# Technology Education Key Learning Area

Case Study: Students should be made aware of the relevance of the technology they are studying to the real world. Case studies on technology and design enable students to put their learning into an authentic context.

Authentic Context: Students could realise the influence of technology and discuss relevant ethical issues such as piracy and copyright through the study of the development of digital music.

Level: S3

Knowledge Context Covered: Common topic - Technology and society
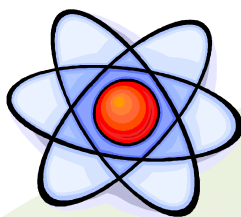
The Development and Impact of Digital Music

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Introduction: Audio Technology Development

Today, music files are commonly distributed in digital form and most of them are sold in the media such as Compact Disc (CD) or being sold through the Internet. Advanced technology enables digitalization of information (sounds, pictures, and texts). Digital music refers particularly to music (files) distributed via the Internet without physical substrates. Digital music can be stored on home computers and other digital player device. For example, one of the common digital music players is iPod.

The most successful digital music player - IPod

In October 2001, Apple computer launched their portable music digital player –iPod. It consisted of a 5GB Hard Disk and was able to store up to 1000 songs. Instead of the pressing control buttons, user can spin a wheel to scroll through a list of song to locate the song to be played. The wheel can also be used to control the menu of the system. This product was well received by the youth market quickly. Then Apple Computers launched the iTunes Music Store (iTMS) in the summer of 2003 and started to develop a platform for the sale of digital music through internet. Nowadays, the iPod becomes one of the most popular digital music and video player in the world.

Figure 1: iPod (2003)

Think about it:

There are lots of MP3 player in the market. What are the reasons for iPod to be the most popular one? If you are the designer of Apple computer, how will you design the new generation music player? Please list the essential features you think they are important to the new design.

Nowadays, we can listen music through different digital player devices, such as our mobile phones, MP3 players or some digital data storage devices. Let us take a look at several technological advances, which set the stage for the rise of digital music.

Brief History of Audio Storage Media

Vinyl

The vinyl record is a type of gramophone record. It is the primary medium used for commercial music reproduction for most of the 20th century, which were popular from the 1950s to the 1990s, and was most commonly used for mass-produced recordings of music.

A vinyl gramophone or phonograph record consists of a disc of polyvinyl chloride plastic, engraved on both sides with a single concentric spiral groove in which a sapphire or diamond needle, stylus, is intended to run from the outside edge towards the centre.

Activity:

Students are encouraged to watch the movie on www.youtube.com: How Vinyl Records are Made (Part 1 and Part 2)

http://www.youtube.com/watch?v=xUGRRUecBik (Part 1)

http://www.youtube.com/watch?v=lReDh9ec_rk&NR=1 (Part 2)

Current situation

Vinyl first designed in the final quarter of the 19th century and held a predominant position for nearly a century. However, by 1988 to 1991 vinyl records experienced a sudden decline in popularity because of the rise of Compact Discs (CD). It left mainstreams by 1991, and continue to be manufactured and sold until now for some minority markets. It is still used by audiophiles for certain types of music, especially electronic dance music, hip hop, punk rock, and heavy metal music.

Stop and Think :
Do you know why this is so? Please suggest some possible reasons for that.

Figure 2: English: A 12" record, a 7" record, and a CD-ROM.

File source: http://en.wikipedia.org/wiki/Image:Vynil_record.jpg#file

Figure 3: Edison Home Phonograph

File source: http://en.wikipedia.org/wiki/File:EdisonPhonograph.jpg

Cassette Tape

Cassette Tape, also refer as Audio Cassette or Compact Cassette, is a magnetic sound recording format. *Philips Consumer Electronics* introduced the Audio Cassette media in 1963. Cassette Tape can store music for up to 120 minutes and the most popular varieties are C46 (40 minutes), C60 (60 minutes), C90 (90 minutes) and C120 (120 minutes). Cassette tape became popular in1980s because it is small in size, its durability and ease of copying.

In the 1980s, Sony introduced *Walkman*, a portable pocket recorders and player to the market. Since then, people can listen to music wherever they are and Cassette tape became a very popular music storage media because it acts as the music container of *Sony's Walkman.*

Decline of Cassette tape:

However, the market for cassettes has declined sharply since its peak in the late 1980s. Its sales was overtaken by Compact Discs (CD) during the early 1990s, which provided higher audio quality and also ease of handling and copying.

Figure 4: Cassette tapes and Sony's Walkman

File source: http://en.wikipedia.org/wiki/Image

Stop and Think:

Do you have any digital audio player device? There are numerous reasons for people to buy CD and MP3 players, such as good audio quality, lower price, easily to integrate with other households etc. However, some audio fevers are still looking for high quality Vinyl and Vinyl players. They think that the sound of Vinyl is "warmer", "softer" and more "human". Can you find any other advantages of using analog media?

Digital Media

Compact disc (CD)

A Compact Disc (or CD) is an optical disc used to store digital data, originally developed for storing digital audio. In 1979, *Sony* and *Philips Consumer Electronics* set up a joint task force of engineers to design a new digital audio disc. After a year of experimentation and discussion, the taskforce produced the *Red Book*, the Compact Disc standard. The basic specifications state that:

Stop and Think:

What is the Red Book? Please search and explain the function and features of Red Book.

1) Maximum playing time is 78 minutes (including pauses);
2) Minimum duration for a track is 4 seconds;
3) Maximum number of tracks is 99;
4) Maximum number of index points (subdivisions of a track) is 99 with no maximum time limit;
5) International Standard Recording Code (ISRC) should be recorded on CD-Rs to appear on the replicated discs.

Currently, there are 2 common standards of Compact Disc:

Physical Size	Audio Capacity	CD-Rom Data Capacity
12 cm (Standard)	74 – 78 min	650 – 703 mb
8 cm (mini CD)	21 -24 min	185 – 210 mb

1990s, the production volume of audio compact cassettes was rapidly declining from its peak of 76 million units in 1988. CD technology had quickly replaced analog audio

technology thanks to its digitally-based, high speed random access and direct search capabilities. CDs were a great success.

Mini disc

Ten years after the launch of CDs, Sony announced a new music medium – Mini Disc. A Mini Disc (MD) is a magneto-optical disc-based data storage device initially intended for storage of up to 80 minutes of digitalized audio. Mini Discs are popular in Japan as a digital upgrade to cassette tapes, but have not been as popular world-wide. Another digital format player – MP3 player, quickly replaced it.

Figure 5: A Sony MiniDisc player and a MiniDisc

MP3

MP3 is the short form for 'MPEG Audio Layer 3'. It was developed in 1987 as a way of compressing CD-quality sound files. Every minute of digitized music stored on a standard CD requires about 10 megabytes storage space. With MP3 compression technology, files occupied only about 1/12 as of the CD disk space occupied by uncompressed files. While MP3 reduces the storage space needed for a sound file, it offers near-CD quality sound (National Research Council, 2000, pp.77-78). The advantages of MP3 are:

- This compression technique makes MP3 files tremendously denser than raw audio data,
- Much faster to distribute;
- Easier to store.

Research Topic:
What are the differences between MP3 and MP4? What is "MPEG"? How do various "MPEG" standards affect the digital entertainment industry? You may access to Internet and find out their differences.

The impacts of MP3 –Music Piracy, Copyright and Digital Right Management (DRM)

Background: Record Industry and Problem of Piracy

In recent years, the rapid development of internet technology has enabled internet users to upload and download MP3 across the world easily. According to the statistics of *IFPI music report in 2008,* 30 percent of all recorded music sold is online or mobile in US, only after five years of the commercial music download business first emerged. The digital revenues are growing and diversifying since consumers can easily purchase music and related products from unlimited digital channels.

However, music piracy remains an ongoing problem in Music Industry. The mature digital music technology caused huge damage to the music industry:

> *"IFPI estimates the trade of pirate discs was worth US$4.5 billion globally in 2005. At the same time, almost 20 billion tracks were illegally swapped or downloaded on the internet in 2005."*
> *www.ifpi.org - 2006*

The trend of music download is irreversible. Music industry is undergoing a revolution that consumers are using the digital platform to obtain and pay for the music. The music industry had tried every means to stop the problems of piracy. The law of the copyright is the first shield to prevent companies and people to download and upload illegal music.

Research Topic:
Please research on the music industry organization – IFPI. What is her role in the industry? What are her suggestions to the online music business?

Copyright

The roles of "Copyright"

The first step of building a secure digital music service platform is to seek strong copyright protection. Copyright law plays three important roles in supporting the culture industry.

1) First, copyright is a legal institution that provides a framework for designating marketable rights in intellectual property.

2) Second, copyright is an economic institution that excludes other competitors in the market and ensures income during periods of low sales.

3) Third, copyright is a cultural institution in which the concept of art, individual rights, collective freedom, and intellectual property is re-encoded.

How do the copyright law protect copyright?

Copyright law is the foundation of the recording industry's income stream. A large amount of the recording industry's revenues comes from the exploitation of various rights. It gives the owners of copyright exclusive rights to deal with their works in a number of ways, such as:

1. Copying;
2. Issuing copies to the public;
3. In the care of computer programs or sound recordings, renting copies to the public;
4. Making available copies to the public;
5. Performing, showing or playing the work in public;
6. Broadcasting or including the work in a cable program services; and
7. Making adaptations or doing any of the above in relation to an adoption

### How to attack "Piracy" in recording industry?

However, the recording industry is hardly to identity every single illegal music download. Even of all piracies are located, a large number of copyright suits would be required. Instead of attacking the problem on the receiving end, the industry attacked the manufacturers in hopes of re-centralizing the infringements:

Napster Inc. Case (1999)

In 1999, the recording industry attacked the Napster inc. Napster Inc. is founded by a 19 years old Shawn Fanning. He developed a music file sharing system called Napster, which allowed users to share their MP3s free over the internet. It is based on peer-to-peer technology (P2P), which essentially enables users to link their computers directly to each other via the internet to share whichever files they choose.

In December of 1999, the Recording Industry Association of America (RIAA), which represents a host of recording companies, took action by filing a federal lawsuit against Napster for copyright infringement. In 2001, Napster offered $1 billion to the record companies in hope settling the lawsuit. Record companies, however, insisted that Napster block all of the unauthorized exchange copyrighted songs.
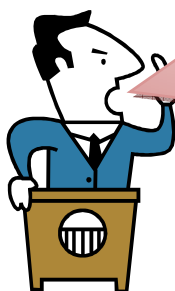
Research Topic:

Is there any government policy in Hong Kong to protect the music industry from the music piracy? What are the impacts of piracy problem to our music and movie industries?

Protection with Technology Advancement: Digital Right Management (DRM)

To protect music from illegal download and playback, music industry also deployed some technological protection service. One of the employed technologies is Digital Right Management (DRM). The technology aims to control use of digital media by preventing access, copying or conversion by end users to other formats. According to Microsoft, DRM is "*a technology that enables the secure distribution, promotion, and sale of digital media content on the Internet*" ("Digital rights," 2002). Many online companies use DRM to restrict users to copy and reproduce their music:

1) The iTunes Store, run by Apple Inc., allows users to purchase a track online for $.99 US. The tracks purchased use Apple's FairPlay DRM system. Downloaded music can be only played on Apple Inc.'s MP3 player – Ipod (or similar devices such as iPhone).

2) Sony offers music download service with the protection of OpenMG DRM technology. Music download from this store is only playable on computers running Windows and Sony hardware (such as PSP)

3) In Hong Kong, EOL Asia. com employed Microsoft Digital Right Management (DRM) technology to protect from illegal playback. The downloaded music can be burnt onto CDs or transferred to those portable digital players which support WMA protection.

However, these different DRM systems are not interoperable. Some online consumers may find that their downloaded music files cannot play on his digital players. Each online store require their users to install a client software and their downloaded music file can be only played on some specify portable digital players (with the use of same DRM system).

Decline of DRM?

Although DRM can help to protect the Internet music from illegal usage, some online music store, such as eMusic and Amazone do not use DRM. Apple's iTune store also start to sell DRM free music. Apple's Steve Jobs has called on the music industry to eliminate DRM in an open letter titled _Thoughts on Music:_

> _Why would the big four music companies [1] agree to let Apple and others distribute their music without using DRM systems to protect it? The simplest answer is because DRMs haven't worked, and may never work, to halt music piracy. Though the big four music companies require that all their music sold online be protected with DRMs, these same music companies continue to sell billions of CDs a year which contain completely unprotected music. That's right! No DRM system was ever developed for the CD, so all the music distributed on CDs can be easily uploaded to the Internet, then (illegally) downloaded and played on any computer or player._

Notes:

(1)   The four big companies are Universal, Sony BMG, Warner and EMI. Those four companies control the distribution of over 70% of the world's music.

The Future of MP3 and Music Industry

The music industry has been declining in the past few years. CDs are not sold in the numbers that they used to. However, the bloom of digital music also create some good news to the industry. In the *report of IFPI 07: Digital Music Report*, they have the following findings:

> 1) *Record companies' digital music sales are estimated to have nearly doubled in value in 2006, reaching a trade value of approximately US$2 billion.*

> 2) *Single track downloads are estimated to have totaled 795 million in 2006, up 89 per cent on 2005.*

> 3) *The number of tracks available online doubled to reach over four million on leading services in the last year.*

> 4) *Portable music players are helping drive digital music consumption. Portable player sales totaled around 120 million in 2006, an increase of 43 per cent on the previous year (Understanding and Solutions).*

> 5) *New revenue streams and business models emerge. Social networking sites exploded in popularity while advertising-supported models such as video licensing on Yahoo! Music and MSN emerged as a potentially exciting revenue stream for record companies.*

> 6) *Lawsuits are having an impact. Recent research from analysts Jupiter shows that illegal file-sharing in Europe has been contained in the last year, in the context of a 30 per cent increase in broadband household penetration.*

The potential for digital download and mobile music stores to generate serious revenues is certainly there, but until issues such as DRM models are resolved, music industry might still have some work to do before it really hits back.
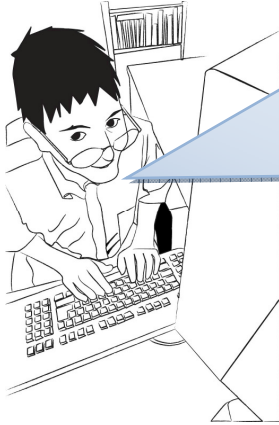
Research Topic:

People are using various peer-to-peer (P2P) file-sharing technologies to share digital files in the Internet. What are the specifications of P2P technology? Please provide one example of a P2P software and explain its pros and cons.

Project 1： Webpage design for a music company

Objective:

1. To investigate the business environment of internet music industry

2. To understand the design process and design a webpage platform that can fulfill the need of an internet music download business

Numbers of Students per group: 5 – 6 students per group

Task: Design a webpage for a music download business

Details:

In this project, students are required to form a design team to prepare design sketched and computer graphic mock-ups for the design of an online store. The design team is working for a well established music company. The company has a huge amount of music stock (with different styles) and wants to start the music download business within a month. Our students, who act as the design team members, are required to develop a webpage prototype with the following requirements:

A. Target customer: age 12 – 45

B. Webpage design:
   i. Homepage: it should be attractive for the youth and people can easily find their favorable music. Some new albums will also be promoted on the homepage.
   ii. Search page: it should be easily to understand and people can easily find their favourite music here
   iii. Payment page: Credit card is the only payment method in this music download business. Customers have to pay $5 for each music track (MP3 only).

Development Process:

1) Define roles among members: students should first define their roles in this project:

   a) A project leader should be selected to monitor the development process;

   b) 1 – 2 researcher/analyst are required to investigate the competitors (other music download company);

   c) 1 – 2 web designers are required to develop the webpage prototype.

2) Research and analysis: students should first conduct researches and visit various internet music download webpage, analyze their business models and study their webpage design considerations.

3) Webpage design: according to the results of previous research, students should develop the prototype. Students can first draft the design with pencil on paper. After further discussion, they should develop the design with computer software, such as Adobe Photoshop or Illustrator. *(Reminder: No need to develop an interactive webpage!!! Just focus on the design and how it fulfill the business need)*

Project Presentation and Submission:

There will be two verbal presentations. Students are also required to submit the group report.

Presentation 1 (10 mins):

Students should first introduce their projects (with background researches):

1) Other popular music download webpage design and their design specifications, such as color scheme, no. of pages, service provided etc

2) Design idea and consideration: students should explain their design idea of this project: how can it attract people stay on the webpage? What kind of services that it can provide?

Presentation 2 (10 mins):

Students are required to present and explain their final design. Students should introduce their design considerations and how do their final design encourage potential customers stay and purchase music on the website.

Final Submission:

The detail report, including all the research data, proposals, recommendations and the presentation file.

Project 2 – MP3 and the Music Industry

Objectives:

Students should be able to:

1) conduct research on a topic which related to music industry and copyright.

2) understand the current situation of music industry and music piracy.

Instructions:

1) Students are divided into groups (3 – 4 students per group);

2) Each group selects one of the following research topic;

3) Conduct research on the topic;

4) Prepare and present the findings.

Project Presentation Duration: *10 minutes per group*

Research Topics:

1) MP3 download has caused huge damage to the music industry. Are there any good effects it brings to the industry? Please states.

2) What is the future development of the music industry in this digital era? Can mobile music download become an important revenue stream for the industry?

3) If you are a CEO of a record company, what means will you propose to increase the revenue from the online music store?

References

CHI JEN HSIEH (2002) From "the MP3 revolution" to pay-to-play [electronic resource]: The political economy of digital music

HACKER SCOT (2000) MP3 The definitive guide Sebastopol [Calif.]: O'Reilly

HSIEH CHI JEN (2002) From "the MP3 revolution" to pay-to-play: The political economy of digital music

Sony History – Mini Disc : a replacement for the Audio Compact Disc
http://www.sony.net/Fun/SH/1-21/h4.html

What is MEPG?
http://www.webopedia.com/TERM/M/MPEG.html

Copyright Ordinance
http://www.hkcla.org.hk/eng/Copyright/Copyright_Ordinance_Content.htm

A History of the iPod: 2000 to 2004
Tom Hormby and Dan Knight - 2005.10.14, revised 2007.09
http://lowendmac.com/orchard/05/origin-of-the-ipod.html#1

Gramophone record
http://en.wikipedia.org/wiki/Gramophone_record#Early_speeds

Apple's Jobs: Just say no to DRM
http://www.mp3.com/features/stories/8588.html

Digital Right Management
http://en.wikipedia.org/wiki/Digital_rights_management

Apple - Thoughts on Music
http://www.apple.com/hotnews/thoughtsonmusic/

數碼娛樂的基石─數碼版權管理
http://www.rthk.org.hk/mediadigest/20060115_76_120767.html

We encourage collaborative learning throughout this case study; therefore peer assessment and evaluation on their learning were suggested. It is recommended that you take a minute to evaluate and reflect on your own leaning after each lesson.   A simple checklist rubric is provided.   You will also take responsibility to assess the performance of other groups during the final presentation with the scored rubrics.   Teacher will take the role as a moderator.   The assessment rubrics will make the assessment more accountable and let you have a clear goal to strive for your best.

Assessment Rubrics for Final Presentation (design presentation)

Student Name: _____	Team: _____		
Focus of Assessment: Teamwork	Date: ____/_____/_____		
Criteria	**Self**	**Peer**	**Teacher**
7. I understand the lesson objectives.	Yes / No	Yes / No	Yes / No
8. I work with team members cooperatively.	Yes / No	Yes / No	Yes / No
9. I give my views responsibly.	Yes / No	Yes / No	Yes / No
10. I respect and listen to other members' ideas.	Yes / No	Yes / No	Yes / No
11. I can draw conclusion after this lesson.	Yes / No	Yes / No	Yes / No
12. I am satisfied with my learning today.	Yes / No	Yes / No	Yes / No

Assessment rubrics (Presentation)

Students can use these rubrics for peer assessment of the final presentation. Teacher needs to explain and discuss these criteria with the students.

Peer Assessment for Final presentation													
Team:								**Date:**		___/___/_____			
Assessors:								**Class:**					
Focus	**No**	**Scores**					**Assessment Criteria**	**Scores**					
Knowledge	1	1	2	3	4	5	← Understanding of the topic →	6	7	8	9	10	N/A
	2	1	2	3	4	5	← Content is consistent with the topic →	6	7	8	9	10	N/A
	3	1	2	3	4	5	← Content is supported with evidence →	6	7	8	9	10	N/A
	4	1	2	3	4	5	← Content is at appropriate level →	6	7	8	9	10	N/A
	5	1	2	3	4	5	← Show key concept in content →	6	7	8	9	10	N/A
Attitude	6	1	2	3	4	5	← Show effort in group discussion →	6	7	8	9	10	N/A
	7	1	2	3	4	5	← Show effort in information search →	6	7	8	9	10	N/A
	8	1	2	3	4	5	← Show effort in preparing presentation →	6	7	8	9	10	N/A
	9	1	2	3	4	5	← Show competency in IT skills →	6	7	8	9	10	N/A
	10	1	2	3	4	5	← Show organization skills →	6	7	8	9	10	N/A
Presentation	11	1	2	3	4	5	← Present their views and idea clearly →	6	7	8	9	10	N/A
	12	1	2	3	4	5	← Logical and consistent flow of ideas →	6	7	8	9	10	N/A
	13	1	2	3	4	5	← Have interaction with audiences →	6	7	8	9	10	N/A
	14	1	2	3	4	5	← Show appropriate use of visual aids →	6	7	8	9	10	N/A
	15	1	2	3	4	5	← Have eye contact with audiences →	6	7	8	9	10	N/A
Total Scores													

* Performance descriptors: 1 is incomplete; 5 is fair; 7 is good; 8 is very good; 9 is outstanding