear as the menu title of the lower-level menus?
Are menu choices logical, distinctive and mutually exclusive?
Does the system prevent the user from making errors whenever possible e.g. for data entry, does the system provide lists instead of direct data entry?

Does the system warn the user before making a potential serious error?

Do data entry screens provide defaults whenever possible?

Does the system remove all possibility of users making errors?

(6) Recognition rather than recall?

Do the data displays start in the top-left of the screen?

For question and answer interfaces, are visual cues and white spaces used to distinguish between questions, prompts, instructions and user input?

Are all data required by the user displayed at each step of the transition sequence?

Are prompts, cues and messages displayed where the user will be looking on the screen?

Have prompts been formatted using white space, visual cues and justification for easy scanning?

Do test areas have breathing space around them?

Is there an obvious distinction between ‘choose one’ and ‘choose many’ options?

Does the system disable or delete labels that are not in action?

Is white space used for symmetry and lead the eye in the appropriate direction?

Are items grouped into logical zones and have heading to distinguish between them?

Have zones been separated by spaces, lines, colour, bold titles?

Are field labels separated from fields by at least one space?

Are optional data entry fields marked clearly?

Is colour highlighting user to get the users attention?

Are size, boldface, underlining, colour, shading used to show the importance of different items?

Are borders used to identify relative groups?

Is colour coding consistent throughout the system?

Is there good colour and brightness used to contrast against the background?

Has light, bright, saturated colour been used to emphasize data?

Is the first word of each menu choice the most important?

Is the relationship between controls and actions apparent to the user?

Are inactive menu items disabled and greyed out?

Are there menu selection defaults?

Do GUI menus make it obvious where selection is possible?

Are there visual cues that identify inactive windows?

(7) Flexibility and efficiency of use

Does the system allow for all levels of expertise?
Does the system provide shortcuts for high frequency commands?
If menu lists are short, can the user select an item by moving the cursor?
Can the user use keyboard shortcuts for the commands?
Does the system guide novice users sufficiently?

(8) **Aesthetic and minimalist design**
Is the system design simple, intuitive, easy to learn and pleasing?
Is all (and only) the information required to make a decision visible on the screen?
Is the system free of irrelevant, unnecessary and distracting information?
Are all icons in a set visually and conceptually distinct?
Have large objects, bold lines been used to distinguish icons?
Does each icon stand out from its background?
Are meaningful groups of icons separated by white space?
Does each data entry screen have a short, simple, clear, distinctive title?
Are field labels short, familiar and distinctive?
Is each lower-level menu choice associated with only one higher-level menu choice?
Are menu titles brief but long enough to communicate?

(9) **Help user recognize, diagnose and recover from errors**
Is sound used to signal an error?
Are prompts stated constructively without implied criticism to the user?
Do prompts imply that the user is in control?
Do error messages place the user in control?
Are prompts brief and unambiguous?
Are error messages worded so the system takes the blame and not the user?
Are error messages grammatically correct?
Do error messages avoid use of exclamation points and hostile words?
Are all error messages in the system consistent in grammar, form and terminology?
Do error messages suggest the cause of the problem and what action the user should take?

(10) **Help and Documentation**
Are instructions visually distinct?
Do the instructions follow the sequence of user actions?
If menu buttons are ambiguous, does the system provide extra instructions when the button is selected?
Are data entry screens supported by navigation and completion instructions?
Is the help button visible?
Is the help system interface consistent with the navigation, presentation and conversation that the system supports?
Is help clear, direct and expressed in simple English without any jargon.

Navigation: is information easy to find?

Presentation: is the visual layout well designed?

Conversation: is the information accurate, complete and understandable?

Is the information relevant?

Goal-oriented (what can I do with this system?)

Descriptive (what is this thing for?)

Interpretive (why did this thing happen?)

Navigational (Where am I?)

Is there context sensitive help?

Can the user change the level of detail available?

Can user easy switch between help and their work?

Is it easy to access and return from the help system?

Can user resume work where they left off after accessing help?
Appendix J – Iteration 1 Results

The alterations to the language of the program have been highlighted in bold font

Log On
- Remove the word ‘provided’ from initial speech bubble as the children will not understand this word

Tutorial
- Alter the header ‘Tutorial’ to ‘Instructions’
- Initial message: ‘If you need help with using the system, please click HERE for quick instructions.’
- Instruction no1 – Navigating the site:
  - Header alteration from ‘Navigation’ to ‘Exploration’
  - ‘To explore around the site use the piano keys on the left hand side. Example: "If you want to compose a rhythm, I will do the following". Please click NEXT.’
  - ‘Please have a go yourself. Try and compose a rhythm for your first exercise.’
  - ‘Well Done, Please click NEXT to carry on with the instructions.’
- Instruction no2 – Receiving help:
  - Alteration to the help button to contain the word ‘help’.
  - ‘If you do not understand some of the instructions. You may ask for help whenever you see the HELP button by my side.’
  - ‘Please click on HELP button to make sure you know it’s position’
  - ‘Well Done. Please click NEXT to continue with the instructions.’
- Instruction no3 – Receiving the next instruction:
  - ‘When the NEXT button appears below. You are ready for further instructions.’
- Instructions finished:
  - ‘The instructions are finished. Good Luck with your composing’

Main Menu
- Remove Appraise, Play and Listen buttons from menu bar as they are not implemented in the program therefore only confusing things.
- Change the titles on the forms when the menu buttons Compose, Rhythm and Melody are selected in order to make it very clear which menu button is currently selected.
- Alteration required to the teachers ‘stick’. At present looks to much like a Cain therefore change so it looks more like a conductor.
- There is need for a HELP button on the main menu in order to give guidance on what is required.
• Instead of showing the quiz and composition result as a percentage, it would be better for the children to see their mark as grades (A, B, C etc) like we do in school.

• It is not possible to get to the Admin form from the main menu and there is no option to get to the Log On screen either. There two options would be needed to reduce the number of times the program would need to be shut down.

Composition – Rhythm Exercise 1.

• Form 1 of 6 – Playing the rhythms
  • ‘I will show you how it is played first then it is your turn. Click START to begin.’
  • ‘The big pictures are the longer beats and the smaller pictures are the shorter beats.’
  • Help: ‘Click on the big picture to see how long is the beat.’
  • Help: ‘Click on the small picture to see how small is the beat.’
  • ‘Now it’s your turn. Click START to begin.’
  • Help: ‘Click on START button to begin playing the beats on your keyboard.’
  • ‘Congratulations, Well Done. You did very well. You may carry on with the second part of the exercise. Please click NEXT button.
  • Help: ‘Click NEXT button to continue’

• Form 2 of 6 – Using the rhythms to compose a piece.
  • ‘Your task is to compose rhythms. Choose the boxes you prefer and start composing your rhythms.’
  • Help: ‘First, I will show you my rhythm. Please click NEXT for me to begin’
  • ‘Please fill all the boxes.’
  • ‘Now you have finished your rhythm. Play your piece and see if you like the sound.’
  • ‘Please carry on changing your rhythm until you are happy.’
  • There is need to explain how it is possible to alter their composition. Possible of having another help showing the teacher performing this activity.
  • When the play button is clicked, have some kind of device that shows the child which rhythm is being played.

• Form 3 of 6 – Recording the composition on the keyboard.
  • ‘Here is your final rhythm. Please play it on the keyboard. Press RECORD to start.’
  • Help: ‘Please click RECORD to start recording your rhythm.’
  • ‘Click PLAY to start your composition.’
  • ‘Are you happy with your composition?’
  • Have a yes and no button to select if they are happy or not. This will make it a lot clearer what action the child should take.
  • If yes: ‘Click SAVE to keep your composition.’
• If no: ‘Click RECORD to change your composition.’

Form 4 and 5 of 6 – Showing the musical elements of what has been completed.

• Change the colour of the highlighted information from red. This colour does not seem to be very clear against the blue background.

• Not much other alteration where suggested in this section as both of the teachers where not music specialists. It was suggested that the music coordinator of the school should look over these parts.

• ‘Please answer the quiz. Click FINISH to end.’

Form 6 of 6 – Quiz.

• It must be shown how the answers are inserted into the quiz. This can be done through the help button. Possible by the teacher showing how he would complete the answers.

Composition – Melody Exercise 1.

Form 1 of 5 – Listening to a musical piece.

• ‘Please listen to the piece of music by pressing PLAY.’

• Help: ‘Listen to the music again to see if you can hear any of the options below. Click PLAY to start.’

• ‘Please select an option?’

Form 2 of 5 – Composing a melody.

• ‘Please use the notes D, E, F, G and A on the keyboard.’

• Help on which musical notes to be used needs to stay on longer and state which note is being highlighted each time.

• Help: ‘Enter the notes used in the boxes by clicking on the arrow by the side of the box.’

• ‘Experiment with the notes on the keyboard then enter the notes used in the boxes below.’

• Have a little arrow showing where exactly the start and finish of the composition is.

• ‘Please click PLAY button to hear your composition. Are you happy with your composition?’

• If no: ‘Keep experimenting to change your composition. Click NEXT when you are happy.’

Form 3 of 5 – Recording the melody on the keyboard.

• ‘Here is your final melody. Play your notes on the keyboard. Please click RECORD button to start.’

• ‘Please click PLAY to hear you composition.’

• ‘Are you happy with your composition.’

• If yes: ‘Click SAVE to keep your composition.’

• If no: ‘Click RECORD to change your composition.’

Form 4 of 5 - Showing the musical elements of what has been completed.
• ‘Read the following. I will test you late.’
• Red not a good colour against the blue background for highlighting.
• As in the rhythm exercise, not much else was suggested as they did not have much experience with music.
• The view button which showed the examples of the pitches used needed to be slowed down.

Form 5 of 5 – Quiz.
• ‘Please answer the quiz. Click the FINISH button to end.’
• The box for the last two questions needed to be extended as it was not displaying the whole of the answers.
• The boxes for questions three and six needed to be raises so that the pull down answers went down and not up, this would be veru confusing to many children.

Administration.
• Selecting Devices:
  • The phrase ‘MIDI in’ and ‘MIDI Out’ was not understood
• Comment on users work
  • Cannot see all the comments at once on the screen.
• Adding users
  • Title needs altering to ‘Add new user’
  • The arrows for selecting the class and year where not used. Therefore need to be made clearer or explained in the explanation.
• Delete user
  • Title needs altering to ‘Delete existing user’
  • It was not obvious that the search button was needed to be clicked. Therefore insert more instructions under the class and year boxes to explain that this is needed to search for the children.
  • Alteration to the label ‘names’ to ‘names found’.

Teachers opinion of program after use:
“As a non-specialist music teacher, with limited ICT skills after suggested alterations and additions to this program, I consider it will fully support me in future teaching and learning situations. I liked the program very much, particularly the help messages that appeared from the Music Teacher. I fully appreciated his support in helping me, to compose my rhythms and melodies. I now feel much more confident to compose further work and alter my rhythms and melodies accordingly. I look forward to using this program with increased confidence and great enthusiasm with my children. It will support their future musical learning within the classroom.”
Appendix K – Iteration 1 Amendments

Log On Form

Problem 7: Remove close window button for each form.

Main Menu Form

Problem 5: Titles change after each menu button click.

Problem 3: Removal of unused menu buttons. Consequently, the menu buttons are in logical order.

Problem 12: Help button tells user what menu buttons need to be clicked.

Problem 18: Show quiz and composition scores as grades.

Rhythm Exercise 1 Form

Problem 9: Menu options left aligned from centre of keyboard key.

Problem 8: Quit button at bottom of list.

Problem 1: Alteration from upper case letter to lower case letter in each instruction speech bubble.
Problem 4: Insertion of back button to see previous instructions.

Problem 22: White space in between each question in order to group related objects.

Melody Exercise 1 Form
Problem 1: Alteration from uppercase letter to lower case letter.

Problem 2: Showing where melody piece starts and ends.

Problem 4: Insertion of back button to see previous instructions.

Problem 11: Slow down timer by two-fold that shows which musical keys to use for exercise.

Problem 1: Alteration from uppercase letter to lower case letter.

Problem 2: Showing where melody piece starts and ends.

Problem 4: Insertion of back button to see previous instructions.

Problem 13: Slow down timer that shows the musical score of each pitch that was used in the exercise.

Problem 4: Insertion of back button to see previous instructions.
Problem 1: Alteration from upper case letter to lower case letter.

Problem 5: Resize the combo boxes for questions seven and eight.

Problem 19: White space in between each question in order to group related objects.

Problem 22: Move question three and six up in order for the answers to be shown below.

Administration Form

Problem 6: Description of MIDI in and out

Problem 10: Default MIDI in and out options of from load

Problem 14: More instructions added to the delete user part.

Problem 15: Alter add user title to ‘Add New User’ and alter ‘Delete user’ to ‘Delete Existing User’.

Problem 16: Modify comment box by adding a ‘Add Comment’ button. Therefore the whole comment can be seen by the administrator.
Appendix L – Iteration 2 Results

(1.) Teacher 1 - Music Co-ordinator

Log On

- Colourful, simple first page. Instructions easy to understand
- The arrows for the names where not used, the names where inputted using the keyboard.

Quick instructions

- Easily found, as it was the first thing that was seen on the page
- Straight forward tutorial, easy to complete however it was not always known that the next button was needed to be pressed.
- Once the tutorial was finished, did not know what to do next.

Main Menu.

- Nice personalised page
- Navigation was a little confusing, the children would be better to have just one option to click each.
- When ‘Compose’ menu button is click, no action actually happens therefore the child would not know what was required of them next. Therefore if instructions where available, after compose was clicked an instruction would appear in the speech bubble for example ‘Well Done, now click RHYTHM.’

Composition – Rhythm Exercise 1.

- Form 1 of 6 – Playing the rhythms
  - Was able to click on the start button to hear the examples of the rhythms, however there was no instruction telling the user that next needs to be clicked. Even though the tutorial explained this, there is still need to inform the user that this is required.
  - Enabling the child to click on any key on the keyboard and not only middle C.
- Form 2 of 6 – Using the rhythms to compose a piece.
  - The help button was not utilized to it full potential. Whenever an instruction was not understood, the help button was not used. The help button will need to be clearer to the user.
  - Confusion when the user was expected to clicking on the rhythm followed by clicking on the intended bar. A better method would be to click and drag the rhythms across, as this is used in the majority of other programs that they use.
  - The help was not utilized here either.
- Form 3 of 6 – Recording the composition on the keyboard.
  - Understood this section very well as the instructions directed the user to each button that was needed.
• Form 4 and 5 of 6 – Showing the musical elements of what has been completed.
  • As the teachers taught Year three and Year four, the early stages of Key Stage Two the musical notation was not provided to all the children. The children who already played musical instruments and understood musical notation were encouraged to use it. However, for the less able children, they simply used graphical scores and pictures.
  • The American notation are used the name of the notes (half and quarter notes) instead of the British notation of crotchets and quavers.
  • This explanation could be used if the children have good musical knowledge however not for the less able children. This explanation could be used later on in the program when musical notation is explained to all the children.
  • A tempo is a difficult concept to explain to the children. For all the children to understand Tempo, simply define it as the overall speed of the piece. Subsequently have extracts of music playing so the child can decide if it has a slow or fast tempo.
  • In addition, the concept of time signatures should be left out till a later stage in the program or merely for musicians.

• Form 6 of 6 – Quiz.
  • Answering this quiz would also need to be changed to click and drag of the objects.

Due to other commitments, the rest of the program could not be evaluated with this user.

(2.) Teacher 2 - No musical knowledge and intermediate computer skills.

Log On
  • The name was typed in, even though the instructions said otherwise.

Tutorial
  • Instruction no1 – Navigating the site:
    • Did not see how the menu bar was used as the writing in the box was being read.
    • Did not understand the command ‘try and compose a rhythm for your first exercise.’ This is not actually what is being asked here.
  • Instruction no2 – Receiving help:
    • No need for the ‘please click next’ instruction. Why not just ask the user to click the help button here.
  • Instruction no3 – Receiving the next instruction:
    • Reword this instruction as it does not tell the user to click on the NEXT instruction button.
  • Instructions finished:
    • What do I do now?
• There is need for extra instructions. For example in the speech bubble tell user to click COMPOSE then RHYTHM then finally EXERCISE 1.

Main Menu.

• Bigger print is required for the marks and the shortcuts section at the bottom of the page.

Composition – Rhythm Exercise 1.

• Form 1 of 6 – Playing the rhythms
  • There is no explanation of what a rhythm is or why there is need to compose a rhythm.
  • There is no mention of using the keyboard to play the notes. The teacher was trying to click the mouse. Need for extra instructions.
  • No rhythm appeared straight away, there was need to click another button before starting.
  • Did not know which key to use on the keyboard.

• Form 2 of 6 – Using the rhythms to compose a piece.
  • There does not seem to be any objective to creating this rhythm. Possibly create a rhythm to accompany a poem.

• Form 3 of 6 – Recording the composition on the keyboard.
  • Maybe NEXT and START should be located in the same area of the screen. Perhaps bring the NEXT button down to the bottom right of the screen. The user will therefore always know where to look all the buttons that are needed in the exercise.
  • The save instructions did not make it clear that the save button was needed to be clicked. Put the save word in capitals like the other instructions.

• Form 4 and 5 of 6 – Showing the musical elements of what has been completed.
  • Examples of tempo would be a good idea in order to understand the concept

• Form 6 of 6 – Quiz.
  • Did not know whether to click SAVE or NEXT. Very confusing, there is need to remove one of these buttons.
  • One all four of the pieces have been clicked; change the instruction to ‘Please click NEXT’. Remove this from the previous instruction as it was making it quite confusing what was needed to be done.
  • Mention that the answers should be dragged over, like when a rhythm is being made.

Composition – Melody Exercise 1.

• Form 1 of 5 – Listening to a musical piece.
  • Remove the ‘1. Listen to the following.’ As this is indicated in the instructions anyway.

• Form 2 of 5 – Composing a melody.
  • Need for the piano keys to be show all the time as the help did not show the notes for long
enough to find them on the keyboard.

• Form 3 of 5 – Recording the melody on the keyboard.
  • Keep the notes up here as well in order to know which notes to play on the keyboard
  • The END and STOP are a little confusing. The teacher tried to click the ‘End’ picture instead of the STOP button.

• Form 4 of 5 - Showing the musical elements of what has been completed.
  • Did not recognise the ‘going down’ pitches therefore change the quiz so it only contains high or low pitches.

• Form 5 of 5 – Quiz.

Administration.

• Selecting Devices
  • With the instructions this was simple to select and test the devices.

• Comment on users work
  • No obvious how to insert a new comment. Need more explanations.

• Adding users
  • The arrows where not used for the class or year. Need more explanation.

Teachers opinion of program after use:
The program needs more explanation on the basics of music before the composing begins. This is my old fashion approach, it may be better to let the children experiment then learn the theory. As I have no previous knowledge of music, this keyboard notes needed to be displayed any time that the keyboard needs to be used. I did not know which notes needed to be used when recording the piece. This could be overcome by possibly having a box showing which note I am playing, therefore I will be learning while experimenting with the keyboard. In my opinion, it is the initial instructions; the first quarter of the program needs more explanation. Once the program is learnt, it becomes a lot easier as I know what is required.
Appendix M – Iteration 2 Amendments

Log On Form

Problem 5: Will not allow user to log on unless they now use the arrows to select names.

Problem 1: Once tutorial if finished, instructions on what to do next appear.

Main Menu Form

Problem 7: Once a menu button is clicked, the options available to the user appear in the speech bubble. E.g. once ‘Compose’ button is pressed:

Problem 16: Remove distracting information while exercise is being shown. The speech bubble will contain the following:

Rhythm Exercise 1 Form

Problem 19: Increase in font size displaying the exercise information.

Problem 4: In each form, wherever next needs to be clicked, it does not count on user to know it needs to be clicked

Problem 9: Removal of other writing that distracts the user from the exercise instructions.
Problem 3: Enable rhythms to be dragged to their destination in the user’s piece.

Problem 12: Replacement of the next button. The user will not know that all of the required commands are at the bottom of the screen. This has been altered in all forms.

Problem 14: Alteration to definition of tempo. Define as ‘the speed of the piece’.

Problem 13: Alteration to content. Only require the user to differentiate between fast and slow tempo. All notation and time signature content have been removed.

Problem 8: Musical extracts of fast and slow tempos are now available.
Problem 3: Enable answers to be dragged to their correct location in the answers.

Problem 13: Attention to content of quiz due to removal of notation and time signature concepts. The user now must play each musical clip and note if it was a fast or slow tempo.

Problem 15: Keyboard keys are shown to the user continuously. They are able to click on the notes to find out the note name.
Problem 10: Remove contradicting name (END) from form. This was only showing the user where the composition finished.

Problem 15: Keyboard keys are shown to the user continuously. They are able to click on the notes to find out the note name.

Problem 13: Alteration to content. Remove all reference to music notation. All the user will have to do is play each pitch and be aware that the pitch is getting higher.

Problem 13: Alteration to content of quiz due to removal of music notation. The user must not play each musical clip and note is it is a high or low pitch.
Administration Form

Problem 21: Divide page up into sections

Problem 20: More explanation given on how to add comments to user.

Problem 18: Attention to the values inserted into the MIDI in and out lists. The values are now understandable to the user. E.g. Instead of ‘Microsoft GS Waveable SW Synth’, the phrase ‘Computer’s Speakers’ will appear.

Problem 17: If arrows not used and an invalid year or class is entered, the system will respond to the administrator telling them to use the arrows to insert the year and class values.

(1) Invalid Class entered

(2) Invalid Year entered
# Appendix N – Evaluation Checklists

## (1.) Child checklist

<table>
<thead>
<tr>
<th>EVALUATION NUMBER:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many user(s) are using the system at once?</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>If two users, does the users seem to work together well on the system?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>What is the musical ability of the user(s)?</td>
<td>excellent + good</td>
<td>Limited + poor</td>
<td>good + good</td>
<td>limited + poor</td>
<td>good + poor</td>
<td>good + poor</td>
<td>Poor + poor</td>
</tr>
<tr>
<td>What is the computer ability of the user(s)</td>
<td>good + good</td>
<td>Good + good</td>
<td>poor</td>
<td>limited + poor</td>
<td>ok + good</td>
<td>poor + good</td>
<td>Poor + poor</td>
</tr>
<tr>
<td>Does the user(s) play a musical instrument already?</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>If yes, what instrument</td>
<td>Clarinet + piano</td>
<td>-</td>
<td>Piano + guitar</td>
<td>-</td>
<td>-</td>
<td>piano</td>
<td>-</td>
</tr>
<tr>
<td>Is the user(s) able to use the system without asking for human assistance?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
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</table>

### Log in and Log out:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Could the user(s) log in to the system successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Could the user(s) log out of the system successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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### Main Menu

<table>
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<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the users able to find the tutorial?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was the tutorial completed successfully?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Did the user know how to access the teacher’s comments?</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
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### Rhythm Exercise:

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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the users find the rhythm exercise easily with the help of the system?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

### (1 of 5)

<table>
<thead>
<tr>
<th></th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the user(s) able to understand the language of the instructions?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to use the NEXT instruction commands?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Question</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Are the user(s) able to find the START button?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to play the musical keyboard successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>(2 of 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the user(s) able to understand the language of the instructions?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to use the NEXT instruction commands?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to drag the rhythms successfully to their composition?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to PLAY their composition successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
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<td>(3 of 5)</td>
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</tr>
<tr>
<td>Are the user(s) able to understand the language of the instructions?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to RECORD their composition successfully using the keyboard?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) aware the STOP button was needed to be used?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to PLAY back their composition?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Did the user(s) SAVE their composition successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
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</tr>
<tr>
<td>Are the user(s) able to understand the musical elements of the rhythm exercise?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Did the user(s) PLAY the musical clips successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Was help needed?</td>
<td>no</td>
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</tr>
<tr>
<td>Are the user(s) able to PLAY each musical clip?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to drag the answers into the quiz?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) aware that finish was needed to be clicked before ending the exercise?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
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<tr>
<td>Melody Exercise:</td>
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</tr>
<tr>
<td>Did the users find the melody exercise easily or with the help of the system?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
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<td>(1 of 5)</td>
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</tr>
<tr>
<td>Are the user(s) able to understand the language of the instructions?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>Are the user(s) able to use the NEXT instruction commands?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to find the PLAY button?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
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<td>yes</td>
<td>yes</td>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to enter the notes used in the correct boxes?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to PLAY their composition successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>yes</td>
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<td>no</td>
<td>yes</td>
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<td>Are the user(s) able to RECORD their composition successfully using the keyboard?</td>
<td>yes</td>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to PLAY back their composition?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Did the user(s) SAVE their composition successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
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<td></td>
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</tr>
<tr>
<td>Are the user(s) able to understand the musical elements of the melody exercise?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Did the user(s) PLAY the pitch of each note successfully?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the user(s) able to PLAY each musical clip?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) able to select an answer from the boxes?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Are the user(s) aware that finish was needed to be clicked before ending the exercise?</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Was help needed?</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

**Conclusion**

| Did you enjoy using the system? | yes | yes | yes | no | yes | yes | yes |
| Do you want to use the system again? | yes | yes | yes | no | yes | yes | yes |

(2.) **Teacher checklist**

**Tasks:**

1. Please enter the administration section of the system
2. Please enter the username: `admin1` and password: `themusicteacher` into the appropriate boxes and click ENTER.
3. Please select the appropriate musical keyboard for use with the system and select to output the sound through the computer speakers
4. Please test the MIDI out
5. Please select the appropriate musical keyboard and select to output the sound through the keyboard speaker
6. Please test the MIDI out
7. Please add a new user to the system for your class
8. Please delete ‘Leonie Hamilton’ who is in Year 4C from the system
9. Please listen to the rhythm and melody composition made by Steve Jones and Gary Thomas and insert a composition score and comment on these compositions.
10. Now please save these additions
11. Please return to the Log In page
<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entering Administration</strong></td>
<td></td>
</tr>
<tr>
<td>Did the user find the administration button successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to enter the username and password into the correct boxes?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>If errors where encountered, where they able to recover from them successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td><strong>Selecting MIDI devices</strong></td>
<td></td>
</tr>
<tr>
<td>Was the user able to find the MIDI device section?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to select MIDI In from Yamaha keyboard and MIDI out through the computer speakers?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to select MIDI In from Yamaha keyboard and MIDI out through the keyboard speakers?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Did the system provide adequate support to select the devices based on their needs?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Was the user able to test the MIDI output successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Did the system provide adequate support to test the devices based on their needs?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td><strong>Adding a New User</strong></td>
<td></td>
</tr>
<tr>
<td>Was the user able to find the add user section?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to add a new user successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Did the system provide adequate support for their needs?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>If errors where encountered, where they able to recover from them successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td><strong>Deleting an Existing User</strong></td>
<td></td>
</tr>
<tr>
<td>Was the user able to find the delete user section?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to delete an existing user successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Did the system provide adequate support for their needs?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>If errors where encountered, where they able to recover from them successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td><strong>Inserting Feedback</strong></td>
<td></td>
</tr>
<tr>
<td>Was the user able to find the feedback section?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Was the user able to play the compositions successfully?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to add a valid composition score for a specific user(s)?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td>Is the user able to add comments a specific user’s composition?</td>
<td>YES □ NO □</td>
</tr>
<tr>
<td><strong>Exiting Administration</strong></td>
<td></td>
</tr>
<tr>
<td>Can the user return to the log in page successfully?</td>
<td>YES □ NO □</td>
</tr>
</tbody>
</table>
(1.) First, the drivers must be installed for the USB device that transmits the midi message from the keyboard to computer. Please follow the instructions set by the manufactures of the device.

(2.) Please insert The Music Teacher CD.

(3.) Now you are ready to install The Music Teacher Program. Drag ‘The Music Teacher’ folder from the CD to any location on your hand drive.

(4.) Open the folder from the hard drive and double click on ‘The Music Teacher’ file. You are now ready to learn!

(5.) Before starting the ‘The Music Teacher’ make sure the midi settings on the keyboard are set to the following:

- Keyboard Out = ON
- Remote Channel = 1