Learning Through Media: The Presence of Engineering Design Principles in Digital Games

Jack Deitz, Phuc Mai, Connor Engels, Walter Myers, Ian Giblin

Introduction

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- The games provide a significant amount of engineering principles
- The games must have a significant usership to be considered
- The games must have a reasonable physics engine
- The games must have enough internet content

These criteria led to *The Legend of Zelda: Tears of the Kingdom* and *Minecraft*

Image 1. Title Image of *TotK* [1]

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Physics

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  - Steve, the character in *Minecraft*, can carry essential infinite weight through the hundreds of $1m^3$ blocks of any material he can carry. *Minecraft* also allows for "floating" blocks making it more unrealistic
- Friction:
  - The friction in *TotK* is very selective based on your environment with ice and soil matching real-life rates, while desert sand is not as effective as human sand
  - *Minecraft* can be directly correlated to its real-life counterpart when looking at friction with soul sand and ice as it compared well to real-life physics
- Collision, Impact, and Momentum
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  - In *Minecraft* gravity, instead of acceleration, is actually a constant velocity at about 52.4 m/s

Cohen's Kappa

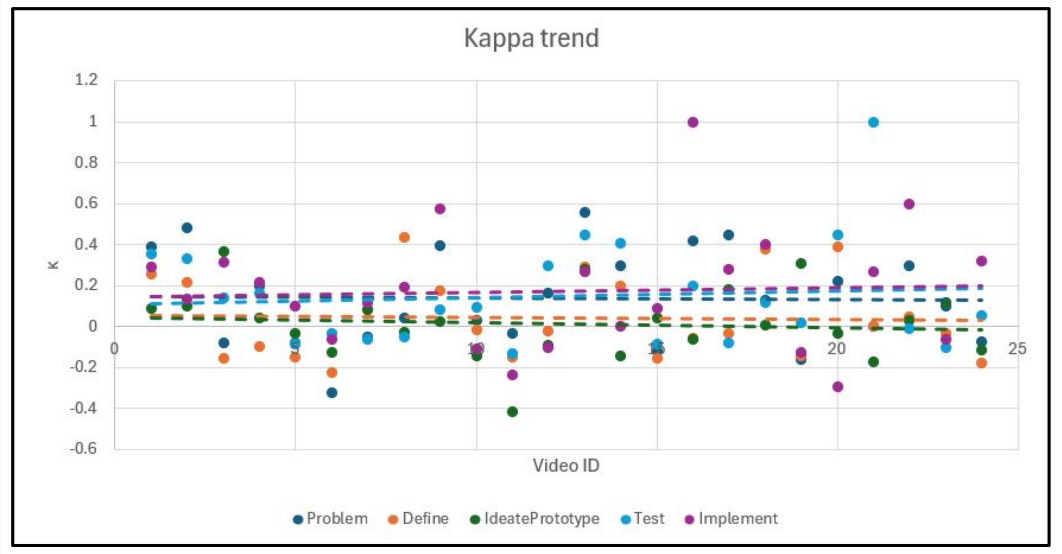

Fig 1. Kappa's trend across 5 investigating categories

Value of Kappa	Level of Agreement
< 0.00	Poor
0.00 – 0.20	Slight
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Fig 2. Landis & Koch, 1977, Interpretation of Cohen's Kappa

- To determine the level of problem solving based on this process, we attempted to redefine each of the stages and give points to them for the purpose of consensus and ease in statistics.
- Our score system is 1 point for each of the stages except for implement, which is 3 points. Implement can be understood as a successful problem solving process, and later will be used to compare the difference between Zelda, an rpg game, and Minecraft, an open world game, in terms of engineering design process rate and level. Later, ideate and prototype are combined together
- Although the graph to the left shows trend lines that are within below 0.2 range – poor to slight agreement per interpretation [3], we still managed to have a consistent kappa number across all time. This is to say what we interpreted from different videos stayed consistently throughout the process. With that having said, if we were playing the video games ourself at that same point in the game, we would stick to our same game style, and our own interpretation of problems and strategies of the engineering design process.
- This is not stated as the purpose of negating our manual-calculated and computer-model consensus. Our consensus based on who has the larger value. The bigger the value, the higher the level of agreement. If data collection with the biggest and it is chosen, it is safe to say that it will has the highest agreement with all other data collection, making it a good enough candidate for a position within the consensus.

Results

After parsing through the data, some trends can be observed in the nature of the gameplay for each game that was observed. Playing through the games in a creative fashion had more points on average than playing the games by adhering to the story. Furthermore, playing through *TotK* in a creative fashion had more points on average than playing through *TotK* by following the story or by playing through *Minecraft*. However, there are some things to note about the videos that may be affecting this data:

- The videos tend to cut out the beginning stages of the engineering design process, leaving only footage of the player implementing their ideas. This skewed some of the videos to have a lot more points than others, as we weighted the implementation step higher than the others.
- The variance in the data can be explained by random error. The video samples that were collected were from many individuals and were sometimes not as dense with steps based on personal preference of what got included in the video
- Another thing to take into account is that the creative playthroughs of TotK were mainly trying to adhere to the story while having some sort of handicap.

Taking these into account, the videos for *Minecraft* demonstrated that it is a game that requires the use of the engineering design process more than *TotK* as the trend of only implementing solutions seemed to affect the *TotK* videos more than the *Minecraft* videos.

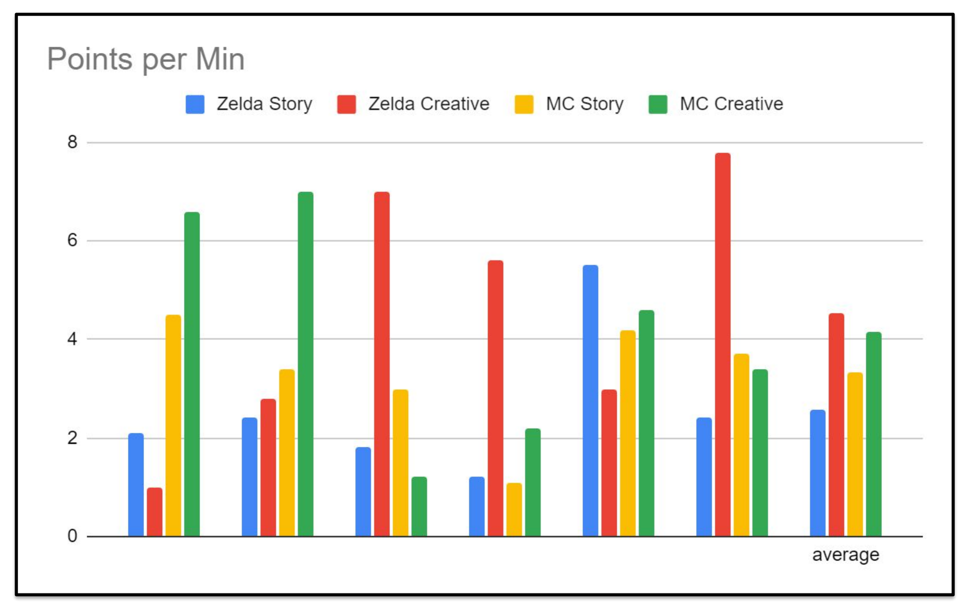

Fig 3. Points per Minute for Each Video Graded

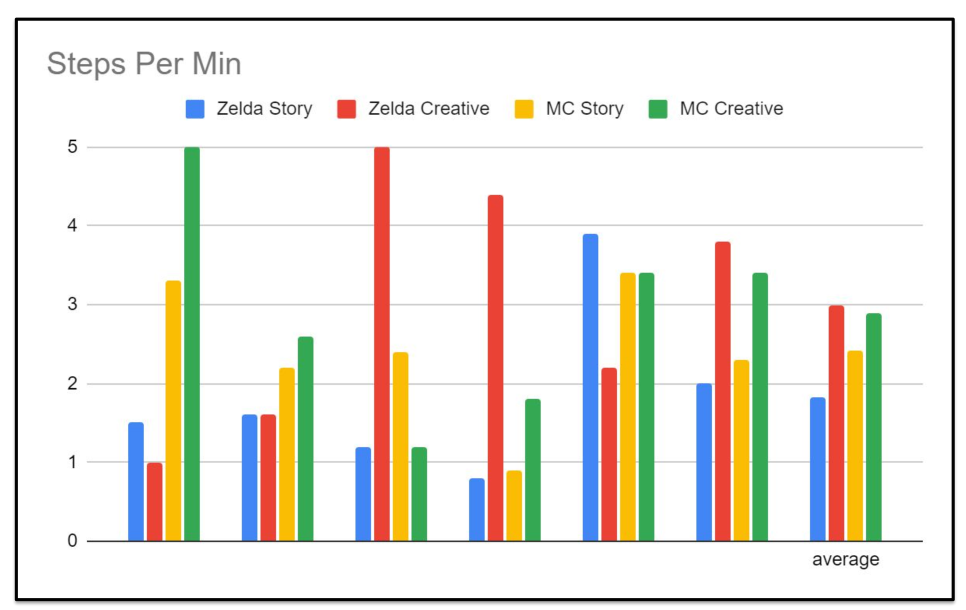

Fig 4. Design Process Steps per Minute for Each Video Graded

Video Acquisition

- The completion of this project relied on the acquisition of videos relating to both *The Legend of Zelda: Tears of the Kingdom* and *Minecraft* that would be able to give us a sample of the engineering design processes everyone would have to use in these games.
- These videos were split into two categories based on their contents:
  - Story Videos: videos in which the player furthered the plot of the game in ways intended by the developers of said game, for example, a video from a Minecraft "Let's Play" series on Youtube.
  - Creative Videos: a demonstration from a player of any process/problem that does not relate to the intended ways of completing the game, for example, a video discussing a vehicle creation in Legend of Zelda: Tears of the Kingdom.
- Videos were found for 5 weeks with 5 videos being found the first four weeks and 4 videos for the last week. The first four weeks were split up to being 5 videos of a category per week, these categories being *Legend of Zelda: Tears of the Kingdom* Story Videos, *Minecraft* Story Videos, *Legend of Zelda: Tears of the Kingdom* Creative Videos, *Minecraft* Creative Videos. Then, during the last week, we found one video per category to give a total of 6 per category, and an overall total of 24 videos.
- For each video found, a time frame was selected within the video for the team grade instead of just grading the whole video in order to streamline the grading process. This time frame was originally 10 minutes within the video, but due to a lack of lengthy videos relating to certain aspects of these games, it was shortened to 5 minutes.
- Three major rules abided by when acquiring videos:
  1. Could not pick a video from the same player twice for the same category to make sure that we were diversifying the data we were getting from the design processes
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Conclusions

- In Totk, the path to complete the game is much more streamlined. While there might be a number of ways to achieve the same end, there numerous tasks that each player must complete in order to further themselves in the game. In other words, there are many puzzles that can not be skipped.
  - In TotK, we saw a few creative examples that demonstrate how many different ways that certain puzzles can be completed.
- In Minecraft, each player must defeat the Ender Dragon to complete the game, however there are not many steps that need to be followed to accomplish this.
  - For example, to get ender pearls for the end portal, a player could kill endermen or trade with Piglins.
  - The variability in minecraft gameplay is caused in part by the fact that each world is different. It is also a result of the fact that you are only required to complete a few tasks: go to the nether, find a nether fortress to get blaze rods, acquire ender pearls, and make it to the End to defeat the Ender Dragon.
- So Minecraft is a bit more flexible when it comes to how you complete the story, but both games incorporate a creative aspect that encourages players to use the design process.
- From our data, we found that players of both games often utilize the engineering design process to complete their goals, whether they are oriented towards the completion of the game or their own personal agenda.

References

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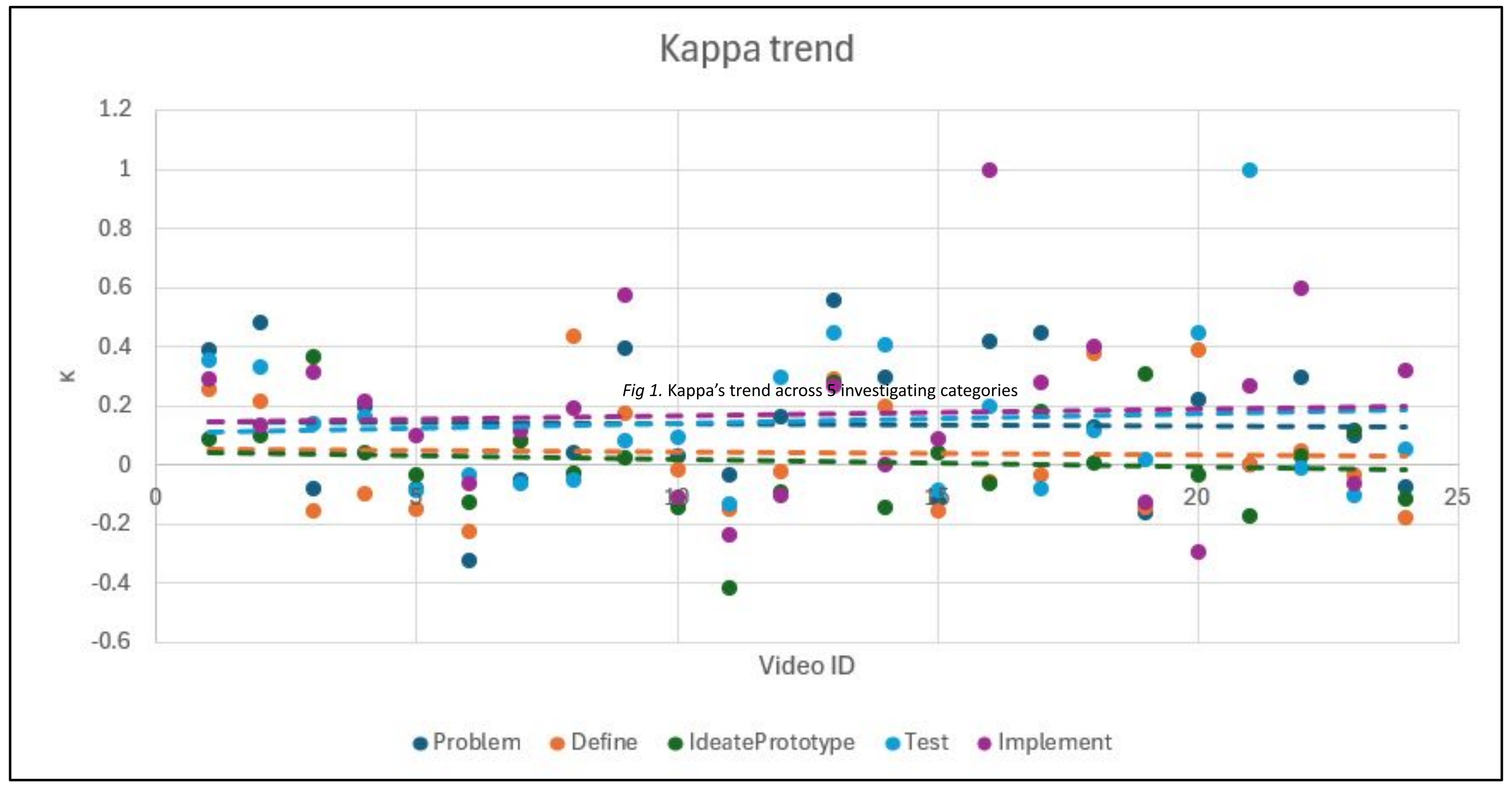

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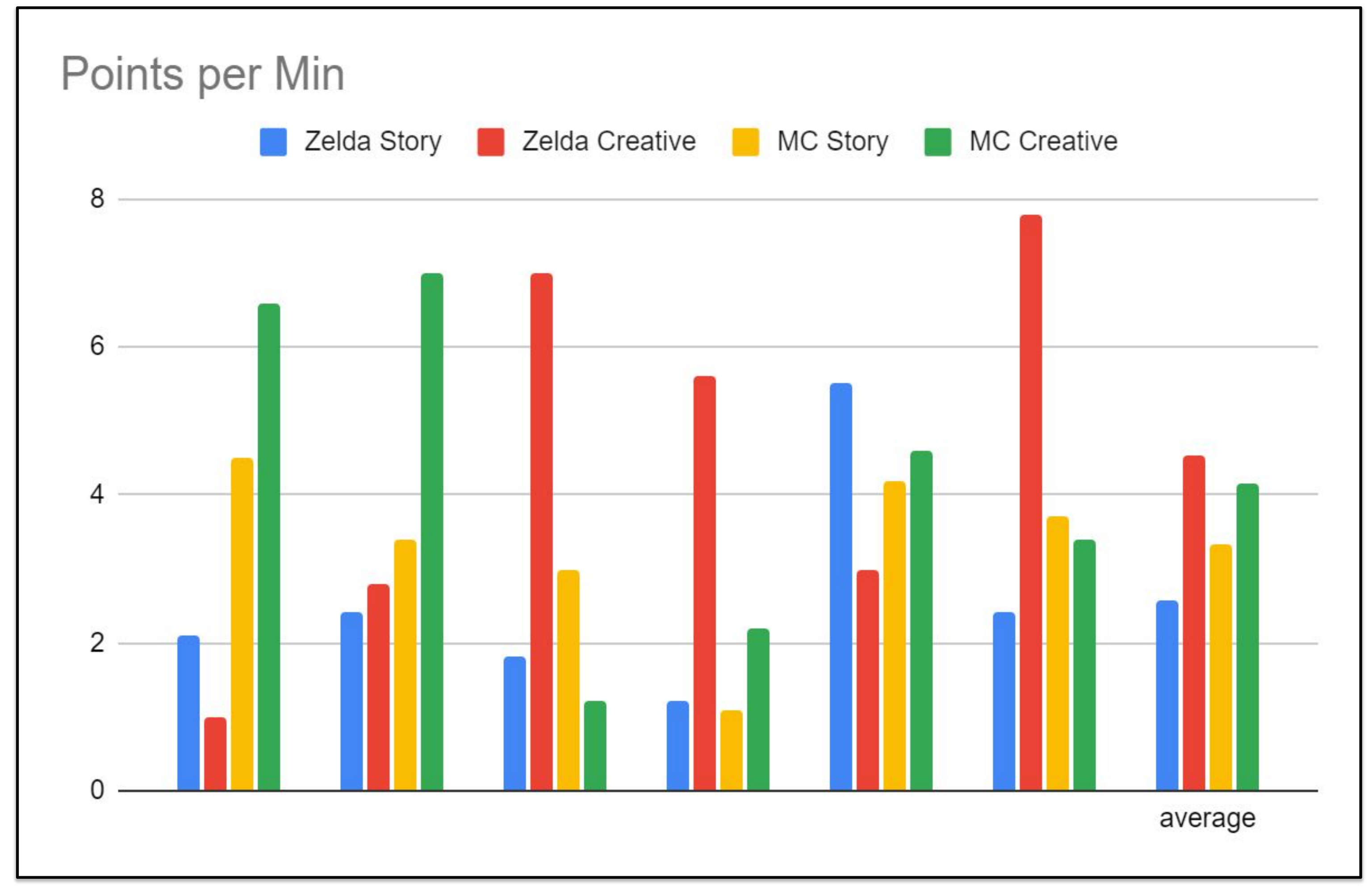

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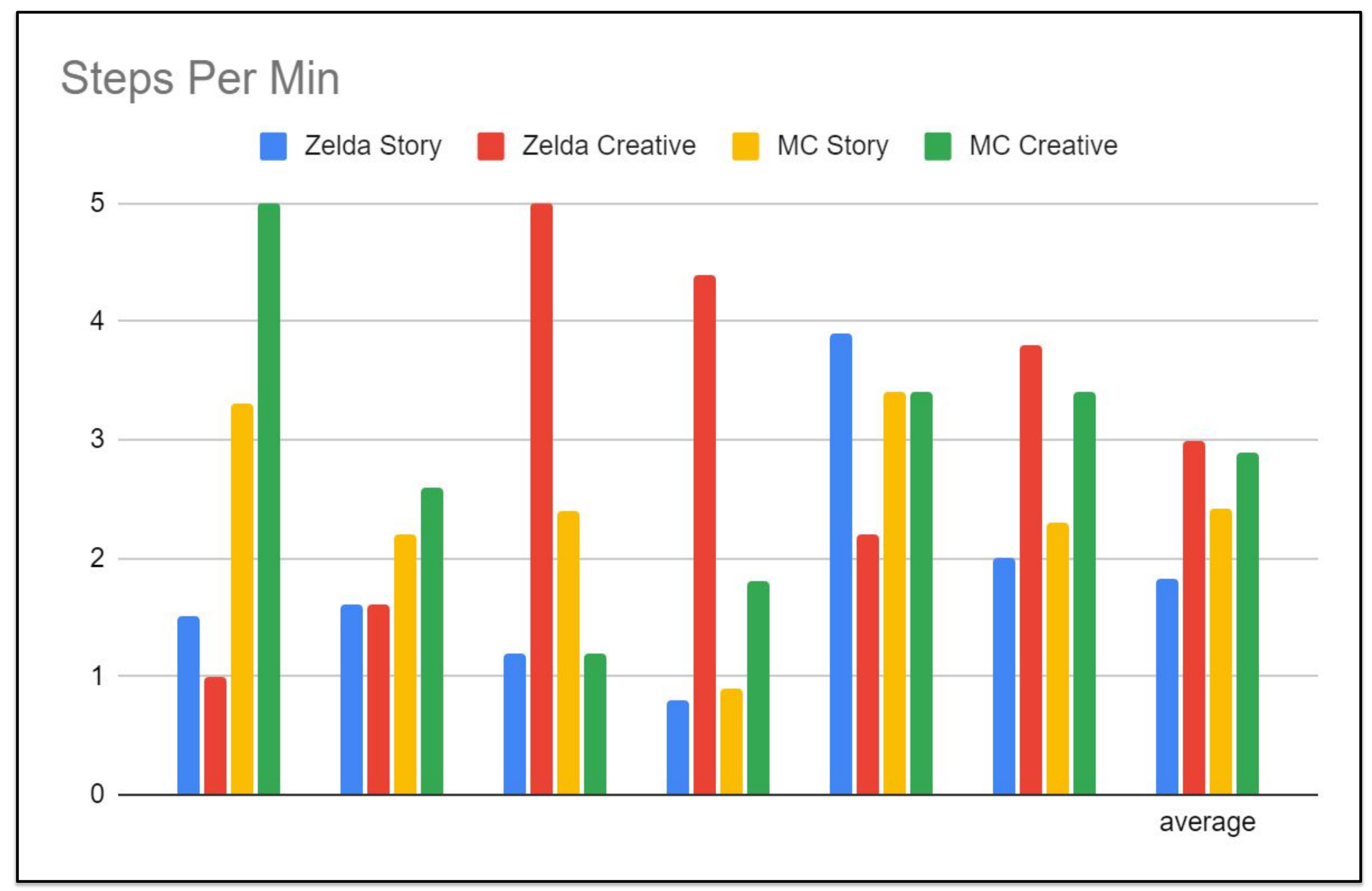

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