Educational Game Achievement Design based on the Analysis of Achievements in Commercial Games

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Abstract: *The commercial educational mobile app, Practi, provides students opportunity of doing Science and Math practices on their digital devices. Students may not want to use Practi continuously for long or every day due to the lack of attractive features. Most of popular commercial games like World of Warcraft and Diablo have many achievements designed in the game for players to complete. These achievements make players actively and continuously spend more time and efforts on playing the games. This paper will reveal how to analyze achievements in commercial games and how to design game based achievements for educational systems such as mobile apps and educational games. The results of this research provide researchers and developers of educational systems six primary achievement types, twelve combinational achievement types and a standard procedure of creating game-based achievements, so they can have custom achievements designed for their systems and users can be attracted to continuously use their systems.*

Keywords: Content analysis, primary type, games, motivation, software lifetime

1. Introduction

Canada leads many other countries in the race to connect all classrooms and is ahead of the United States in the percentage of classrooms with high speed internet access. Still, although a large number of Canadian students use digital devices in school, few report being able to use their own personal devices (Media Literacy Week, 2014), even though many Canadian schools and provinces are creating Bring Your Own Device (BYOD) policies (Felps, 2014). Therefore, mobile apps can be implemented into Canadian schools easily so that students can use devices to learn. However educational mobile apps may not so attractive for students to continuously use every day.

Commercial games have become the most popular entertainment in these few years (Entertainment Software Rating Board, n.d.). The two main types of commercial games are online games and console games (Education.com, n.d.). Online games allow players to create and manipulate their own avatars and to interact with each other via chatting, in-game Emotes (ElderScrollsOnline.info, n.d.), raiding and dueling (Bartle, 2003). On the other hand, console games only allow players to interact with

computers (Voida & Greenberg, 2010). Although these console games can also successfully attract players, players could feel boring after they have played the game for a long time. Therefore, many commercial games have added achievements in order to increase the lifetime of the games.

In this research, the research team analyzes achievements in the existing commercial games. According to the results of content analysis, we extract important keywords that achievements in commercial games use and find common achievement types. Not all achievement types and their keywords we found are useful for educational systems including mobile apps. The research team then identifies the primary achievement types and possible combination types that can be applied to the systems. Last but not least, we create more than a hundred game-based achievements for the commercial educational mobile app, Practi.

The next section introduces why achievements are so important for games. We analyze four different games and describe how to find important keywords and common achievement types that are used in the achievements of commercial games in Section 3. Section 4 describes how to design game-based achievements for Practi according to the content analysis results. Section 5 summarizes the research and discusses possible future works that we can do later.

2. Impacts of achievements in commercial games

Space Invaders[1], in 1978, is the first game using the concept of achievements. The game allows players to use their favorite initials to post the score that they have achieved on the highest score board (Blair, 2011). Microsoft implements game achievements in Xbox 360 games (Giant Bomb, n.d.). When users play any Xbox 360 game, they can unlock an achievement when they finish a particular task such as leveling up their avatar to a designated level and defeating a named boss.

In recent years, the concept of using game achievement is very common. Many gaming platforms and online games such as Steam, PlayStation and Word of Warcraft have implemented their own achievement mechanism in order to extend the lifetime of games (Axiang's Internet Note, 2007). For example, a famous game – Gears of War, only has five campaigns in single player mode. The players can unlock a new campaign after they gain enough amount of achievements.

Achievements can be used to tell the difficulty of tasks that players have completed. The easiest achievements may ask players to collect in-game items and the most difficult achievements may ask players to clear all stages in nightmare mode. Some game platforms like Xbox Live and Play Station allow players to share their achievements with their friends. Therefore, achievements can engage players to play the games more and repeatedly.

In general speaking, there are two ways to present achievements to the players – titles and trophies. Most of games provide the players titles when they complete the designated task. For example, in the first person shooter game – Left 4 Dead 2, if the players survive in the Dead Center campaign, they can

[1] http://en.wikipedia.org/wiki/Space_Invaders

earn a title "Price Chopper". They can even check how many achievements they have and how many players have earned the same achievement on the website. Some games provide the players trophies as well as in-game items – reward points and golds. For example, in the World of Warcraft, if players' avatars reach forty, the game will give the players a special mount as a reward. Both of titles and trophies can obviously attract players and can motivate them trying to do something in different ways; which leads them repeatedly and spending more time on playing the game.

For the players who prefer to play games alone, they could feel bored after clearing all stages/levels and completing all tasks if the game has no achievements designed. The use of achievements can get them motivated in putting more time and efforts to play the games (Begy & Consalvo, 2011; Sotamaa, 2010). On the other hand, for game companies, they hope that players can play their games longer so they can have enough time to design and develop further contents for the games or new games.

3. Analysis of commercial games' achievements

In order to understand how many and what kinds of achievements can be used in educational systems including mobile apps and educational games, this research does in-depth survey on the achievements that popular games have. The research team chooses the achievements in the four commercial games (i.e., Left 4 Dead 2, Diablo 3, Resident Evil 6 and Heroic Biography) to do content analysis and summarize the important keywords and find the achievement types. The First Person Shooter game[2], Left 4 Dead 2 is running on Windows, Mac OS, Linux and Xbox 360, has eight different modes (i.e., Single player, Survival, Versus, Realism Versus, Realism, Mutations and Scavenge) and seventy achievements to attract more than ten thousands players[3]. Diablo 3 on multiple platforms (e.g., Windows, PlayStation 3 and Xbox 360) is the most popular action role-playing game[4] from 2012 to present and has attracted 2.7 million players (Williams, 2014). Many players love its gameplay and graphics. It has at least four hundred achievements. Resident evil 6 is a third-person shooter game[5,7] running on Windows, PlayStation 3 and Xbox360, has rich story, six main playable characters, and seventy achievements for players to unlock with different playable characters. Heroic Biography is an interested and popular Martial Arts browser game[6] which provides a hundred and thirty achievements and many players are attracted by its in-game rewards.

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[2] http://en.wikipedia.org/wiki/First-person_shooter

[3] http://steamcharts.com/app/550

[4] http://en.wikipedia.org/wiki/Action_role-playing_game

[5] http://en.wikipedia.org/wiki/List_of_third-person_shooters

[6] http://en.wikipedia.org/wiki/Browser_game

[7] http://www.ebay.com/gds/What-Are-the-Differences-Between-First-Person-Shooter-and-Third-Person-Shooter-Games-/10000000177589743/g.html

Take Left 4 Dead 2 as example, the research team use blue color to annotate the keywords in the achievement descriptions as Table 1 lists; for instance, the achievement – Connecting fights, asks players to play Dead Air from the beginning to the end in versus mode. Playing a game from the beginning to the end indicates that the players need to complete something, so the research team categorizes this achievement into an Accomplishment achievement type that a commercial game may have. Similarly, the achievement – Clownd, asks players to honk the noses of 10 Clowns. Honking means the players need to do something, so the research team classifies this achievement to a Doing achievement type.

Table 1. Examples of achievements in Left 4 Dead 2

Achievements	Descriptions	Type
Connecting fights	Play a Versus game on Dead Air from start to finish.	Accomplishment
Clownd	Honk the noses of 10 Clowns.	Doing
Fried piper	Using a Molotov, burn a Clown leading at least 10 Common Infected.	Utilization
Level a charge	Kill a Charger with a melee weapon while they are charging.	Condition
Acid reflex	Kill a Spitter before she is able to spit.	Condition
Grass Menagerie	Kill one of each Uncommon Infected.	Condition
A ride denied	Kill a Jockey within 2 seconds of it jumping on a Survivor.	Condition
Head honcho	Decapitate 200 Infected with a melee weapon	Utilization

3.2. Finding the primary achievement types and their relationships

The researcher team take all achievements in the four games into consideration while analyzing frequency that each type of achievements occurred in the games. After all achievements in the chosen four games have been categorized, the number of achievements that each achievement type has in the games are sum up and listed in Table 2.

Table 2. Amount of achievements that each achievement type has in the games

Achievement type	L4D2	L4D2 rank	D3	D3 rank	RE6	RE6 rank	HB	HB rank	Total times	Total Rank
Accomplishment	17	2	221	1	31	1	46	2	315	1
Doing	20	1	157	2	25	2	56	1	258	2
Utilization	13	3	17	4	3	5	0	6	33	3
Explore	0	9	32	3	0	7	0	6	32	4
Condition	9	4	14	7	5	3	0	6	28	5
Avoidance	6	5	15	6	5	3	0	6	26	6
Raise	0	9	2	12	0	7	24	3	26	6
Time interval	3	6	13	8	1	6	4	4	21	8
Read	0	9	16	5	0	7	0	6	16	9
Priority	1	7	10	9	0	7	0	6	11	10
Maintenance	0	9	4	10	0	7	0	6	4	11
Requirement	0	9	4	10	0	7	0	6	4	11
Login	0	9	0	15	0	7	4	4	4	11
Distance	1	7	1	14	0	7	0	6	2	14
Lead	0	9	2	12	0	7	0	6	2	14

The research team also analyzes the relationships among achievement types as Figure 1 shows. The achievement types in red (in Figure 1) means that there are more than 200 achievements belonging to the types have been found in the games; the types in blue means that the types' achievements in the games are around 31 to 40; the types in green means that the types' achievements are around 21 to 30; and, an arrow between two achievement types implies an achievement can be designed to fulfil both of the two achievement types. Most achievements that the four games have are belonging to seven achievement types: Accomplishment, Doing, Utilization, Explore, Condition, Avoidance and Raise. Moreover, each of the seven achievement types has more than twenty five achievements designed in

the four games. Therefore, the research team considers the top seven achievement types to design game-based achievements for educational systems, the educational mobile app, Practi in particular.

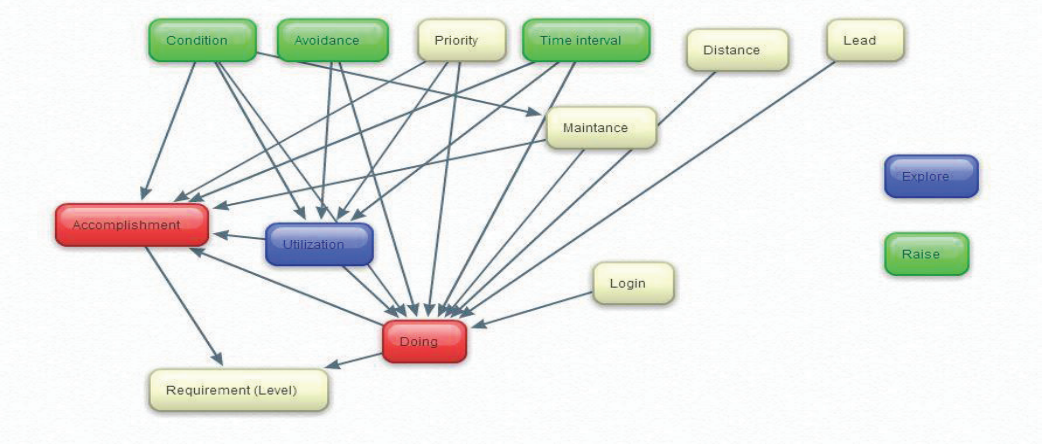
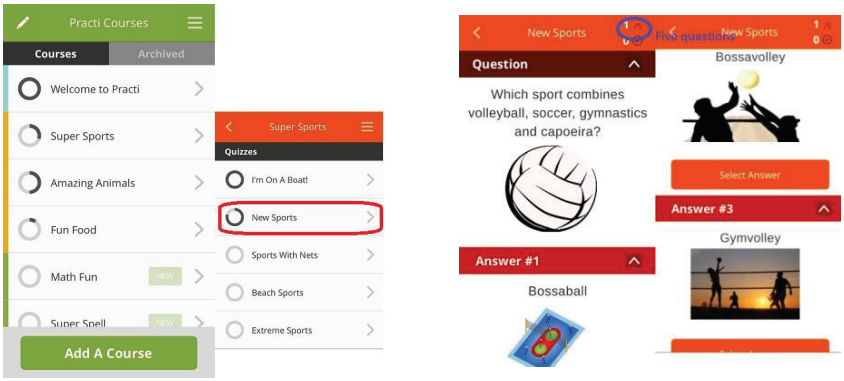


Figure 1. Relationships among achievement types

4. Achievements design for Practi

Practi is an educational software with two components: Press and Play. Press is a web-accessed authoring tool that allows teachers of any technological skill level to create educational content, instantly publish it to student mobile devices and monitor students' progress. With Play, students engage in meaningful skills practice on their own iOS or Android devices by completing quizzes, interacting with classmates and tracking their own performance. Its manufacturer – Mathtoons, has created dozens of mobile educational learning apps and has had over three million questions answered worldwide. The goal for Practi is to engage more students to perform the practice that is necessary to succeed in academics. Adding game-based achievements to the practice experience is a proven method to increase student retention and lengthen skills practice. Figure 2(a) shows that Practi can offer students many courses and each course has at least five quizzes. Figure 2(b) shows that the New Sports quiz has five questions and each question has three answer candidates for students choose the correct one they believe.



(a) (b)

Figure 2. Courses, quizzes, and questions in Practi

Before we can design achievements for Practi, we need to know whether or not the chosen seven achievement types can be used in Practi. The research team finds that the Raise type cannot be used because Practi has no level hierarchy for its users. The combinations of the remained six achievement types are then considered as the primary achievement types. Table 3 lists all achievement types include six primary and twelve combination types that can be used while designing achievements for Practi. The research team then further lists important keywords that can be used to create achievements in Table 3. For example, the keyword "finish" can be used for designing an Accomplishment type achievement like "to finish a quiz". Another example, the keyword "answer" can be taken to create a Doing type achievement – "to answer questions".

Table 3. Achievement types and important keywords that can be used in Practi

Achievement types	Keywords for Practi
Accomplishment	Complete/Finish/Achieve, Activate
Doing	Take/Answer, Sign-in/Login,Activate, Decorate, Buy/Purchase/Exchange
Explore	Read
Utilization	Use, Spend, Redeem, Buy/Purchase/Exchange
Condition	Within, During, After, Before, Continuous, Reach, Exceed
Avoidance	Without
Condition + Utilization + Doing + Accomplishment	Within+Use+Exchange+Complete
Doing + Utilization + Accomplishment	Answer+Use+Purchase+Redeem
Doing + Accomplishment + Condition	Answer+Complete+Within,Activate+Complete+Within, Activate+Complete+Reach, Decorate+Complete+Reach
Doing + Accomplishment	Login+Answer+Complete, Answer+Complete, Activate+Complete, Decorate+Complete, Purchase+Complete
Accomplishment + Condition	Complete+Within, Comlete+Before, Complete+After, Complete+Reach
Doing + Avoidance + Accomplishment	Answer + Complete + Without
Avoidance + Accomplishment	Without+Complete
Doing + Utilization + Condition	Use+Exchange+Reach, Use+Exchange+Continous
Utilization + Doing	Use+Exchange, Use+Activate, Use+Decorate
Doing + Condition	Answer+Continuous, Login+Continuous,Activate+Continuous, Buy+Continous...
Doing + Avoidance	Answer+Without
Avoidance + Utilization	Not+Exchange

The research team creates example achievement for every primary and combination types and use bold and different colors to represent the corresponding achievement types. For example, an achievement of the combination achievement type of Doing plus Utilization plus Condition can be something like "Spending reward points to exchange THREE avatar's accessories within THREE days."

Table 4. Example achievements designed for Practi

Achievement types	How to apply into Practi
Accomplishment	**Finish/complete** all the quizzes of a course
Doing	**Answer** quizes for few times
Explore	**Read/understand** course material
Utilization	**Use/spend** their reward point then .....
Condition	**Within, During, After, Before, Continuous, Reach, Exceed** certain condition to ....
Avoidance	**Without, not**
Utilization + Doing + Accomplishment + Condition	**Use** points to **exchange 3 avantar's wears within** 3 days
Doing + Utilization + Accomplishment	**Answer** quiz and **use** the point to **redeem** cap
Doing + Accomplishment + Condition	**Activate 3 avartar's wears** whose value is **more than** 500 points **within** 7 days
Doing + Accomplishment	**Login** and **answer all quiz** of a course
Accomplishment + Condition	**Complete** quizes of a course **within** 3 days
Doing + Accomplishment + Avoidance	**Answer all the question** of a course **without** using any tip
Accomplishment + Avoidance	**Complete** quizes of a course **without** any incorrect answer
Utilization + Doing + Condition	**Use** points to **exchange** 3 wears **for 3 days**
Utilization + Doing	**Use/spend** reward points to **exchange** wears
Condition + Doing	**Continously answer** the 30 correct answers
Doing + Avoidance	**Answer** a quiz **without** any incorrect answer
Avoidance + Utilization + Doing	**Not success** to answer THREE questions after **using** point to **exchange** quest boost reward

At the end, we design more than a hundred of achievements for each of primary and combination types and correspondent important keywords we chose and found. Table 5 lists the amount of achievements we design for Practi. Each achievement type has three to eight achievements designed.

Table 5. Statistic of achievements

Achievement types	How many achievements I have designed
Accomplishment	8
Doing	8
Explore	3
Utilization + Doing + Accomplishment + Condition	8
Doing + Utilization + Accomplishment	6
Doing + Accomplishment + Condition	8
Doing + Accomplishment	8
Accomplishment + Condition	8
Doing + Accomplishment + Avoidance	8
Accomplishment + Avoidance	8
Utilization + Doing + Condition	8
Utilization + Doing	3
Condition + Doing	8
Doing + Avoidance	8
Avoidance + Utilization + Doing	3
Total	103

5. Conclusion

The research team conducts content analysis for the existing achievements in the chosen four commercial games and finds important keywords, common achievement types, and relations among types. Based on the analysis results, researchers and educationists can identify appropriate primary and combination achievement types for their educational systems no matter what the nature their systems are – that is, no matter their systems are desktop applications, web-based systems, mobile apps, or educational games. They can design and create hundreds of game-based achievements easily according to their needs and their systems' use cases.

With the game-based achievements designed, we expect to see that students treat achievements as different kinds of challenges so that they will use Pract much more to complete courses and quizzes for gaining achievements. We can adopt motivation and usability questionnaire to collect the students' perceived achievement usability and motivation in terms of using Practi more often and longer. Moreover, we can compare the time that students averagely spent on Practi before and after the game-based achievements integrated into Practi to prove the effectiveness of the achievements.

The content analysis results are based on the four chosen games. In the future, achievements in the commercial games of other game genres (e.g. strategy games, tower defense and fighting games) should be taken into consideration to find out whether or not there are more achievement types and correspondent keywords can be used for researchers and educationists to create game-based achievements for their education systems.

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