

# Examining The Effects Of Two Web-Based Digital Storytelling Types On The Development Of Students' Imaginative Ability And Creative Thinking

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## Abstract

This study aimed at assessing the effect of two different types of digital storytelling (audio vs. visual) on developing the imaginative ability and creative thinking in teaching science for second grade students. Both types were introduced as e-content learning materials within an online learning environment. The researcher employed the quasi-experimental design of the implementation, and the research sample included 40 male and female students enrolled in the second grade, who were divided into two equal experimental groups: the first consisted of 20 students, who were exposed to the auditory style of digital storytelling, and the second group consisted of 20 students, who were exposed to the visual style of digital storytelling. Two scales were administered to students to measure each of the imaginative ability and creative thinking. Students in the research sample were found to be interactive during and after the presentation of the two styles. They demonstrated an evident ability to simulate and add new events and characters to the content of the two stories, with the superiority of the visual style in developing creative thinking due to the number of senses involved in students' interaction with the story. As for the development of imaginative ability, results showed that there were no statistically significant differences between the mean scores of the experimental groups in the post-administration of the imaginative ability scale. This indicates the effectiveness of the two types in developing imaginative ability.

**Keywords:** Digital Storytelling - Audio Digital Storytelling - Visual Digital Storytelling - Imaginative Ability - Creative Thinking

## 1. Introduction

Storytelling is considered one of the ancient literary arts, which has been developed while preserving its originality, shifting from oral narration to digital narration. Instead of relying solely on the narrator's voice and facial expressions and gestures, multimedia is used to develop storytelling using pictures, videos, animations, and sound effects to enhance its design and improve its effect on students (Choo et al., 2020). Moreover, it can stimulate students' imagination which is one of the main components of creative thinking, by which students free themselves from the limitations and restrictions imposed by immobility of inertia into their own world, through their awareness of stimuli in their environment, and connecting them together to reach new creative links (Camargo-Borges, 2017; Al-Toura et al., 2017).

Digital storytelling has different styles, including written, audio, visual, video and animation, although they all share an effective role in the educational process. There is, however, some peculiarity in the effectiveness of each style as well as a guidance into using it in the best way in the field to achieve the desired goals (Al-Omari & Al-Subhi, 2018).

New concepts and facts can be built through digital stories, as they stimulate imagination and creativity (Camargo-Borges, 2017), especially when students produce digital storytelling by their own, as this practice highlights their creativity in generating ideas, without being limited in their thoughts (Yang et al., 2020). In this regard, Akyeamong (2018) argued that students could successfully transform their readings and reflections on societal issues into digital storytelling in a creative way.

The researcher targets choosing both audio and visual styles to study their impact on developing imagination and creative thinking in teaching science for second grade students. Therefore, the opinions of some specialists were surveyed regarding these two styles, and they reported the importance of identifying their impact on developing imagination and creative thinking and transferring that experience to the practical field. Thus, the main research question can be stated as follows: What is the effect of two different styles of web-based digital storytelling (audio and visual) on developing the imaginative ability and creative thinking in teaching science for the second grade?

## 2. Literature review

Digital storytelling is defined as “an integrated mixture of multimedia elements, designed and developed using specific software to produce a story that embodies events, situations and characters in certain circumstances” (Mahdi, 2018, p. 293). It contains specific elements, namely: a point of view, a dramatic question, an emotional content, narrator's voice, soundtrack, economy, and speed (Rahimi, & Yadollahi, 2017).

Using the visual style of digital storytelling is effective in raising students' attention, make them entertained and turn them to active learners during the instructional situation while interacting with more than one sense at the same time (Abdul-Momen, 2018).

Thus, many technical criteria should be considered during the production of digital storytelling, such as the compatibility of the image with the sound, its synchronization with the texts, and the clarity of the voices of the characters being more audible and intense than the musical background (Seker, 2016). Also, educational standards of developing digital storytelling should be considered as well, such as prompting students to ask questions, sparking, and igniting their imagination, directing them to think and reflect, and encouraging them to express themselves. (Al-Khalis, 2019)

It is worth noting that imagination relates to creative thinking and is considered one of the most important mental activities that enrich the innovation process, and thus making learners able to think about both possible and impossible things, and find meaning (Al-Abd, 2020; Al-Osaimi, 2018). On the contrary, fiction depends on the context to which it is connected, as good imagination leads to good thinking, while bad imagination leads to bad thinking, which does not have to be creative, even with the use of instructional technologies such as digital storytelling in all its forms (von Wright, 2021).

Storytelling that depends on the narrator's voice and facial expressions and gestures represents one of the oldest methods of presenting stories, which makes the listener imagine the events of the story and its characters, as if he/she internally sees a visual tape in his mind.

In this regard Abdul-Samad (2017) argues that audio-digital storytelling is effective on developing the imaginative ability of learners with visual disabilities at the primary stage, he reported that through the voices of the characters, and the various sound effects, learners felt affiliated with the environment. Merjovaara et al., (2020) agreed with this and used the auditory style with the primary stage students, which made them imagine and represent the roles of the characters and their events and add some scenes from their own imagination and confronted events. These kinds of practices are reflected positively on participation and teamwork, as indicated by Chuang et al. (2019). Also, Camargo-Borges (2017) demonstrates that the auditory style helps learners to comprehend scientific concepts, after performing activities based on imagination, which turns imagination into abstract images to be stored in the mind.

On the other hand, the visual style (animation) has an active role in the development of imagination because through using it, fictional and historical events can be embodied (Curtis et al., 2019; Trisciuzzi 2017). It can enhance the students' ability to find correlations between concepts, linking them to daily life, and developing their thinking skill, while using and employing extraordinary new ideas outside the box to find solutions on their own (Camargo-Borges, 2017). Moreover, Cheng and Chuang (2018) indicated that the use of digital storytelling is an ideal approach to developing imagination, through which learners can reconstruct and organize knowledge.

In addition, several studies have reported a relationship between visual digital storytelling ability on one hand, and imaginative and creative thinking on the other, such as Al-Sayed (2017) who targeted teaching mathematical concepts in the cartoon

or animation style and reported high impact on developing imagination and innovative thinking among kindergarten children. Also, Saritepec (2021) concluded that the use of digital storytelling to teach science led to deeper learning, and enhanced students' imagination and creative thinking more than oral narration of stories, because it contains abstract and complex concepts, along with multimedia use that led to clarifying information in an enjoyable way as well as increasing learners' productivity.

There is a direct relationship between visual images and innovative thinking for learners (Abdul-Latif et al. ,2017). The use of visual style of digital storytelling can lead to the development of learners' ability to produce and come up with something new using imaginative skills, activating them in the thinking process, and reaching new ideas and linking them to reality (Dewi et al., 2018). In the same vein, Tabieh et al. (2021) investigated the effectiveness of visual digital storytelling compared with traditional narration to present concepts for 200 primary-three students in Jordan, results demonstrated that the model based on technological multimedia in addressing more than one sense was effective in developing students' imagination and creative thinking skills. The researcher believes that this applies to the constructivist philosophy, in which learners build their own knowledge to reach meaning, connecting their past and current experiences to find a creative solution to the situations they encounter (Astuti, 2020).

### **3. Research hypotheses**

1- There is a statistically significant difference at the level of 0.05 between the mean scores of the 1<sup>st</sup> experimental group (audio style) students in the pre-administration and their mean scores in the post-administration of the Imaginative Ability Scale in favour of the post-administration.

2- There is a statistically significant difference at the 0.05 level between the mean scores of the 2<sup>nd</sup> experimental group (visual style) students in the pre-administration and their mean scores in the post-administration of the Imaginative Ability Scale in favour of the post-administration.

3- There is a statistically significant difference at the level of 0.05 between the mean scores of the 1<sup>st</sup> experimental group (auditory style) students and those of the 2<sup>nd</sup> experimental group (visual style) in the post administration of the Imaginative Ability Scale in favour of the students of the 2<sup>nd</sup> group (visual style).

4- There is a statistically significant difference at the level of 0.05 between the mean scores of the 1<sup>st</sup> experimental group (audio style) students in the pre-administration and their mean scores in the post-administration of Torrance's Test of Creative Thinking in favour of the post-administration.

5- There is a statistically significant difference at the level of 0.05 between the mean scores of the 2<sup>nd</sup> experimental group (visual style) in the pre-administration, and their mean scores in the post-administration of Torrance's Test of Creative Thinking in favour of the post-administration.

6- There is a statistically significant difference at the 0.05 level between the mean scores of the 1st experimental group (auditory style) students and the 2<sup>nd</sup> experimental group (visual style) students in the post-administration of the Torrance's Test of Creative Thinking for in favour of the 2<sup>nd</sup> experimental group students.

#### **4. Methodology**

For the research purposes, the quasi-experimental approach was employed to investigate the impact of two different types of digital storytelling (audio and visual) on the development of imagination and creative thinking for second grade students.

##### **4.1 Research Sample**

The target original community of research includes second-grade students in the Sultanate of Oman, whose ages range from 7-8 years. The research sample consisted of 40 students enrolled in the second grade at a private school, who were divided into two matched experimental groups, each of which consisted of 20 students.

##### **4.2 Research design**

Both experimental groups were pre-assessed using the two research tools before each group received the experimental treatment (1<sup>st</sup> group: audio style, 2<sup>nd</sup> group: visual style). The two groups were then assessed again using the same research tools in the two constructs (imaginative ability and creative thinking skills). Paired-Samples T-test and independent-samples T-test were used to verify the research hypotheses.

##### **4.3 Research Tools**

###### **4.3.1 Imaginative Ability Scale (prepared by the researcher)**

After reviewing the relevant literature and studies (Zabelina & Condon, 2019; Jankowska & Karwowski, 2015; Dziedziewicz & Karwowski, 2015; Jankowska, Gajda & Karwowski, 2019), the researcher prepared a scale to identify the imaginary level of the research sample. The scale consisted of 10 paragraphs in proportion to the characteristics of the sample members, so that the answer was chosen from among five levels. It was submitted to a group of jury members to adjust and approve it for the actual administration. The scale was piloted on 20 students and reliability was checked where Cronbach's alpha indicated high reliability value (0.835).

###### **4.3.2 Torrance's Creative Thinking Test**

It is a universal test that measures four basic abilities: fluency, flexibility, originality, and elaboration. It consists of three questions: (1) image, construction; (2) images completion, which consists of 10 shapes to be completed in an innovative way with suggested titles; and (3) parallel lines, in which these lines need to be connected, and a story should be weaved or composed based on them. The researcher codified the test in proportion to the Omani environment, then submitted it to some jury members for

review to adjust and approve or endorse it for administration. To check reliability, the test was administered to a pilot sample of 30 students, and it was re-administered after 10 days to the same sample, except for some students who did not attend the re-administration (i.e., the sample became composed of 28 students). The Pearson correlation coefficient showed high correlation coefficient between the scores of the 1<sup>st</sup> and 2<sup>nd</sup> administrations of the scale, which indicates its reliability.

## 5 Results

### 5.1 Testing the validity of the 1<sup>st</sup> hypothesis

To verify the first hypothesis, the Paired-Samples T-test was used, where the differences were calculated between the mean scores of the 1<sup>st</sup> experimental group students in both the pre- and post-assessment on the total score of the imaginative ability scale, as shown in Table 1:

**Table 1: T-test value of the significance of the differences between the mean scores of students in the 1<sup>st</sup> experimental group in both the pre- and post-administration of the Imaginative Ability Scale**

Assessment	No	Mean	STD Deviation	Freedom	T value	Significance Level
Pre- assessment	20	17.85	3.49	19	19.52	<b>0.0001</b>
Post- assessment	20	30.7	3.32			

It is noted from table 1 that there is a clear difference between the arithmetic means in both the pre- and post-administration in favour of the post-administration, where the arithmetic means of the pre-assessment reached 17.85, while the arithmetic means of the post-assessment reached 30.7. Also, the value of T reached 19.52 at a probability value of 0.0001, which is smaller than the significance level adopted in this research study (0.05). This indicates the validity of the hypothesis, as the researcher confirms that students in the research sample went through experiences of added value to what they learned through this style, which greatly contributed to the development of their imaginative ability through a wide range of sound effects and dialogic style. These contributed to stimulating students' imagination, especially with the absence of any accompanying visual effects, which helped in developing that ability for them at a high level considering the great difference between arithmetic means. This was confirmed by the results of some previous research studies (e.g., Seker, 2016; Abdul-Samad, 2017; Al Khalis, 2019), which indicated the effectiveness of the auditory style of digital storytelling in developing the imaginative ability of learners.

## 5.2 Testing the validity of the 2<sup>nd</sup> hypothesis

To verify the second hypothesis, a Paired-Sample T-test was used, where the differences were calculated between the mean scores of the 2<sup>nd</sup> experimental group students in the pre- and post-assessment on the total score of the Imaginative Ability Scale, as shown in Table 2:

**Table 2: T-test value of the significance of the differences between the mean scores of students in the 2<sup>nd</sup> experimental group in both the pre- and post-administration of the Imaginative Ability Scale**

Assessment	No	Mean	STD Deviation	Freedom	T value	Significance Level
Pre-assessment	20	19	3.34	19	16.19	<b>0.0001</b>
Post-assessment	20	31.4	2.34			

It can be noticed from table 2 that the value of T reached 16.19 at a probability value of 0.0001, which is smaller than the significance level adopted in this research study (0.05). There is a clear difference between the arithmetic means of the pre- and post-assessment in favour of the post-assessment, where the arithmetic mean for the pre-assessment was 19, while it was 31.4 for the post-assessment. This indicates the validity of this hypothesis, as the researcher confirms that the availability of visual elements and effects in the form of multimedia. This had an effective impact on the development of the research sample students' imaginative ability, especially because there was consistency and integration between the visual elements along with the voice commentary of the narrator. This had a clear impact on stirring imagination in the students' minds throughout their interactions with this visual style. This was confirmed by the results of studies by Trisciuzzi (2017), Seker (2016), (Tabieh et al., 2021), which indicated the effectiveness of digital storytelling in the visual style in developing the imaginative ability of learners.

## 5.3 Testing the validity of the 3<sup>rd</sup> hypothesis

To verify the third hypothesis, the researcher used an independent-samples T-test, where the differences were calculated between the mean scores of the first experimental group and the second experimental group students' scores on the total score of the imaginative ability scale in the dimensional measurement as shown in the Table 3:

**Table 3: T-test value of the significance of the differences between the mean scores of students in both the 1<sup>st</sup> and 2<sup>nd</sup> experimental groups in the Imaginative Ability post-test**

Assessment	No	Mean	STD Deviation	Freedom	T value	Significance Level
1st Experimental	20	30.7	3.32	38	0.769	<b>0.447</b>
2nd Experimental	20	31.4	2.34			

It can be noticed from table 3 that the value of T reached 0.769 at a probability value of 0.447, which is greater than the significance level adopted in this research study (0.05). There is a clear convergence between the arithmetic means of the post-assessment in both the 1<sup>st</sup> and 2<sup>nd</sup> groups, where the arithmetic mean of the post-assessment for the 1<sup>st</sup> group was 30.7, while the arithmetic mean of the post-assessment for the 2<sup>nd</sup> group was 31.4, and therefore, the hypothesis was rejected. The researcher believes that the difference between the added value of audio and visual effects in digital storytelling was not of a large degree of difference, while the sound effects alone could stimulate the imagination of the students in the research sample in the first group; and so was the case with the visual effects, which could also stir students' imagination in the 2<sup>nd</sup> group. In light of this, the researcher emphasizes the effectiveness of the two styles (audio and visual) of digital storytelling in developing the imaginative ability.

#### 5.4 Testing the validity of the 4<sup>th</sup> hypothesis

To verify the fourth hypothesis, the Paired-Samples T-test was used, where the differences were calculated between the mean scores of the 1<sup>st</sup> experimental group students in both the pre- and post-assessment on the total score of the Torrance Test of Creative Thinking, as shown in Table 4:

**Table 4: T-test value of the significance of the differences between the mean scores of students in the 1<sup>st</sup> experimental group in both the pre- and post-administration of Torrance's Test of Creative Thinking**

Sub-dimensions	Assessment	No	Mean	STD Deviation	Freedom	T value	(sig)	Significance level
<b>Fluency</b>	Pre-assessment	20	12.3	1.45	19	1	0.330	Non-significant
	Post-assessment	20	12.65	1.72				
<b>Flexibility</b>	Pre-assessment	20	11	1.41	19	0.900	0.379	Non-significant
	Post-assessment	20	11.3	0.97				



<b>Originality</b>	Pre-assessment	20	4.4	0.99	19	0.623	0.541	Non-significant
	Post-assessment	20	4.5	0.94				
<b>Elaboration</b>	Pre-assessment	20	16.1	1.58	19	0.900	0.379	Non-significant
	Post-assessment	20	16.25	1.16				
<b>Total Score</b>	Pre-assessment	20	52.8	3.13	19	1.506	0.149	Non-significant
	Post-assessment	20	53.7	2.69				

It is noticed from table 4 that the T values ranged between 0.623 and 1.5, and the probabilistic values were greater than the significance level adopted in this research study (0.05), and therefore the hypothesis was rejected. This result differs from what was stated in the results of studies by Al-abd (2020) and Al-Osaimi (2018), which confirmed the existence of a relationship between imagination and creative thinking.

The researcher believes that if the auditory style was able to develop the imaginative ability of the same students of the 1<sup>st</sup> experimental group in the research sample, it was natural that the same style would be also able to develop creative thinking among the sample members due to the aforementioned relationship between imagination and creative thinking. Therefore, the researcher believes that although there was no significance between the assessment means in both the pre- and post-administration of the four targeted skills of creative thinking, there is a slight improvement between the means of the pre- and post-administration in favour of the post-administration of the four skills as well as the total score of the skills. The researcher confirms that the difference between the means could have increased in favour of the post-administration if a scale or test that was consistent with the nature of the presentation style for digital storytelling with the 1<sup>st</sup> experimental group (audio style). However, due to the characteristics of the individuals, in terms of the age group they belonged to (7 - 8 years), there was no other option other than using a scale or test that was mainly based on pictures and shapes.

### 5.5 Testing the validity of the 5<sup>th</sup> hypothesis

To verify the fifth hypothesis, a Paired-Samples T-test was used, where the differences were calculated between the mean scores of the 2<sup>nd</sup> experimental group students' in both the pre- and post-assessment on the total score of the Torrance Test of Creative Thinking, as shown in Table 5:

**Table 5: T-test value of the significance of the differences between the mean scores of students in the 2<sup>nd</sup> experimental group in both the pre- and post-administration of Torrance's Test of Creative Thinking**

Sub-dimensions	Assessment	No	Mean	STD Deviation	Freedom	T value	(sig)	Significance level
Fluency	Pre-assessment	20	13.55	1.46	19	6.24	0.000	Significant at 0.0001
	Post-assessment	20	16.7	1.26				
Flexibility	Pre-assessment	20	12.45	1.05	19	8.1	0.000	Significant at 0.0001
	Post-assessment	20	15.3	0.97				
Originality	Pre-assessment	20	6.85	0.81	19	5.31	0.000	Significant at 0.0001
	Post-assessment	20	8.2	0.89				
Elaboration	Pre-assessment	20	18.2	1.5	19	4.38	0.000	Significant at 0.0001
	Post-assessment	20	20.25	1.16				
Total Score	Pre-assessment	20	51.05	2.3	19	11.52	0.000	Significant at 0.0001
	Post-assessment	20	60.45	2.70				

It can be noticed from table 5 that there is a clear difference between the arithmetic mean of the pre- and post-administration in favour of the post-administration in all the four targeted skills, where the mean of the pre-administration of the total score was 51.05, while the mean of the post-administration of the total score was 60.45. Also, T values ranged between 4.38 and 11.52 at the probability value of 0.0001, which is smaller than the significance level adopted in this research study (0.05), and this indicates the validity of the hypothesis, i.e. there are statistically significant differences at the level of 0.05 between the mean scores of the students of the 2<sup>nd</sup> experimental group in the pre-administration and their scores in the post-administration of the Torrance Test of Creative Thinking in favour of post-administration. This is evidence of the validity of the hypothesis, and thus the researcher confirms that the availability of visual elements of images, shapes and visual effects contributed to encouraging and

stimulating thinking for the sample members in unusual ways and methods that eventually led to a tangible development of those skills. This result was also confirmed by the results of some previous studies (Camargo-Borges, 2017; Dewi et al., 2018; Astuti, 2020), which indicated the effectiveness of the visual style of digital storytelling in developing innovative thinking skills.

### 5.6 Testing the validity of the 6<sup>th</sup> hypothesis

To verify the sixth hypothesis, the researcher used Two-Independent Samples T-test, where the differences were calculated between the mean scores of the 1<sup>st</sup> experimental group and the mean scores of the 2<sup>nd</sup> experimental group on the total score of the Torrance's test of Creative Thinking in the post-administration, as shown in Table 6:

**Table 6: T-test value of the significance of the differences between the mean scores of students in the 1<sup>st</sup> and 2<sup>nd</sup> experimental groups in the post-administration of Torrance's Test of Creative Thinking**

Sub-dimensions	Assessment	No	Mean	STD Deviation	Free-d-om	T value	(sig)	Significance level
Fluency	1 <sup>st</sup> Experimental	20	12.65	1.75	38	8.47	0.000	Significant at 0.0001
	2 <sup>nd</sup> Experimental	20	16.70	1.26				
Flexibility	1 <sup>st</sup> Experimental	20	11.3	0.97	38	12.92	0.000	Significant at 0.0001
	2 <sup>nd</sup> Experimental	20	15.30	0.98				
Originality	1 <sup>st</sup> Experimental	20	4.5	0.94	38	12.71	0.000	Significant at 0.0001
	2 <sup>nd</sup> Experimental	20	8.20	0.89				
Elaboration	1 <sup>st</sup> Experimental	20	16.25	1.16	38	10.86	0.000	Significant at 0.0001
	2 <sup>nd</sup> Experimental	20	20.25	1.16				
Total Score	1 <sup>st</sup> Experimental	20	53.7	2.69	38	7.90	0.000	Significant at 0.0001
	2 <sup>nd</sup> Experimental	20	60.45	2.70				

It is clear from table 6 that there is a clear difference between the arithmetic mean of the post-assessment of the 1<sup>st</sup> and 2<sup>nd</sup> experimental groups in favour of the second group in all the four targeted skills. The arithmetic means of the post-assessment of the total score of the 1<sup>st</sup> experimental group reached 53.7, while it reached 60.45 in the 2<sup>nd</sup> group. Also, the T values ranged between 7.9 and 12.92, and the probabilistic values were smaller than the significance level adopted in this research study (0.05), reaching 0.0001. Therefore, the hypothesis was verified and accepted, and this was confirmed by the results of some previous studies (e.g., Tabieh et al., 2021; Abdul-Latif et al., 2017), which highlighted the importance of using visual elements in developing creative thinking skills for learners. Agreeing with that, the researcher proposes that the nature of the instructional content provided through digital storytelling in the visual style plays an important role in developing creative thinking skills; more specifically, the instructional content of a practical nature contributes more than that content of a theoretical nature; and this was what happened in the targeted instructional content, which included some concepts related to science.

## **6 Discussion**

Students were given two measures to assess their imaginative abilities and creative thinking. During and after the presentation of the two styles, students in the research sample were found to be highly engaged with learning. They demonstrated a clear ability to replicate and add new events and characters to the content of the two stories, with the visual style outperforming the audio style in terms of promoting creative thinking owing to the number of senses engaged in the students' involvement with the story. In terms of the development of imaginative ability, it was evident that the two styles were efficient in developing it. However, the post-administration of the imaginative ability scale revealed no statistically significant changes in the mean scores of the experimental groups.

Students' imaginations and creative thinking skills were developed as a result of teaching using digital storytelling for this age group. Because some technical standards were considered during the production of the digital storytelling, the images used, characters, colours in the visual style, and the clarity of characters' voices, as well as the degree of their intensity in the auditory style, may have played a role in this improvement. This is in line with Seker's findings (2016), which found that adhering to the right technical standards when creating digital storytelling caused children to concentrate more and listen more intently to the conversations between the story's characters.

The use of an online platform and the availability of supporting devices such as headphones in the study's implementation had a positive impact on students who listened to the story with their own headphones. This helped them concentrate without being distracted by other noises, and it also helped them imagine the story's events, scenes, and details using various sound effects. This made them feel connected to the story's various environments as indicated by Abdul-Samad (2017), especially since the

lesson's topic was about "different places to live in". These locations included a variety of natural settings (e.g., seas, deserts, mountainous environments, and agricultural environments). One important observation was that after listening to this auditory style for a while, the children began to ask questions and have open discussions with the teacher. This shows how the students' imaginations were piqued, prompting them to ask questions and direct their imaginations to contemplation and thought. Al-Khalis (2019) indicated that this is considered one of the literary standards for digital storytelling.

The students' ability to embody characters, and to act out roles and sequential events contained in the auditory style was clearly noticed after the teacher asked them to do so which is consistent with Merjovaara et al. findings (2020). They were not only satisfied with that, but also added some scenes from their own imagination, and other students were involved in the same context. It was also noticed that the children's ability to simulate and mimic the sound effects that were mentioned in the auditory style while they were acting scenes, such as the sounds of sea waves and wind, which indicated many different environments. Furthermore, after engaging in some mental activities based on imagination, the students were able to assimilate the scientific concepts presented in the lesson. These activities stimulated the mind to depict things that had no connection to reality and transform them into abstract images in the mind (Camargo Borges, 2017).

On the other hand, it was observed that students enjoyed and were focused on the course and events of the visual story and its characters, as evidenced by the discussions that followed the presentation, when the teacher began to ask questions (i.e., What if...? - What would you do if...? - List a different ending to the story), students began to respond to the questions, demonstrating their imagination as well as their ability to link the events. This is in line with the findings of Trisciuzzi (2017).

The compatibility between the voice and movement of the characters, as well as the compatibility between the written text and the image, can explain the students' attraction to characters, graphics, colours, and music during the presentation of the visual style. Throughout the presentation, they were alerted and drawn in by this. Furthermore, the multimedia used in the creation of this style aided in the development of their imagination skills, which then addressed their senses, their vision of various environments with their colours, such as the sounds of waves, the colours of the seas, deserts, mountainous environments, agricultural environments, and the accompanying sounds of animals, causing them to become involved while exploring their imagination. This was evident in their responses to questions and their creative completion of the drawings. They also used the images and scenes included in this style to fuel their imagination (Trisciuzzi, 2017; Tabieh et al., 2021).

Generally, the researcher believes that the use of digital storytelling in its audio-visual styles develops learners' imaginations by reconstructing knowledge. This is also confirmed by Cheng and Chuang (2018). In light of the foregoing, the researcher confirms that there are no statistically significant differences in the imaginative ability

scale between the participants of the two experimental groups (audio/visual styles), and that both styles had a significant impact on developing the imaginative ability of learners who could clearly interact with both types on a nearly equal level.

In terms of creative thinking, the findings revealed that learning through digital storytelling resulted in statistically significant differences in average performance between the two experimental groups (both audio and visual styles). The discrepancy in the results was very small, with no difference from the results of the pre-administration, according to the researcher's observations while administering the Torrance's test of creative thinking to students after using the auditory style. This contradicts what the researcher had noticed after using the visual style, which was that the students' drawings were unique; the majority of them were able to connect lines and shapes to find relationships between them, resulting in innovative and extraordinary ideas consistent with Camargo-Borges (2017). Their drawings, in particular, were characterized by flexibility in terms of the diversity and differences of ideas, and they were not contained within a single frame. The researcher also noticed that students were quick to generate ideas and solve problems in accordance with the real world: that is, they were based on real knowledge rather than guesswork. This is in line with Dewi et al findings. (2018). Furthermore, both in their participation after being exposed to the visual style and through their drawings in the test, students' answers and responses were marked by elaboration (giving details) and the addition of new ideas. This demonstrates their ability to connect previous experiences with new ones, implying that they have the necessary understanding to come up with a creative solution (Astuti, 2020).

The use of multimedia that the students interacted with resulted in deeper learning, especially because the science course included some abstract concepts; the visual style assisted them in generating new ideas and connecting them to the knowledge base in order to come up with innovative and creative solutions. This is consistent with Tabieh et al findings (2021). As a result, according to Abdul-Latif et al. (2017), visual images – which were processed in memory and later retrieved in other situations – played an active role in the development of creative thinking. Students were found to recall the sequence of events, added new events, came to conclusions, and devised creative solutions.

Finally, students in the research sample were found to be very engaged in learning both during and after the presentation of the two digital storytelling styles. They demonstrated a clear ability to replicate the content of the two stories and add additional events and characters, with the visual style outperforming the audio style in terms of encouraging creative thinking. The students' thoughts were stimulated by the nature of the content, and they began to think more visually, creating their own images and characters to respond to the teachers' questions. This means that if the entire educational situation is designed using a user-centered and participatory design technique that allows students to actively participate in the design and development of the story, students will be more engaged, and their learning will be scaffolded (Addone et. al., 2021). Yang, Chen, and Hung (2020) also asserted that digital storytelling can

effectively encourage students' growth as creative thinkers by providing authentic and relevant learning opportunities that allow students to participate in the design process using their imagination. Thus, the current study suggests that allowing students to add their own characters and events to the story will help to authenticate the learning experience and increase student engagement.

## **7 Conclusion**

The study demonstrated the effective impact of digital storytelling in its audio and visual styles, on the development of the students' imaginative ability. This was evident through the researcher's observations on the research sample (i.e., the two experimental groups), their interactions during and after the presentation of the two digital stories, and their ability to simulate by adding new characters and events to the story. This meant that the mind was being stimulated to imagine and represent imaginary objects and turn them into abstract images. The visual style was found to be superior to the auditory style in terms of developing creative thinking. This was attributed to the visual style's use of multiple senses, whereas the auditory style relied primarily on one sense: hearing. Teachers who assisted in the administration of the study's intervention expressed positive feelings about using these two teaching styles in science classes because of the positive impact they observed on students. The researcher emphasizes the use of digital storytelling styles in general, and in teaching science courses in particular, via online platforms and even MOOCs for higher levels. In the educational field, he suggests using different styles of narrating digital stories and conducting more recent studies on imagination skills independent of other mental skills. The researcher also suggests that more detailed specialized studies be conducted on the styles of digital storytelling and their relationship to the development of some higher-order thinking skills, as well as studies to develop a scale that supports creative thinking using other elements other than graphics and images. Finally, according to the findings, allowing students to contribute their own characters and events to the tale would assist to legitimize the learning experience and boost student engagement.

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