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Differences in Primary School Students' Problem-Solving Skills: Comics vs. Movies

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Abstract

Background: Children's ability to solve problems is a critical component of their cognitive and academic development. Few studies have examined the effect of visual storytelling mediums on improving these skills, despite the fact that traditional learning methods have been extensively studied. Previous studies have demonstrated the positive effects of visual content on young learners' attention, comprehension, and memory. The effectiveness of various visual media, especially animated films and comics, in developing primary school students' problem-solving skills is lacking, though.

Aim: This study's main goal was to evaluate how well comics and movies work as visual aids for improving students' problem-solving abilities in Standards III through VII. Based on the body of research on visual learning and cognitive development, the study sought to determine whether one medium significantly outperforms the other in enhancing kids' problem-solving skills.

Method: 30 students from a nearby primary school, ages 12 to 13, participated in the study using an experimental design. They were split equally between two groups: one for movies and one for comics. Through their respective media, both groups were exposed to the same story content. To evaluate improvements in problem-solving abilities, a Problem-Solving Assessment Sheet was used. The effectiveness of each medium was assessed by comparing the mean scores of the two groups using an independent samples t-test.

Result: The movie group demonstrated higher mean problem-solving scores compared to the comic.

Conclusion: According to the results, animated films, as opposed to static comics, better engage the cognitive processes required for problem-solving because of their dynamic and immersive presentation. The study emphasizes the need for more research into multimedia-based cognitive interventions and advances educational psychology by suggesting the use of animated content in classrooms.

Keywords: Comics and learning, critical thinking development, movies as educational tool, primary school education, problem solving skills.

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Introduction

Duncker (1945) states that a problem arises when a person has a specific aim but he/she does not achieve it. For instance, when Rishi goes out to his car in the morning, he discovers that he has a flat tire. Problem solving is the process of finding solutions to different or complex issues and is a signature attribute of adult humans (in the above-mentioned example, Rishi must first overcome the obstacle of successfully removing the flat tire and properly attaching the new one so that he can get to work.), and is something that is necessary to be taught since childhood. One of the pioneers in the field of problem solving is Polya who bases his model on cognitive theory of problem solving (Polya G. 1945). In his book "How To Solve It," Polya provided four fundamental steps that serve as a compass for handling mathematical challenges.

Understand the problem.

Devise a Plan.

Carry out the Plan.

Look Back and Reflect.

Polya promoted the idea that the application of general problem-solving strategies was key to problem-solving expertise and intellectual performance. General problem-solving strategies have also been called heuristics. A commonly used synonym for heuristics is the rule of thumb. In problem-solving literature, the term implies the general methods used in problem solving.

In this research paper, we will be focussing on the linear problem-solving process. Linear problem-solving processes are structured approaches to addressing problems in a sequential manner, typically involving a series of predefined steps that are followed in a linear or chronological order. These processes provide a systematic framework for problem-solving and are often used in various fields such as engineering, project management, and computer science.

There are several studies which talk about the positive effects of problem-solving skills in children even below 3 years of age (Rachel Keen, 2011; Bryan B. Bushman, 2010; Ulutas et. al., 2017). Roxi Finney in his research paper (wherein he reviews different research studies) has included various other research papers across multiple disciplines which call for the need to improve problem solving skills of students and the need to improve the methods of teaching problem solving skills.

With a lot of different techniques and approaches emerging to effectively teach problem solving to children, advances in technology have introduced media (this could include a film clip, song, podcast, comics, etc.) which complements the traditional approaches of teaching. Hu et. al. (2019) conducted a meta-analysis to study the multimedia effect in problem solving. The multimedia effect in problem solving describes the phenomenon whereby an individual's problem-solving performance is enhanced when equivalent pictures are added to illustrate or replace part of the problem text.

Using meta-analytic techniques, they sought to determine the overall proportion of multimedia effect in problem solving and the possible boundary conditions. The results showed a significant multimedia effect on the response accuracy and response certainty, but no significant effect on response time. The meta-analysis brought to our notice that multimedia effect in problem solving is diverse and limited by multiple boundary conditions.

A survey was conducted in Yogyakarta by Marpanaji, Mahali and Putra, 2018 to explore information related to the teacher's task in carrying out planning and learning preparation, especially in terms of the selection and development of learning media. It appeared that 78.05% of the respondents used learning media as a basis for choosing and creating learning media. There is a process of selecting a specific learning medium which includes four steps (Hikmah, 2019) - Writing an objective, Determining the three domains of learning: cognitive, affective and psychomotor, Selecting an appropriate strategy and, Selecting the authentic media (authentic media refers to educational materials that are real, genuine, and reflective of real-world contexts, situations, or artifacts. These materials are not artificially created for educational purposes but are instead sourced from authentic sources such as newspapers, magazines, websites, videos, audio recordings, literature, art, and cultural artifacts).

The present research has specifically focussed on the ‘simulated problem solving’, wherein a hypothetical scenario is presented. As it is a ‘simulated problem solving’ activity, the learning media chosen for this purpose were comics and movies. Comics and movies can be appropriate in simulated problem-solving skills courses for several reasons such as engagement, visualization, emotional connection, realistic scenarios, diversity of perspectives and creativity and imagination. Although these two types of media may appear to look very similar to each other , there are many differences in both media types (excluding the reading and the viewing aspect) which makes them more effective as a problem-solving tool in certain areas than the other. Movies (in this context, animated short movie clips) visually depict scenarios with realism which could make certain problem-solving challenges more relatable or easier to understand. Its multisensory impact makes the problem-solving experience more memorable. Using Movies, one could directly show problem solving actions, making it easier for viewers to follow and observe specific strategies in action.

Although movies are an active medium, passive viewing is a very common thing these days, but isn’t always the case with comics. Comics require the readers to fill in the gaps between frames with their imagination, enhancing their involvement and interpretation of problem-solving steps. It keeps the viewer engaged and guides them through a linear problem-solving process.

A study by Suryatin and Sujiman (2019) aimed at generating a product in the form of a comic book along with displaying the feasibility and the effectiveness of the comic book in improving the mathematical problem-solving skills and the self confidence of grade IV students in Yogyakarta. Comic books as a learning medium produced for problem based learning were proven to be effective as students were able to establish their knowledge through their learning experiences in problem solving (Devi Afriiyuni Yonanda, Yuyu Yuliati and Dudu Saputra, 2019). On the other hand, movies are also an effective medium to improve students' problem-solving skills (Yuni Irawati, R., Bariyyah, K., Seojantoe, L., and Pambudi, P., 2020).

Although there are researches like those mentioned above highlighting the effectiveness of both the mediums, there's a gap found in these researches regarding the comparison of the effectiveness between these two types of media as there are different studies focussing on either of the two types of media separately.

The objective of my research was to attempt to fill in this research gap. I aimed to determine whether there is a difference in problem solving skills in people exposed to comics, as opposed to those who are exposed to movies.

The problem statement was 'To measure the difference in primary school students' problem-solving skills by exposing them to two different types of visual media (comics vs. movies)'.

The directional hypothesis stated that the score of the student on the problem-solving task will be significantly better when exposed to the hypothetical scenario, i.e., the problem in a movie format as compared to exposure in a comic format.

Joseph E. Camphoux advocates for the use of films as a teaching resource, highlighting their familiarity to students and ability to sustain interest in academic topics. Films engage both hemispheres of the brain, aiding comprehension and recall compared to text-based media. Cowen (1984) suggests that visual media makes concepts more accessible and memorable. Additionally, films, as audio-visual mediums, have a greater impact on children's problem-solving experiences than comics. They capture attention instantly, provide immersive environments, and foster emotional connections with characters, encouraging deeper engagement and creative thinking.

The study is structured as follows: it begins with a review of relevant literature highlighting the role of visual mediums in learning and cognitive development. This is followed by the articulation of the study's aims and hypotheses. The method section details the experimental design, participant selection, and assessment tools employed. The results section presents the statistical findings comparing the two groups, while the discussion and conclusion interpret these results in the context of existing

research, their implications for educational practice, and suggestions for future studies.

Method

Study Design

This study employed a quantitative, experimental, between subjects design to examine the effect of comics and animated movies on problem solving skills in primary school children. An experimental method was chosen as it allows for controlled manipulation of the independent variable (media type) and observation of it's impact on dependent variable (problem solving performance), aligning directly with the study's objective.

Participants were randomly assigned to one of two groups- one exposed to comics and the other to animated movie enduring fair comparison and reducing selection bias. A between subjects design was selected to avoid carry over effects that might occur if same participants experienced both the conditions.

Random assignment and content standardization minimized confounding factors, strengthening the causal interpretation of results. This design effectively supported the investigation of how different visual media influence cognitive skill development in children.

Participants

Mumbai and Thane based schools were targeted. Children who were between ages 7 to 11 and those who were good at reading and writing in English were targeted. Hence, purposive sampling was used. The reasons behind the same being that according to Piaget, the children are in the concrete operational stage during ages 7 to 11 and among all the advances children acquire during this stage, some of the important ones include applying logic and reasoning to the concrete events, to make logical arguments and to use problem solving strategies. Children at this stage are able to use more than one strategy at a time, they can rehearse and preview actions better, and they are more accurate in their choice of strategy. If problem solving skills are developed and nourished at this stage of life in an effective manner, it will definitely help the child to be a better problem solver in the future. The sample size was 128 students. Since, all the content, be it the movie scenes, or the comic strips, will be in English, there was a requirement for the participant to be good at English while reading and writing the response.

Procedure

The initial step involved a meeting between the researcher and the school officials, during which the entire research process was explained and clarified. On the first two days, all 128 participants were gathered for controlled condition, where they were presented with a hypothetical scenario printed on a paper, followed by four questions required to answer. After participants submitted their responses, the answer sheets were collected and the participants were randomly assigned to two distinct groups, designated as the 'movie group' and 'comic

group'. Within each of these groups, participants were further subdivided into smaller groups (this was only done for the comics group), groups of five, a strategy employed to enhance cost effectiveness of the research. On the third day, movie group was shown three different short animated movie clips from PIXAR movies. After viewing each scene, participants completed a questionnaire with four questions, with three separate questionnaires corresponding to the three different scenes. On the fourth day, the comic group was presented with three different comic strips depicting the same scenes from the movies. Following the reading of each comic strip, they were given questionnaires containing four questions to answer. All the questions given for all the movie and comic conditions were heavily based on Polya's theory of problem solving. Finally, all answer sheets from participants were collected and meticulously stored in preparation for the subsequent scoring process.

In order to score the answers given to the questions, a rubrics of Polya's 4 stages of problem solving was used. Rubrics is an explicit criteria used for assessing a particular type of work or performance and provides more details than a single grade or mark. Rubrics therefore helps grade more objectively. The rubrics used in the current research was developed by the Hostos Community College and is an analytical rubrics which assess each criterion separately, using descriptive ratings. Each criterion receives a separate score. Analytical rubrics takes more time to score but provides more detailed feedback.

Ethical Considerations

The process of data collection began at B.R. Madhavi English High School located in Dombivli East, after the permission was granted to do so. The access to two divisions of 7th grade was given. Verbal consent was obtained from all the participating students, and they were informed about the purpose and nature of the study, ensuring that participation was voluntary and they could withdraw at any time without consequence. Measures were taken to ensure a safe and supportive environment during the study.

Given the minimal risk associated with the research and the age of participants, written consent forms were not collected directly from the students. Instead, verbal consent was deemed appropriate and sufficient for this context. All procedures adhered to the ethical standards of B.R. Madhavi English High School.

Data Analysis

Independent or unpaired t-test was employed in the current research since I wished to see if there was a significant difference in the mean values of two independent groups, one assigned to the movie condition and the other one assigned to the comic condition. The results of each groups were separately submitted to Statistical Independent samples t test. The threshold for statistical significance was set at $p < 0.05$

The random assignment of participants to two distinct groups ensured any individual differences like prior exposure, learning ability, interest in the media or problem solving skills being evenly distributed across both the groups. Additionally, the content exposure time was also controlled.

Result

Presentation of Data

The results of independent samples t-test (2 sample t-test assuming unequal variances) indicated that the difference in problem-solving skills between the comics and movies groups is statistically significant at the 0.05 level. Since the mean problem solving score for group B (i.e., movie group) was significantly higher than group A (i.e., comics groups), it was clear that the data was in trend with the hypothesis which stated, 'the score of the student on the problem solving task will be significantly better when exposed to the hypothetical scenario, i.e., the problem in a movie format as compared to exposure than when exposed to the problem in a comic format.'

Descriptive Statistics

(Table 1) Differences between children's problem-solving skills when exposed to movies v/s comics

	Mean	Var.	Obs.	Hypothesized mean difference	df	T-stat	P(T<=t) one-tail	T critical one tail	P(T<=t) two-tail	T critical two tail
Movies	19.11	89.37	54	0	86	8.32	5.68	1.66	1.14	1.98
Comics	6.6607	32.4101	56							
	11	83				99	E-13	27	E-12	79
	1	7				3		7		3
	0	0				0	0	0	0	0

Discussion

Interpretation of Findings

The findings from the independent samples t-test supported the hypothesis that students perform better on problem solving tasks when presented with scenarios in a movie format compared to those presented in a comic format.

The several reasons behind the obtained data are as follows-

While correcting the papers it was observed that students when given the stories in printed format to read, they used to mindlessly mark some sentences of the story with pencil which they thought were the answers to the questions and just copy them as it is. This may also unfortunately be because of the way they were previously taught to write their answers looking at the textbooks. Because of this style of writing, it was very much evident that students were used to rote learning stuff. Surprisingly, this style was also seen while writing the answers for the comic version, wherein students copied the dialogues of the characters as their answers and wrote them as it is. This was not the case when writing the answers for movie questions and hence, students scored better.

The movie group was better at writing answers for the last question asked at the end of every story which was 'what ideas would you suggest?' Children came up with innovative ideas apart from those used by the characters. I speculate that might be because of how movies actually take the audience into a new world and give them a chance to look at the problem situation realistically by visually living there.

It was observed that students were facing problems in reading comic strips and due to this lack of understanding, students took much time reading the strip and simply couldn't finish their paper in time or in a hurry, wrote improper answers. Students of B.R. Madhavi high School weren't familiar with the American culture of comics. They might have read Indian graphic novels like 'Amar Chitra Katha' but the format followed there is completely different from the PIXAR comics. Comics have a way of reading, in this case since it was an American comic series based on PIXAR movies, the following are the steps we need to keep in mind (WikiHow staff, 2023)-

1. American comics are read from left to right, top to bottom.
2. Move to the next panel as you reach the right side of the first panel.
3. Read panels that are stacked on top of each other together.

I think that films as an audio-visual medium has a greater impact on the child's problem solving experience because it instantly captures childrens' attention, whereas in comics, although the pictures look attractive, there's still an element of staticity that restricts the comics. Both comics and movies cater to the child's creativity and imagination but the world created by movies looks more real or 'coming into life' than the comics.

As the conductor of the experiment, I was told by the authorities that even though the students were taught in English, the majority of the students' first language wasn't English and so the explanation of the content should be once done in Hindi. The content of the material and the language of writing the answers remained English, however, the explanation was delivered in Hinglish (a molten mixture of the English and Hindi languages) with a bit of Marathi for those who do not understand Hindi. This might have also in a way interfered in their processing of the material.

Additionally, by understanding the following cognitive processes, one can better interpret the problem-solving abilities demonstrated by children when interacting with these different visual mediums and also why group 'A' (provided with the movies) did better than group 'B'

Comparing the two visual mediums **Movies:** provide continuous and dynamic visual and auditory information, requiring simultaneous processing of visual scenes and auditory dialogue. The pacing is controlled by the

filmmakers, which can influence the viewer's attention and comprehension.

Comics: offer a static, segmented visual and textual narrative, allowing readers to control the pace of their engagement. This medium requires readers to piece together the sequence and meaning from individual panels, relying heavily on visual literacy and inferential thinking.

Perception:

Movies: Children perceive dynamic images and audio. They process visual scenes continuously, including facial expressions, body language, and background details, along with auditory information like dialogue and sound effects. This multi-sensory input aids in building a richer understanding of the scenario.

Comics: Children perceive static images and text. They need to put mental efforts in order to decode visual cues from the illustrations and integrate them with the written narrative. This involves recognizing characters, interpreting facial expressions, and understanding scene transitions between panels. Although students were able to identify and understand the characters and their facial expressions, they were having a difficult time to decode visual cues and integrate them with the narrative probably because of their lack of understanding of the format of the comic strip.

Attention:

Movies: Watching movies demands attention to both visual and auditory streams of information simultaneously. The continuous flow of the movie can help maintain engagement, but children need to focus on relevant details amidst potentially distracting elements.

Comics: Reading comics requires sustained attention to detail as children move from one panel to the next, ensuring they don't miss critical elements of the story. In the present study, it was noticed that children presented with comics weren't able to sustain their attention due the lack of understanding of the format of the comic strip.

Memory:

Movies: Working memory is used to follow the plot, remember dialogues, and understand sequences of events. Long-term memory helps in making connections with previously seen scenes or known information about the characters and settings.

Comics: Children rely on working memory to retain information from previous panels while integrating it with new content. Long-term memory also plays a role in recalling familiar characters or past events in the storyline.

The process of following the plot, remembering the dialogues and understanding the sequences of event was found to be smoother when watching movies than reading comics.

Comprehension:

Movies: Comprehension in movies includes understanding spoken language and interpreting visual actions. The combination of auditory and

visual cues enhance understanding, making it easier to grasp complex scenarios.

Comics: Comprehension in comics involves interpreting both visual and textual information. Children often face difficulty understanding the context provided by images and how the text complements these visuals to build a coherent narrative. They have to put extra efforts here than movies.

Reasoning:

Movies: Reasoning in movies involves making predictions based on the unfolding events, understanding cause-effect relationships, and synthesizing information from multiple sources (visual and auditory) to solve problems.

Comics: Problem-solving in comics often involves inferential reasoning. Children infer what happens between panels (closure) and predict future events based on the narrative clues. Since, participants in the present experiment had difficulty to understand the format of the comic strip itself, a coherent narrative wasn't formed in their minds and hence the ability to predict the future events based on the story clues was challenging.

The findings suggest that movies may offer a more effective medium for enhancing problem-solving skills among 7th-grade students compared to comics. This can be attributed to the different cognitive processes engaged by each medium. Movies provide continuous visual and auditory stimuli, which can enhance attention and memory retention, thereby improving comprehension and reasoning. The dynamic nature of movies also helps in maintaining sustained attention and providing a richer context for understanding complex scenarios. In contrast, comics, while requiring detailed attention and interpretation, engage inferential reasoning and closure, which may be more cognitively demanding for some children.

Comparison with Existing Literature

Although earlier research has acknowledged the educational value of both comics and movies, this study goes one step further by demonstrating that animated films are superior to comics at enhancing problem solving abilities. This might be because, in contrast to comics, which are static, movies provide a dynamic, multisensory experience. Variations in sample demographics, content familiarity, or research design may account for discrepancies from previous studies that favored comics. These findings support the increasing focus on multimedia instruction in elementary school.

Theoretical Implications

The study's findings hold important implications for the theoretical frameworks of cognitive load theory and dual coding theory which served as it's guiding theories. The findings which demonstrated that animated movie clips improved children's problem-solving skills more than comics provide compelling evidence in favor of Paivio's dual coding hypothesis. Movies give kids an integrated

problem-solving experience that improves understanding and memory retention by delivering information simultaneously through verbal and visual channels. Movies offer a premade immersive world, which lessens the cognitive effort required for visualization, in contrast to comics, which require kids to mentally create dynamic images from static visuals. John Sweller's Cognitive load theory, which highlights working memory's finite capacity, is also in line with this. With their captivating and well organized presentations, movies reduce needless cognitive load, freeing up kids to concentrate more on comprehending the issue and coming up with solutions. In addition to creating a personal connection, the animated characters and emotionally compelling stories help kids internalize their problem as their own, which in turn encourages active problem solving. Together, these findings contribute to the validation of these theories in educational psychology and suggest that integrated animated content in learning environments can significantly enhance cognitive skill development in children.

Practical Implications

The study's practical implications extend beyond the classroom, potentially influencing educational practices, resource selection, and parental guidance strategies to support the development of problem-solving skills among primary and secondary school students.

Educational Strategies: The findings could inform educators and curriculum developers about the effectiveness of different visual mediums in enhancing problem-solving skills among students. Depending on which medium proves more effective, educators could incorporate relevant materials into their teaching methods to better engage students and improve learning outcomes.

Media selection: The concept of 'Classrooms' is becoming more flexible with the introduction to self paced or online learning. Content creators and other professionals working at such platforms could make use of the research findings in order to select the appropriate teaching medium to support their content in a better fashion.

Parental guidance: Parents and guardians can also benefit from the study's findings when guiding their children's educational activities outside of school. Knowing which visual medium is more effective for developing problem-solving skills can help parents select appropriate learning materials for their children's leisure time, such as comics or movies with educational content.

Limitations

Because printing comic strips was an expensive business, only 10 comic strips for each of the 3 stories were printed and distributed among students after asking them to form a group of 6. That students are sharing the comics with each other was looked after, still there is a chance

that some might have not gotten a chance to look at the comic strip properly or as much as they want to which was not the case in the first condition where, each and every student got a separate sheet of question paper with the stories printed on it or in the condition where each and every participant could see the movie clips clearly.

The experiment took 4 days to complete with each condition fulfilled each day. Despite the warning, it is possible that students from one group might have shared the information with the other group.

It was made clear to the students that the following experiment is not an examination and they won't be marked for their performance (with a clear intention to maintain transparency between the experimenter and the participants) but it would have impacted the other way round wherein the students took it even more lightly.

Future Research Directions

Present research opens a lot of areas for future research like measuring different cognitive functions like creativity, communication skills using these two visual mediums and incorporating other visual mediums like Virtual Reality headsets to see its effect on student's understanding of problem solving (because maybe there they could perform better when it comes to creating your own solution).

The study illustrates how dynamic, multisensory experiences, such as movies better engage young learner's cognitive processes than static visuals by directly comparing two common visual media. This supports the expanding field of multimedia-based education by indicating that the use of animated content in classroom can improve the development of cognitive skills. Although the study provides insightful information, its reach was constrained by sample size, media cultural familiarity and short term evaluation. By examining long term impacts and incorporating a variety of populations, future studies can build on these findings.

Conclusion

This research shows that movies are more effective than comics when it comes to improving problem-solving skills in primary school students. The results from the independent samples t-test clearly indicated an important difference, with the movie group achieving higher average problem-solving scores than the comic group. This backs up the idea that the visual and auditory elements in movies engage several cognitive processes—like perception, memory, and reasoning—in a more lively and immersive way, making it easier to understand and think creatively.

One of the big takeaways from this study is that movies create a more vivid and realistic representation of problem situations, helping students to visualize solutions more effectively. On the other hand, the static nature of comics can be tricky for some students, especially those who aren't familiar with the narrative style of American comics, which may make it harder for them to grasp the content. Besides, students in the

movie group showed greater creativity in coming up with new solutions, reinforcing the notion that movies not only share information but also inspire critical and imaginative thinking.

However, we need to keep in mind that both methods have their own unique benefits. While movies do a great job of offering immediate engagement and building an emotional connection, comics promote inferential reasoning and creative interpretation. Teachers and content creators should take into account factors like student age, cultural context, and learning goals when choosing visual materials.

This study opens up exciting possibilities for future research, such as examining other cognitive areas (e.g., creativity or communication) and incorporating advanced visual tools like virtual reality. By improving how we use visual storytelling in education, we can create more effective learning experiences and boost problem-solving skills in young learners.

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Author contributions

There was only one author who single handedly conducted the research study

Competing interests

I declare no competing interests.

Corresponding Author

There was only one author

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