DST ELEMENTS: INFUSION IN THE DEVELOPMENT OF TABLET-BASED TEACHING PRODUCTS (APPS)

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ABSTRACT

The usage of instructional media (apps) is poorly delivered due to inappropriate content of the presentation. Recent studies showed that perceptions among students and teachers regarding the use of apps are very low. Thus, Digital Storytelling (DST) concept is infused in developing the apps. Nevertheless, students are unable to comprehend DST clearly. The aim of this study is to identify DST elements for the development tablet based teaching products (apps). Critical analysis and comparative analysis are employed based on eight samples of DST tools to formulate generic DST elements. Eleven DST elements are formed and learning theories are adapted based on correct principles and procedures. The elements should contribute a new pedagogical approach for teachers in developing apps with mobile technology.

Keywords: Digital storytelling, DST elements, Comparative analysis

1.0   INTRODUCTION

Digital Storytelling (DST) is a digital narrative with infused multimedia elements, namely videos, images, audio and animations that deliver information effectively [1]–[3]. DST presents interesting information for specific topics which is introduced by Dana Atchley (pioneer of DST) [4], [5]. Precisely, there are three categories of DST based on its content: (i) personal narratives, (ii) stories on historical events, and (iii) stories on inform or instruct [6]–[8]. This study emphasizes on the narrative to instruct stories, due to the factor that there are still students who are unable to differentiate DST with non DST [9][10]. Recent study has shown that the implementation of the DST concept facilitates teachers in solving problems of self-learning and diversity of students' knowledge [11]. Moreover, teachers are able to better strategize their teaching and learning approaches by including DST concepts in developing learning apps. This would eventually ease teachers in tailoring lessons [12], [13]. The aim of this study is to infuse DST elements in the development process so that the concept is comprehended. This article first explains the DST Concept, DST dimensions, proposed DST elements, learning theories and guidelines. The next section covers the methodology and then the conclusion.

1.1   DST concept

The introduction of DST concept has a positive effect on refining the students' achievement and knowledge with the multiplicity of the learning resources towards the need for the latest technology [14][15]. In line with that, high demands for teaching products (apps) have boosted the creation of tablet-based teaching products (apps). However, the usage of apps is poorly delivered due to inappropriate content of the presentation. Recent studies showed that perception among students and teachers regarding the use for apps are very low. Thus, DST concept is infused in developing the apps. Nevertheless, initial study show that students are unable to comprehend DST clearly[16]. The concept of DST is recognized by elements to distinguish DST from other types of media such as film, television, video and blog [17]. Besides, in order to draw audience's attention to listen to stories is based on its elements. The element is essential in describing the characteristics of DST. Meanwhile, a dimension consists of a list of elements which has the same functionalities and commonalities.

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1.1.1 DST dimensions

Figure 1 illustrates a brief overview of the mapping process in proposing the DST dimensions. In order to determine the DST elements, Abstract Layer Model by Schäfer is referred for better justification. Initially, the model is the prior DST model to describe DST dimensions that can be grouped into five different layers [18]. The Abstract Layer Model displays the relation between dimensions of each layer according to the divergent level of complexity. Basically, the model consists of five layers: Origin, Construction, Interaction, Appeal and Presentation. The model by Kim, Moon, Han and Chang [19] is designated in the mapping process based on interactivity that meets with the objective of the study [20]. The model consists of four dimensions, namely narrative, tool, interface and output. The mapping process took place based on their commonalities of features for each layer (dimension). As a result, four DST dimensions are formed, namely, narrative, functional, tablet interface and multimedia to comply with the aim of this study mainly on DST, tablet based and multimedia technology.
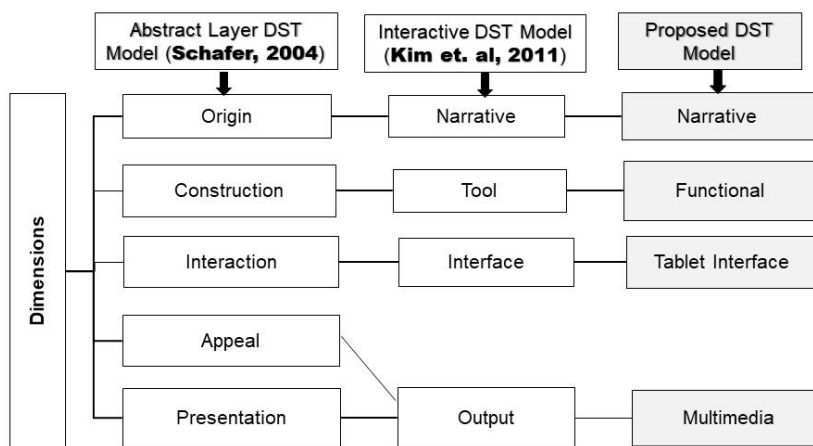

Fig 1. DST Dimensions

1.1.2 Proposed DST elements

There are various DST elements according to different perspectives of experts in order to comprehend DST concepts. Previous study by [21] suggested 14 key interactive DST elements, namely perspective, intention, personal, dramatic question, engagement, articulation, sound track, tempo, story map, expression, significant content, collaboration, user contribution and minimal. The elements are validated by seven prominent DST experts. Nevertheless, the elements are scarce and not in touch with the current technology. Table 1 lists the recommendations of the proposed DST elements in this study. The DST elements are clustered according to DST dimensions: narrative, functionality, tablet interface and multimedia. Narrative dimensions are situated in the early stage of storytelling process and initiated the preparation of media materials. The elements comprise of story objective, story content and story style. Meanwhile, functional dimension is the interaction between the designer and DST tool during the development process. This dimension involves character, editing media and authenticity in order to produce quality media that gives impact to the story. Tablet interface is another dimension which involves the interaction of the audience on the apps with the story system and consists of elements: interactivity, screen display and collaboration. This is to illustrate the relationship of communication between the story system and the audience. The final dimension is to attract audience with a compelling presentation which involves articulation and story beat using multimedia technology.

Table 1. Proposed DST elements on touch screen tablet

Dimension	Element	Sources
Narrative	Story objective, Story content, Story style, Character	[5], [22]–[24]
Functionality	Editing media, Authenticity	[6], [25]–[27]
Tablet interface	Interactivity, Screen Display, Collaboration	[19], [28]–[30]
Multimedia	Articulation, Story beat	[31]–[33]

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1.2 Learning Theories

The learning and storytelling theories namely, Cognitive Theory of Multimedia Learning (CTML), Cognitive Load Theory, Connectivism Theory and Neo Aristotelian Theory are adapted in the proposed DST elements [34]. In order to justify the selection of the proposed DST elements, correct principles of the theories are adapted as tabulated in Table 2. With theoretical support, DST elements for touch screen tablet are formed to provide a proper guide to ease the development of apps.

Table 2. Adaptation of learning theories in DST elements on touch screen tablet

Element	Principles	Theory	Justification
Story objective	Eliminate the working memory load associated by integrating several sources of information	Cognitive Load	Learning objective is focussing on essential learning content
	Signalling	CTML	Learning is effective if designed on essential materials to attract student's attention.
Story content	Capacity to know more is more critical than what is currently known	Connectivism	Learning content includes the development of the concept of knowledge to foster students' knowledge.
	Limited working memory	Cognitive Load	Learning material content is sufficient and limited
	Dramatical structure	Neo Aristotelian	Storytelling content consists of title and structure and narrative format (story map)..
Story style	Personalization	CTML	Message is delivered in conversational style rather than formal style
	Dramatic experience is through audience and character	Neo Aristotelian	Message is delivered in dramatically question for audience's awareness.
Character	Object	Neo Aristotelian	Character or image representation provides two-way communication for interactive storytelling.
Editing media	Learning may reside in non-human appliances	Connectivism	Various functional tools enable ease of teaching process.
Authenticity	Realism	Neo Aristotelian	Digital media are displayed in real situation.
Interactivity	Learning is a process of connecting specialized nodes or information sources	Connectivism	Interactivity occurs through the connection between the audience (touch screen interaction) and the story system (apps).
Screen Display	Limited working memory	Cognitive Load	Screen working area is built optimally based on tablet screen size.
Collaboration	Learning and knowledge rest in a diversity of opinions	Connectivism	The combination of designer skills and engagement from audience are to create an effective story
Articulation	Modality	CTML	The use of text is presented as narration (spoken words) or using auditory, rather than presented as a written text to accompany the graphics.
Story beat	Redundancy	CTML	Combination of animation with voice recording are applied rather than animations, voice recording with text on the screen for effective learning

1.3 Guideline for the development of apps with DST concept on touch screen tablet

Recently, there are many users enable to interact with touch screen devices, even though these interactions are easy to learn [35], [36]. Due to the lack of principles and established guidelines with touch screen have triggered an idea of proposing a guideline[37]. With the infusion DST elements in the development process, the understanding of the concept of DST is achieved. A comprehensive analysis is employed to form the five components of the guidelines, namely, process development, DST elements, system requirement, DST dimensions, as shown in Figure 2. The

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production of apps should go through four phases of activities: pre-production, production, post production and distribution in the development process, [38]. The four dimensions stated in Figure 1. The DST elements comprise of story objective, story content, character, editing media, authenticity, interactivity, screen display, collaboration, articulation and story beat. The guidelines require hardware and software specification for instance, Android as an operating system, touch screen tablet and DST tools (storyboarding, editing and authoring)[39].
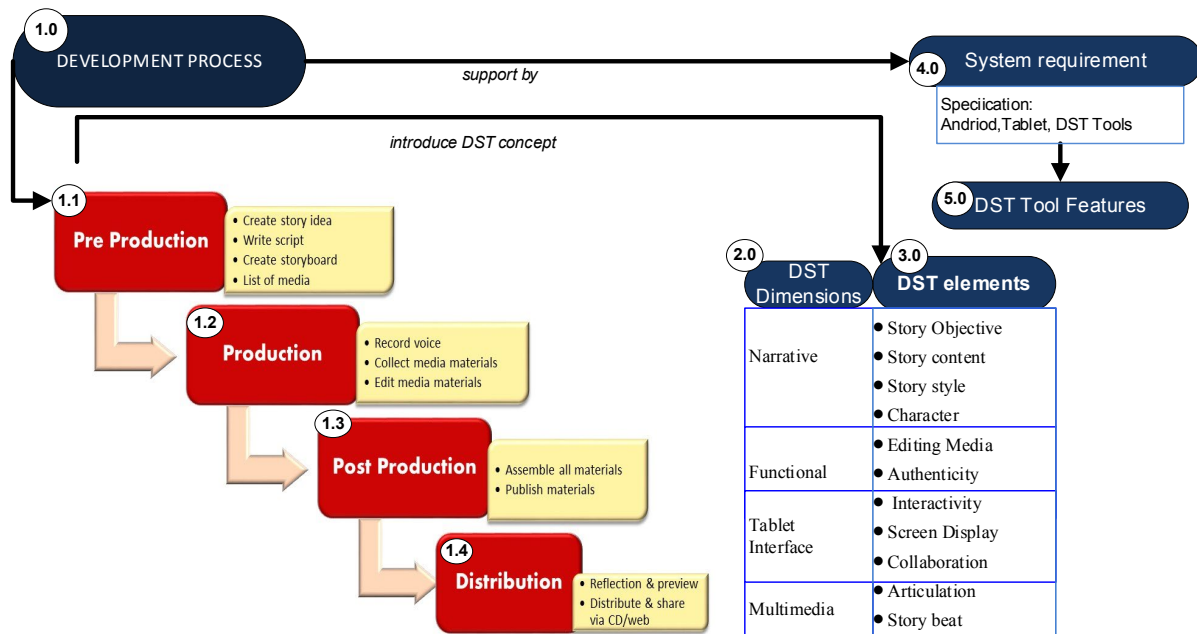

Fig. 2. Guideline for development of apps with DST concept on touch screen tablet [39]

2.0 METHODOLOGY

A series of activities are employed in this study as shown illustratively in Figure 3. The study involves three phases of activities namely critical analysis, comparative analysis and expert review, respectively. A critical analysis is carried out using content analysis from previous studies on eight samples of DST tools. In order to identify the generic DST elements with concrete justification, the adaption of three learning theories and two storytelling theories is employed. In the second phase, a comparative analysis was conducted to seek for the commonalities and determine appropriate DST elements. The proposed elements are based on the majority scores. Finally, the expert review phase takes place where thirteen appointed experts validate the proposed DST elements with a checklist form. A descriptive analysis is performed to calculate the scores of each element.
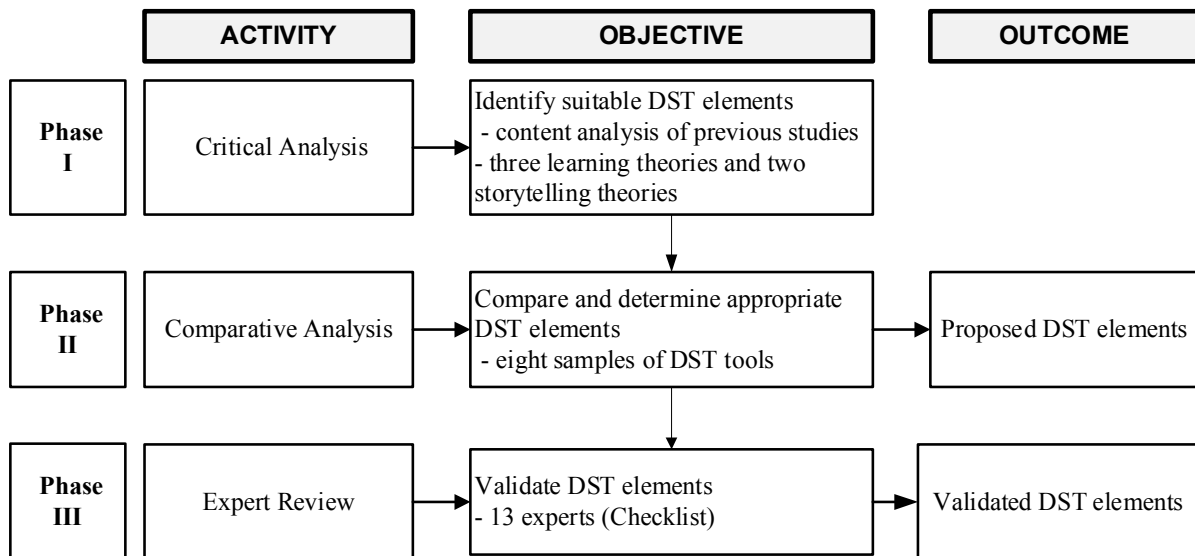
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Fig. 3. Summary of activity

2.1 Findings and Discussion

As mentioned in previous section, the gap on the aspect of mobile technology design with touch screen interaction is identified as a major contribution in the DST elements for touch screen tablet. In order to provide a clear explanation in the design aspect, a detailed characteristic of the DST element is required. Thus, the context of design principles with touch screen interaction is determined according to appropriate narrative elements as a guide in understanding the elements. The following are the activities employed in the development of DST process.

2.1.1 Comparative Analysis

A total of eight samples of DST tools from previous studies are determined to select the appropriate design principles of DST elements. A comparative analysis is employed to select the design principles of DST elements as shown in Table 3. Thus, the elements are designated based on commonalities of the majority scores applied in other studies.In seeking the common elements, comparative analysis is important to ensure that the elements are formed based on established root.

The findings is analysed based on the condition for classification of generic elements using statistical calculation to form three groups of data as shown in Table 4 [47]. If the score is between 6 to 8, this indicates that the elements compulsory recommended, but if the score is between 3 to 5, the elements are recommended. Instead, if the score is less than 2, the component is discarded. This is important to attain an accurate result and appropriate elements for the guidelines. Results indicate that 30 design principles based on eleven DST elements are compulsory to be included in the development process of apps. The common elements with majority scores is designated based on the results as the scores are more than four. A detailed list of the DST elements with design principles according to dimensions is formed. Next, the elements are then validated by experts before they are infused in the development of the apps.

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Table 3. Comparative analysis for DST elements

Element	Design principle	Sources								Total Score
		[40]	[42]	[44]	[28]	[41]	[43]	[45]	[46]	
Story objective	Aim	✓	✓	×	✓	✓	✓	✓	✓	7
	Focus	✓	✓	✓	✓	✓	×	✓	✓	7
Story content	Title	✓	✓	×	✓	×	×	×	✓	4
	Type	×	✓	×	✓	✓	✓	✓	×	5
	Learning Material	×	✓	×	✓	✓	✓	✓	✓	6
	Limited resources	✓	✓	×	✓	✓	✓	×	✓	6
	Structure and story format	✓	✓	×	✓	✓	×	✓	×	5
Story style	Appreciate	✓	✓	✓	✓	✓	✓	✓	×	7
	Awareness	×	✓	×	✓	×	✓	✓	×	4
Character	Facial expression	✓	✓	✓	✓	✓	✓	✓	✓	8
	Body language	×	×	✓	✓	✓	✓	✓	✓	6
Editing media	Move	✓	×	✓	✓	✓	✓	✓	✓	7
	Delete	✓	✓	×	×	✓	✓	✓	✓	6
	Change Size	×	✓	×	×	✓	×	✓	✓	4
	Change format	✓	×	✓	✓	✓	✓	✓	✓	7
Authenticity	Background	✓	✓	✓	✓	✓	✓	×	✓	7
	Angle view	✓	×	×	×	✓	✓	×	✓	4
Interactivity	Navigation	✓	✓	×	✓	✓	✓	✓	✓	7
	Optional finger input	✓	✓	✓	✓	✓	×	✓	✓	7
	Interactive touch screen	✓	✓	×	✓	×	×	×	✓	4
	Object	×	✓	×	✓	✓	✓	✓	×	5
Screen Display	Work display	×	✓	×	✓	✓	✓	✓	✓	6
	Object arrangement	✓	✓	×	✓	✓	✓	×	✓	6
Collaboration	Involvement	✓	✓	×	✓	✓	×	✓	×	5
	Contribution	✓	✓	✓	✓	✓	✓	✓	×	7
	Share	×	✓	×	✓	×	✓	✓	×	4
Articulation	Audio & text	✓	✓	✓	✓	✓	✓	✓	✓	8
	Narration	×	×	✓	✓	✓	✓	✓	✓	6
Story beat	Image duration	✓	×	✓	✓	✓	✓	✓	✓	7
	Transition/ animation	✓	✓	×	×	✓	✓	✓	✓	6

✓: elements applied   ×: elements not applied

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Table 4. Condition for classification of generic components [47]

Condition (Total score)	Indicator
6 to 8	Compulsory
3 to 5	Recommended
0 to 2	Discarded

2.1.2 Expert Review

An expert validation involves thirteen academic lecturers from the Institute of Teacher Education (ITE) and local universities . Their roles are to review and comment the proposed elements based on relevant expertise. An expert's checklist form is made to collect data based on the understanding of DST elements. The data is analysed by frequency and percentage scores [34]. Figure 4 represents experts' feedback on DST elements. Based on the results, it can be seen that majority of the experts (76.92%) have a clear understanding, 22.38% of the experts require a little explanation and only one expert (0.70%) requires a clear explanation on screen display. Table 5 lists eleven DST elements with the summarized design principles based on experts' comments. It is important that justification and comments made by experts are applied in the development process.
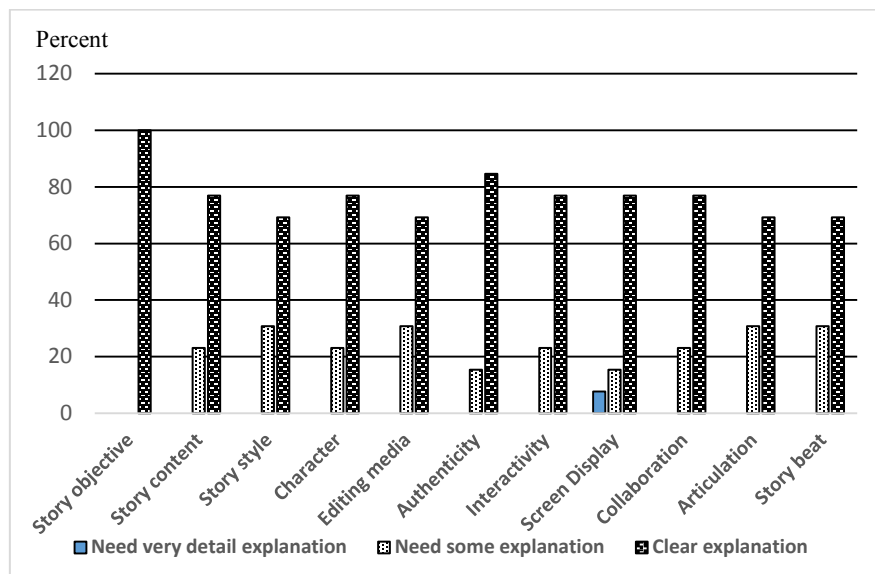

Fig. 4 Percentage of experts' feedback on DST elements

Table 5. DST elements on touch screen tablet

Dimension	Element	Design principle
Narrative	Story objective	Provide aim and focus of the story based on audience background.
	Story content	Provide a headline, type of story and adequate learning materials.
	Story style	Show audience's appreciation and awareness with dramatic questions and views.
	Character	Provide an image for interaction via two-way communication. This is to draw audience's attention through facial expressions or body language.
Functionality	Editing media	Enable media editing to manipulate the media (changing size and format, move and delete).
	Authenticity	Provide a suitable background or image with the correct angle of view.

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Dimension	Element	Design principle
Tablet Interface	Interactivity	Enable interaction with audience for navigation via finger input based on the size of media
	Screen Display	Provide suitable and adequate working area on the touch screen.
	Collaboration	Enable engagement from audience and designer via interaction with story's system to share stories.
Multimedia	Articulation	Provide narration or voice recording and combination of text or voice with effective background music
	Story beat	Enable image display at a certain time at each scene using transition and animation to demonstrate the continuity of the story.

3.0 CONCLUSION

The DST elements are formed to comprehend DST concept in the development of apps in the guidelines. The previous study on the creation of the guideline embarks further study on the DST elements [39]. An experts' validation is carried out after a critical analysis is employed to determine the elements. As a result, eleven DST elements, namely story objective, story content, story style, character, editing media, authenticity, interactivity, screen display, collaboration, articulation, story beat. The elements are clustered based on DST dimensions (narrative, functionality, tablet interface and multimedia). The experts' validation is to confirm the correct terms and principles of the DST elements. The infusion of DST elements in the development process creates the novelty of the guidelines. Additionally, learning and storytelling theories are pedagogical aspects in adapting the DST elements in the development process. In order to provide a solid justification, the established design principles of DST elements are supported by these theories. This study contributes towards content development of learning material and national agenda as transforming shift towards Education 4.0. In line with that, machine (multimedia technology and tablet) and human development (teachers) will integrate in improving learning and teaching strategy for educational purposes. For future prospect, DST elements can be incorporated with the design of DST tool to create a compelling application for novice designers cum teachers to create their own apps.

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