LEARNER-GENERATED COMIC (LGC): A PRODUCTION MODEL

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Abstrak

Perkembangan alat pengarangan telah memupuk minat yang meluas terhadap penggunaan komik sebagai medium Penceritaan Digital. Pendekatan pembelajaran berasaskan teknologi ini dikenali sebagai Penjanaan Komik Digital (LGC); di mana pengetahuan dan idea pelajar berkaitan dalam suatu subjek disintesis dalam bentuk komik pendidikan digital. Walaupun pelbagai faedah dari sudut ilmiah telah dilaporkan daripada aktiviti LGC bagi mencapai matlamat pedagogi tertentu, rata-rata penyelidik tidak memberi penekanan kepada teknik produksi LGC yang berkualiti, disokong oleh teori, strategik dan menyertakan unsur-unsur utama yang saling berkaitan dalam kaedah produksi LGC. Kesannya, terdapat kecenderungan kepada tanggapan bahawa produksi LGC adalah mencabar dan tidak praktikal. Pada asasnya, terdapat kekurangan model konsepsual dan kaedah yang komprehensif dalam mengintegrasikan teori, unsur, teknik, teknologi, dan proses produksi LGC yang sistematik. Maka dalam konteks ini, kajian ini mencadangkan model produksi LGC yang berfungsi sebagai satu pendekatan sistematik yang merangkumi komponen asas untuk pelajar menghasilkan komik pendidikan digital. Oleh itu, dalam usaha untuk mencapai matlamat utama, beberapa cabang objektif dibentuk: (1) mengenalpasti komponen teras model produksi LGC, (2) membina model produksi LGC sistematik berdasarkan komponen yang dikenalpasti, (3) menilai model produksi LGC yang dicadangkan itu, dan (4) menilai produk LGC dibangunkan oleh pengguna model yang dicadangkan. Kajian ini mengaplikasikan metodologi Penyelidikan Sains Rekabentuk sebagai rangka proses penyelidikan. Aktiviti pembinaan model produksi LGC melibatkan kajian literatur dan perbandingan, perundingan pakar, dan penyertaan pengguna. Model yang dicadangkan ini dinilai melalui ujian pengalaman pengguna dan kajian pakar. Keputusan daripada ujian hipotesis menyimpulkan bahawa kualiti model produksi LGC yang dicadangkan adalah signifikan sebagai garis panduan untuk pelajar untuk merekabentuk dan membangunkan komik pendidikan digital. Analisa juga melaporkan bahawa model yang dicadangkan telah diterima baik oleh pakar-pakar tempatan dan antarabangsa. Di samping itu, penilaian produk LGC dibangunkan dari ujian pengalaman pengguna menunjukkan terdapat perbezaan signifikan antara produk LGC dibangunkan oleh pengguna model yang dicadangkan dan bukan pengguna. Kesimpulannya, penggunaan model produksi LGC secara sistematik dan berilmiah mampu menyumbang kepada perancangan, pelaksanaan, dan penilaian sesi Penceritaan Digital yang meningkatkan mutu pembelajaran melalui rekabentuk dan pembangunan LGC.

Kata kunci: Komik, Penjanaan Komik Digital, Model Konsepsual, Penceritaan Digital, Penjanaan Kandungan Pelajar

Abstract

Recent advancement of authoring tools has fostered widespread interest towards using comics as a Digital Storytelling medium. This technology integrated learning approach is known as Learner-Generated Comic (LGC) production; where learners' knowledge and ideas on various subjects are synthesized in a form of digital educational comic. Despite the prior evidences for the didactic values of LGC production, most scholars do not emphasise on a quality, theoretically supported, and strategic LGC production methodology that accommodate to interrelated key elements and production methods of LGC. As a result, there is a tendency to view LGC production as challenging and impractical. Essentially, there is a lack of conceptual models and methods that comprehensively tailor the crucial theories, elements, techniques, technological, and systematic processes of LGC production. Within this context, this study attempts to propose LGC production model that serves as systematic approach which includes the fundamental components for learners to produce digital educational comics. Therefore, in order to accomplish the main aim, a number of sub objectives are formed: (1) to determine the core components for LGC production model, (2) to construct a systematic LGC production model based on the identified components, (3) to evaluate the proposed LGC production model, and (4) to assess the LGC products developed by the proposed model users. This study adopts the Design Science Research methodology as the framework of the research process. Activities of LGC production model construction include literature review and comparative study, expert consultation, and user participation. The proposed model is evaluated through user experience testing and expert review. Results from hypothesis testing concludes that the proposed LGC production model is significantly perceived as having quality in serving as a guideline for learners to design and develop digital educational comics. It was also found that the proposed model has been well-accepted by local and international experts. In addition, assessment of LGC products developed from the user experience testing has implicated there are significance differences between LGC products developed by the proposed model users and non-users. In conclusion, adoption of a systematic, scholarly grounded, and authenticated LGC production model can contribute to the planning, implementation, and evaluation of Digital Storytelling session that enhance learning experience through LGC design and development.

Keywords: Comics, Learner-Generated Comic (LGC), Conceptual Model, Digital Storytelling, Learner-Generated Content

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Table of Contents

List of Tables

List of Figures

List of Appendix

List of Abbreviations

LGC	Learner-Generated Comic
DST	Digital Storytelling
DSR	Design Science Research
FX	Effects
ASCII	American Standard Code for Information Interchange
UUM	Universiti Utara Malaysia
ESOL/ESL	English as a Second Language
MA	Master of Arts

CHAPTER ONE
INTRODUCTION

In this introductory chapter, background of study; followed by the motivation aspects of the study; the problem statement; objectives, significances, and limitations of the study; theoretical and research framework; as well as the definition of the terms used during the course of the research are presented.

1.1 Overview

Authoring tools technology has evolved from generating ASCII text, graphics to multimedia-rich web-based output. With the outburst of user-generated content online phenomena (Boyd & Ellison, 2007; Figueiredo, Almeida, Goncalves, & Benevenuto, 2014; Seretan, Roturier, Silva, & Bouillon, 2014), interactive authoring systems provide novice computer users the opportunity to become designers of their own digital content. Within educational context, user-generated content is referred as learner-generated content that enables knowledge creation and sharing with the support of Web 2.0 technology (Dale & Povey, 2009). Driven by non-profit goals, learners produce digital stories, blogs, wikis, videos, podcasts, e-portfolios, games, as well as comics to enhance their learning experience.

Synonymous with computer games which are formerly intended abundantly for amusement purpose, there are now tantalizing evidences on the educational impact of comics (Spiegel, McQuillan, Halpin, Matuk, & Diamond, 2013). Immense number of higher institution instructors have utilized variety of comic based

activities in their classrooms such as scrutinizing existing comics as historical substances, production of learner-generated comics (LGC) for reaching a pedagogical aim, and other instructive manners (Upson & Hall, 2013).

Essentially, LGC production refers to a Digital Storytelling (DST) approach; where learners produce digital stories in a form of educational comics. According to Alaba (2007), educational comic is defined as "a form of cartoons in which a cast of characters present an educational story in a sequence of closely related drawings designed to entertain and educate the reader" (p. 916). Hence, LGC production allows learners' knowledge and ideas on various subjects to be synthesized in digital educational comics. As a result, this student-centred activity empowers learners to absorb difficult academic topics (Engler, Hoskins, & Payne, 2008) and polish their inquiry skills (Martell, 2008).

Therefore, this study attempts to construct a conceptual production model of LGC which accommodates the attributes of learner-generated content and DST. A conceptual model is a set of concepts, with or without propositions, used to represent or describe an event, object, or process (Meredith, 1993). Hence, it is anticipated that the proposed LGC production model would be a contributing method for learners to design and develop LGC products. In addition, several aspects that motivate this study are outlined in the next section.

1.2 Research Motivations

Several trends in comics have triggered the acceleration of this study. This section summarizes these phenomena which motivate the research.

1.2.1 Advancement of Comics in Academia

Formerly, comics have once received general prejudice where they were stereotypically pondered as inferior sorts of literature with no inherent pedagogic merit (Sabeti, 2011). Now on the contrary, comics are merely dismissed as a form of low culture (Czerwiec & Huang, 2014). The academic community has extended the studies on comics beyond the art field such as education, cognitive science, sociology, multimedia, and computer science. Due to comic's presentation and development complexity, this medium deserve critical and scholarly attention as much as prose-based novels and traditional films (Crutcher, 2011). Being the oldest form of non-photorealistic visual representation (Chun, Ryu, Hwang, & Cho, 2006), analysing the multimodality of this medium is as important as understanding the internet, television and film (Jacobs, 2007; Dallacqua, 2012). Successively, as illustrated in Figure 1.1, the increasing number of comic-centric MA theses and doctoral dissertation submitted to ProQuest demonstrates the growth of comics studies as an actual field (Steirer, 2011; Humphrey, 2014).

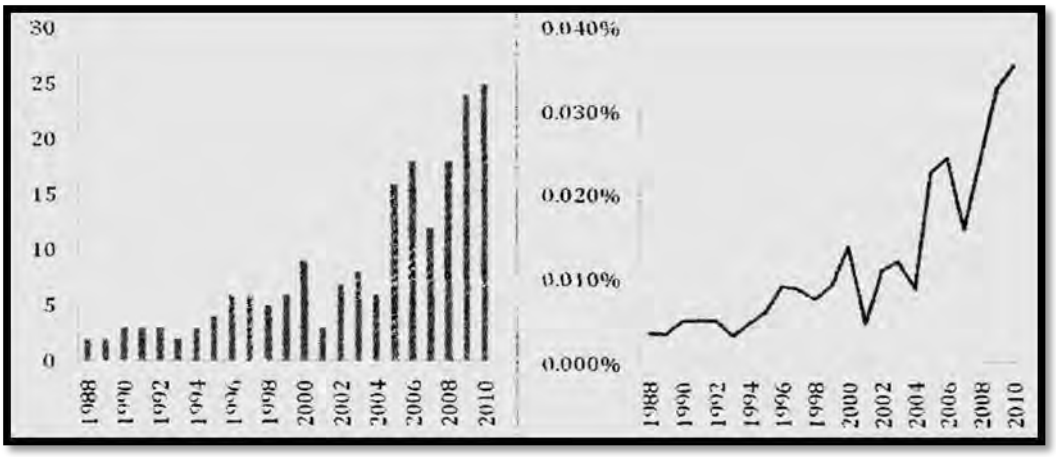


Figure 1.1. Number and percentage of comics-related dissertations published in ProQuest from 1988 to 2010 (Steirer, 2011).

The rising number of articles published in practitioner journals which accentuated comic's literary potential (Connors, 2013) had stirred university programmes in UK to officially incorporate comics as part of their curricula (Williams, Murray, Green, & Chan, 2014). Further serious recognition towards comic is exhibited when more institutions offer the avenue to study comics at postgraduate level (Mcnicol, 2013).

Moreover, on the year 2013 only, more than 20 academic conferences focusing on comics were held around the globe (Humphrey, 2014). Comics are a worthy of academic study because prestige journals are accepting graphical abstracts and articles in a form of comic (Caldwell, 2012) as depicted in Figure 1.2.

Figure 1.2. Academic articles presented in comic format by Yang (2008), Al-Jawad (2013), Carpenter, Stephen, and Tavin (2012), Humphrey (2014), and Shaltout (2016)

Ultimately, Sousanis (2014), a doctoral candidate in Columbia University defended his dissertation, written entirely in comic book form (see Figure 1.2). This ground-breaking accomplishment of comics in the academia has challenged and reimagined what future research and academic writing might transpire.

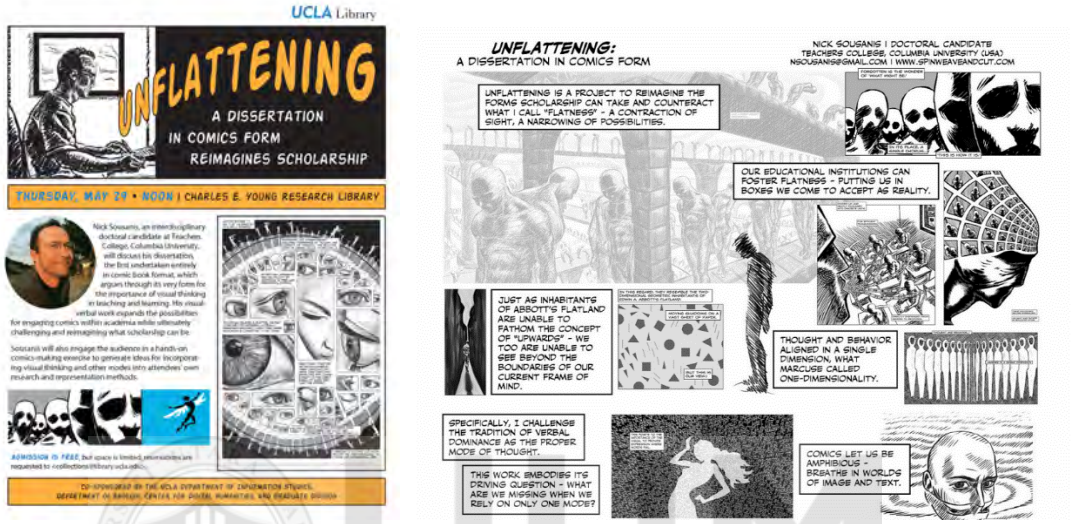


Figure 1.3. The first academic to compose his entire dissertation in comic form (Sousanis, 2014)

Witnessing scholars growing direction to a deeper understanding of comics as a literary, artistic, cultural, and cognitive phenomenon (Cohn, 2014a), the prominence of multi-disciplinary study on comics and at the form as used in various media should not be overlooked.

1.2.2 Widespread Use of Comics as an Instructional Tool

Theoretical advances in cognitive science are shaped by multimedia instruction of how words and pictures facilitate teaching (Mayer & Moreno, 2003). Comparably, comics narrates a story through a combination of image and text in sequence (Fischbach, 2014). These characteristics clearly signify the capability comics as

instructional tools. Thus, it was no surprising that empirical research of comics in complementing the traditional method of learning have begun since the 1940s (Hutchinson, 1949; Evangelia, 2013). Since then, besides being undoubtedly entertaining, comics have shown to instantaneously generate students' interest to become more intellectually and aesthetically engaged (Schendel, 2013; Guzzetti & Mardis, 2014). Comics not only proved to have an upper hand to both heavily-illustrated novel and traditional novel (Jennings, Rule, & Zanden, 2014), in fact, some conventional tools are unable to present certain themes as effective as comics (Juneau & Sucharov, 2010). Furthermore, comics are capable to address almost any subject, fiction and nonfiction, and all range of audiences' age (Gibson, 2010). As a result, comics have been embraced in massive areas from language, literary, history (Norton, 2003), science (Spiegel et al., 2013; Cooper, 2011; Cheesman, 2006) mathematics (Edel M Reilly, 2015), engineering (Metraglia & Villa, 2014), computer science (Cervesato, 2011), economy (Wyk, 2011) to ethics (Fischbach (2014). Eventually, academic libraries continue to provide comics as useful learning and teaching resources (O'English, Matthews, & Lindsay, 2006).

Meanwhile in Malaysia, an analysis towards students' reading habits (Khairul Hamimah, 2014) revealed that comics are the second most preferred reading material close to mystery and fashion themed content (see Figure 1.4). Nurtured by numerous Malaysian readership behaviour which utterly associate reading with academic tasks (Inderjit, 2014), Khairul Hamimah (2014)'s findings indicated that there is a substantial potential of utilizing comics in Malaysian tertiary institution. This is because, as a form of edutainment, factors such as information recall and learning engagement contain in comics, a more engaging, rather than passive, curriculum can

be potentially developed for students (Cirigliano, 2012). As learning is a productive process, edutainment provides learners having a good time with the way of creating and experiencing (Aksakal, 2015). Hence, LGC production grants learners to communicate information in an understandable, memorable and enjoyable way (Negrete, 2013).

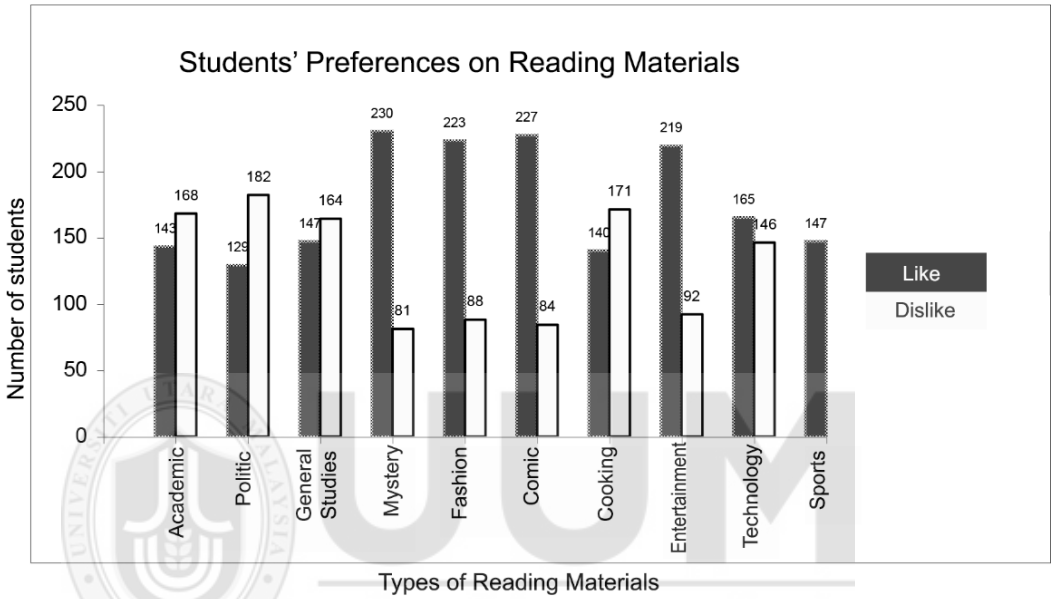


Figure 1.4. A survey of Malaysian students' preferred reading materials (Khairul Hamimah, 2014).

Accordingly, several local researchers have attempted to incorporate comics in teaching science (Nee & Amir Hamzah, 2012), history (Azalina, 2013; Ching & Fook, 2013), and Japanese language (Roslina, Roswati, Normaliza, & Hazlina, 2014). Overall, positive educational impact was demonstrated by the Malaysian students who participated in the mentioned studies. Determinedly, Nee and Amir Hamzah (2012) stated that future comic integrated classroom activities should focus on applying constructivism methods. Hence, it is implied that LGC embodies the transformation of local education landscape by aligning with Malaysian National

Institute of Translation's program that endorse comics as a flexible approach to learn critical subjects and nurture creative thinking skills (Rashiqah Ilmi, 2010). Thus, in assisting Malaysian students to experience constructive learning through production of digital content, more investigation should be performed to galvanize the application, assess, and adoption of LGC.

In summary, the emerging of comics as a solid research field, instructional tool, and local support have motivated to the initiation of this study. Affiliating these potentials, a preliminary study was carried out, as explained in the next section.

1.3 Preliminary Study

Driven by the research motivations compiled in the previous section, a preliminary study was conducted as a fragment of the process in developing the research focus and supporting the justification of the research area. Initially, producing LGC for educational benefit is considered a new innovation especially in Malaysia. Therefore, it is important to know the perception of people, particularly students towards comics and LGC.

1.3.1 Method

The objectives of the preliminary study is to investigate (i) respondents' background related to reading comics and their supporting technology (ii) respondents' perceptions towards comics as an instructional tool (iii) respondents' expectations and drawbacks of LGC (iv) indication of digital tools that respondents feel are promising for LGC production. The study used closed-question questionnaire as the instrument for data collection (refer to Appendix A) starting from 19th to 21st May

2014. There were 74 respondents from UUM (aged between 20 and 26 years old students) participated in the survey. In order to assist their understanding on the topic of the questionnaire, an A2 sized poster of a comic was presented (see Figure 1.5).

Figure 1.5. A comic presented to respondents during data collection as an introduction to educational comics.

1.3.2 Findings

This subsection presents the findings of the survey and analysis of results. It highlights the key issues arisen from the obtained responses.

1.3.2.1 Demography of Respondents

First, demographic profile of the respondents is exhibited in Table 1.1. About 40% of the respondents are female and the remainder male. As for race composition, the majority of the respondents are Malay (73%), while the rest are Chinese (19%), Indian (3%), and other races (5%) such as Siamese and Indonesian.

Table 1.1 *Respondents Demographic Profile*

Race	Male	Female	Total
Malay	14	40	54
Chinese	1	13	14
Indian	0	2	2
Others	1	3	4
Total	16	58	74

1.3.2.2 Comic Reading Behaviour

In the first question, the respondents were asked how frequent do they read comics in weekly basis. As depicted in Figure 1.6, nearly 60% of the students read printed comics once or more, while the rest rarely or almost never read comics. The frequency rate also showed that 70% of the respondents used social media to read online comics. Contrariwise, half of the respondents download comics from mobile apps stores. These statistics revealed that there was a balance between respondents' preferences towards printed and digital comics. Plus, it was also indicated that comics are a common and non-isolated media among more than half of the students.

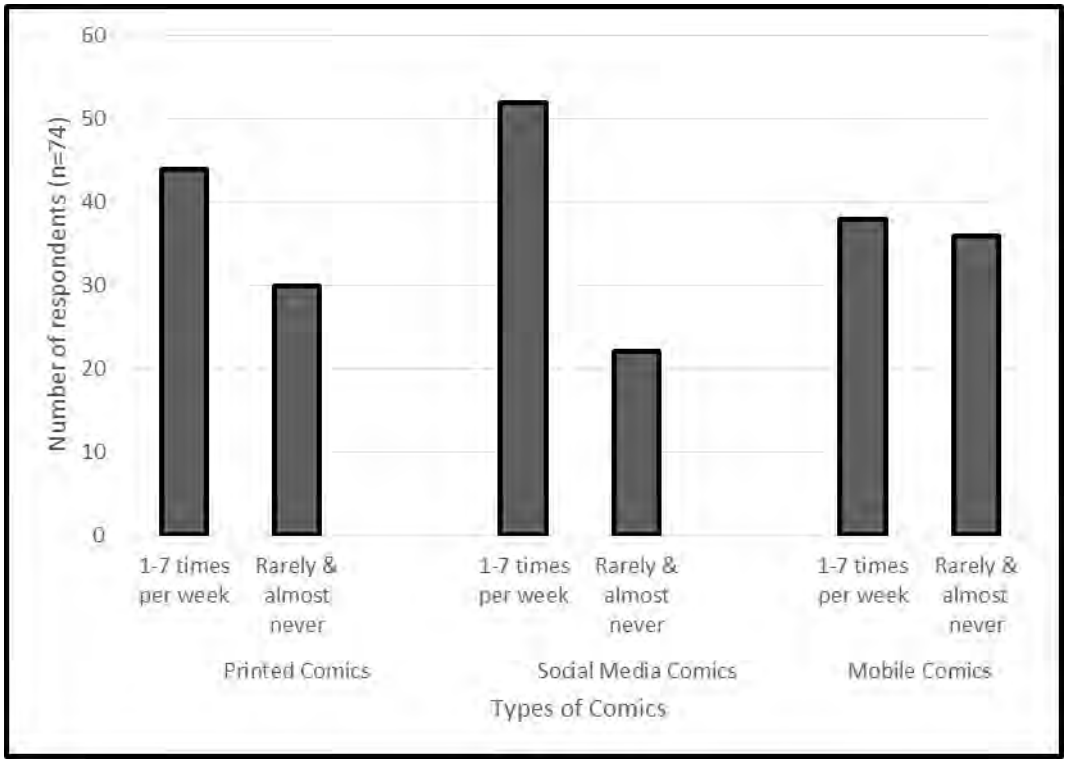


Figure 1.6. Comics Reading Frequency

Second question asked why students read comics (see Figure 1.7) where the questionnaire comprises of a 5-point Likert scales, 5-strongly agree, 4-agree, 3-slightly agree, 2- disagree, 1-strongly disagree. More than half of them agreed that comics are a fun leisure (55%) and able to reduce stress (51%). 28% of the respondents strongly agreed, and only one student disagreed with the both mentioned statements. Aside from that, the overall percentage reported that majority of students (73%) preferred comics because their message is effectively presented with less text and sequenced visuals.

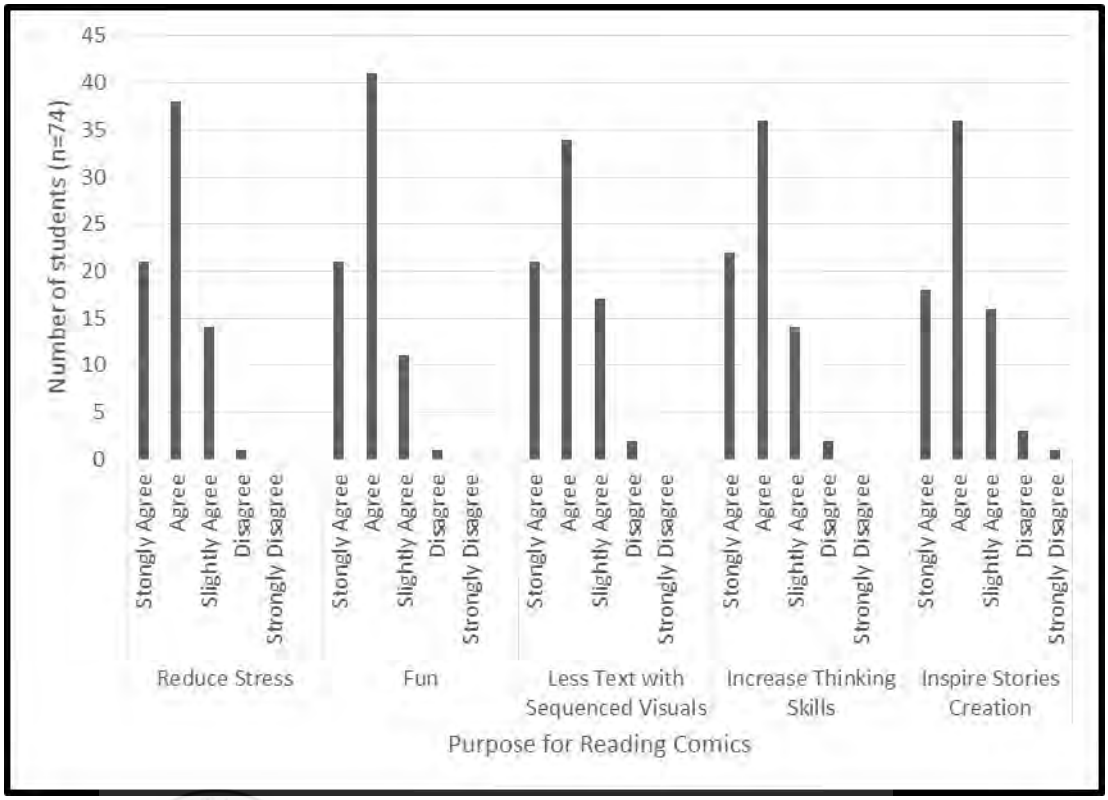


Figure 1.7. Reason and motivation for reading comics

Furthermore, students also agreed that comics helped them boost their mind and thinking skills (49%). About 30% and 19% of the respondents strongly and slightly agreed, plus only 2 students disagreed with the previous statement. Literally, students also stated their opinion whether comics inspire them to create their own stories in other forms such as novels or movie scripts. Overall, 95% of respondents found comics are useful for the mentioned purpose while only 5% did not in contrast. Based on the statistics, it could be concluded that comics are an easy and visually entertaining reading material which also amplify students' thinking and storytelling skills.

1.3.2.3 Views towards Educational Comics

When the students were questioned about the potential of educational comics, they were firstly asked if they have read educational comics previously. Amusingly, nearly 80% of the respondents admitted that they have past experience reading them. However, 88% of the respondents agreed that there is a shortage of educational comics that comply with Malaysian school syllabus as shown in Figure 1.8.

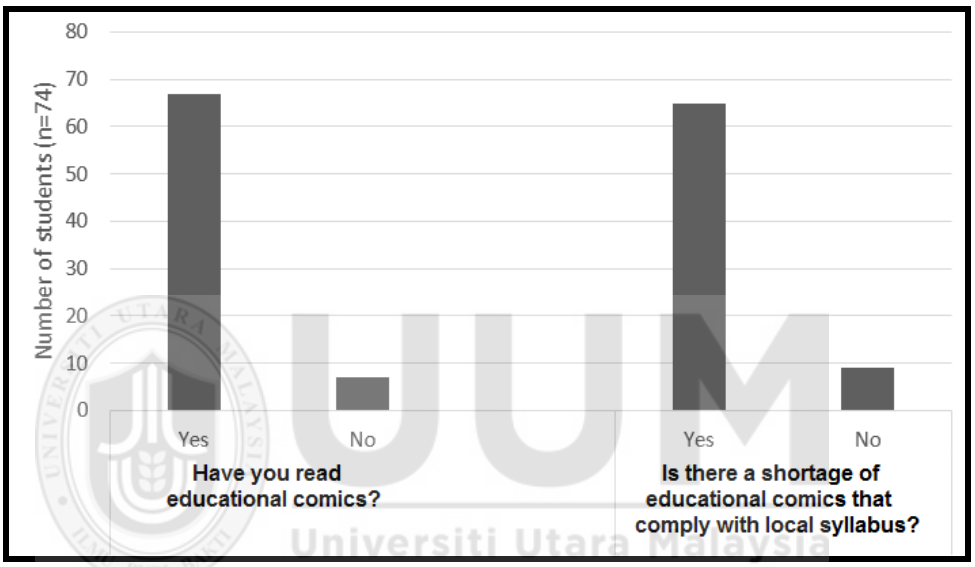


Figure 1.8. Educational Comics General Survey

Afterwards, respondents were given several questions in order to acquire their outlook on benefits of educational comics (see Figure 1.9). The overall results exposed that majority of the students (97%) had come into a whole agreement that that educational comics are able to teach moral and spiritual values. The respondents also entirely agreed that educational comics could help them remember and memorize facts better. Additionally, respondents also majorly concurred that educational comics could assist them to understand difficult technical and scientific content. These findings aligned with prior claims that comics are able to aid students' comprehension (G. Mallia, 2007; Recine, 2013; Yıldırım, 2013).

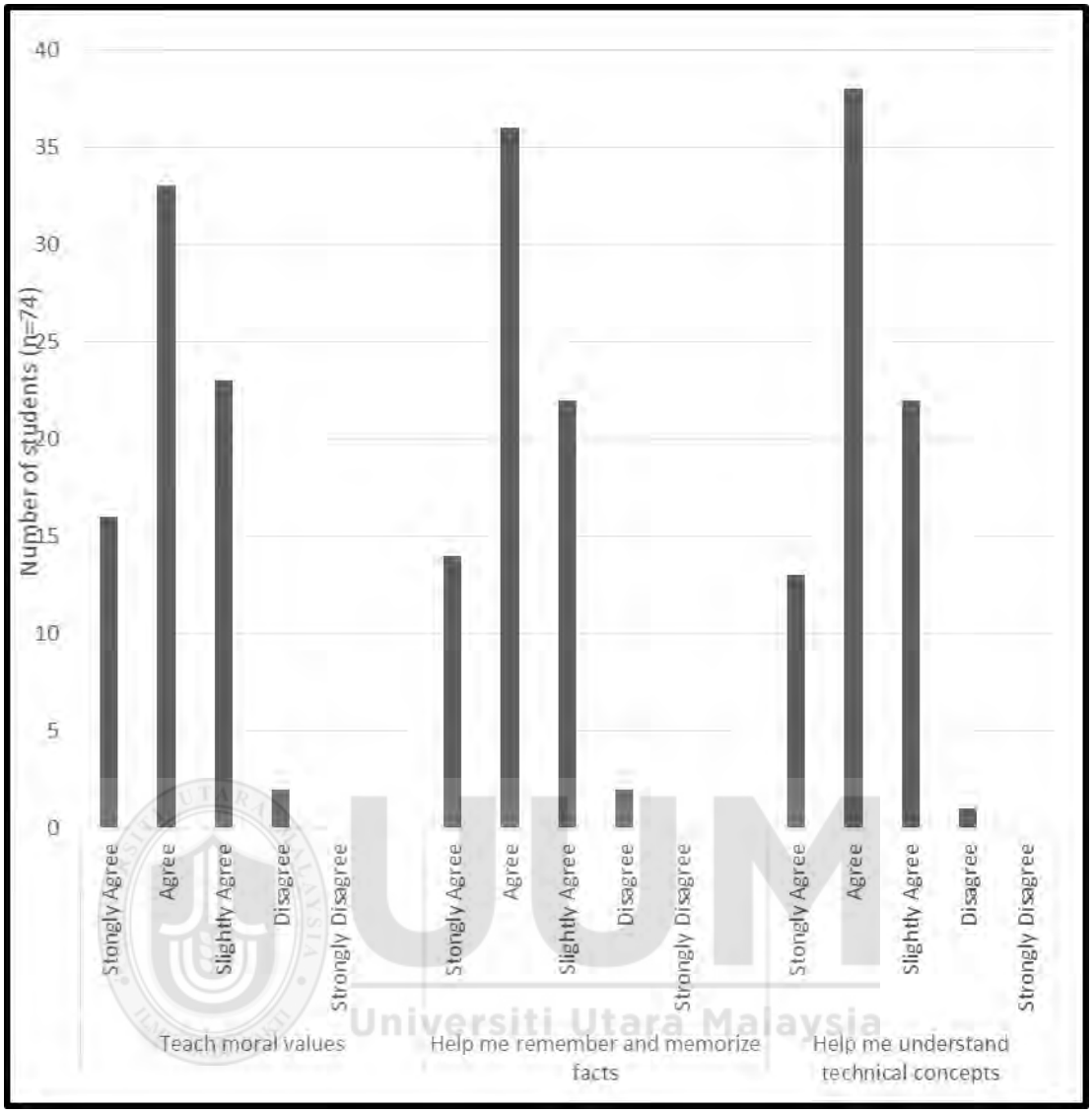


Figure 1.9. The Didactic Benefits of Educational Comics

These findings suggested that, although comics are recurring materials for entertainment purpose, students are fully aware of the values of educational comics. Therefore, the potential of educational comics as a tool in improving students' learning experience should be put into consideration.

1.3.2.4 Views towards LGC

Next, respondents were given several questions in order to acquire their perception towards LGC. All 74 students responded to the questions depicted in.

Table 1.2 *LGC Questionnaire*

No	Survey Questions
Q1	I am interested to design an educational comic that could improve my understanding and recall a topic in my study.
Q2	I would like to create an educational comic that fits with my personal taste.
Q3	My personalized educational comic should contain more academic content rather than the story.
Q4	There should be a balance between academic content and story in my personalized educational comic.
Q5	My personalized educational comic must exhibit Malaysian image and identity.
Q6	I hope my personalized educational comic could be used as an educational resource for other students.

As seen in Figure 5, most of the students (85%) stated that they are interested in developing LGC to assist their learning (Q1) while the rest did not. 88% of the respondents agreed with Q2, Q3, and Q5, concluding that the LGC they developed should fit learners' own personal taste, represents local image and identity, and contain more academic content than the story. However, a slightly higher percentage was achieved in Q4 where 90% of the students favour a balance between academic content and story in their personalized LGC.

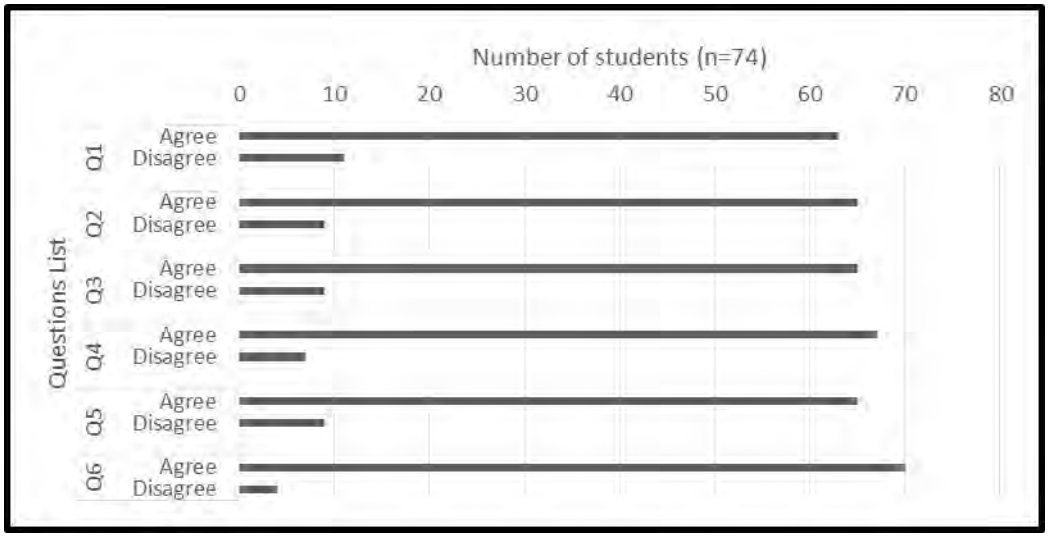


Figure 1.10. Respondents' preferences towards LGC

Inclusively, a vast majority of the respondents (95%) agreed with Q6 which projected their hope that the LGC created by them could be utilized as an instructional resource for other students to a certain extent. These statistics described that, students not only expressed high interest in LGC, but they also have certain criteria towards their creations, so that the educational comics could be a useful means for other learners besides themselves.

In addition, the survey also enquired students' problems in LGC production as shown in Figure 1.11. Respondents were asked the difficulties they expect to confront while designing their own LGC products. The highest percentage exposed that the drawing and illustrating (96%) are the hardest tasks in LGC development. Second, 93% of the students claimed their limited command in English to tell their story. Close to the second difficulty, 92% of the respondents disclosed they lack of expertise in demonstrating educational content.

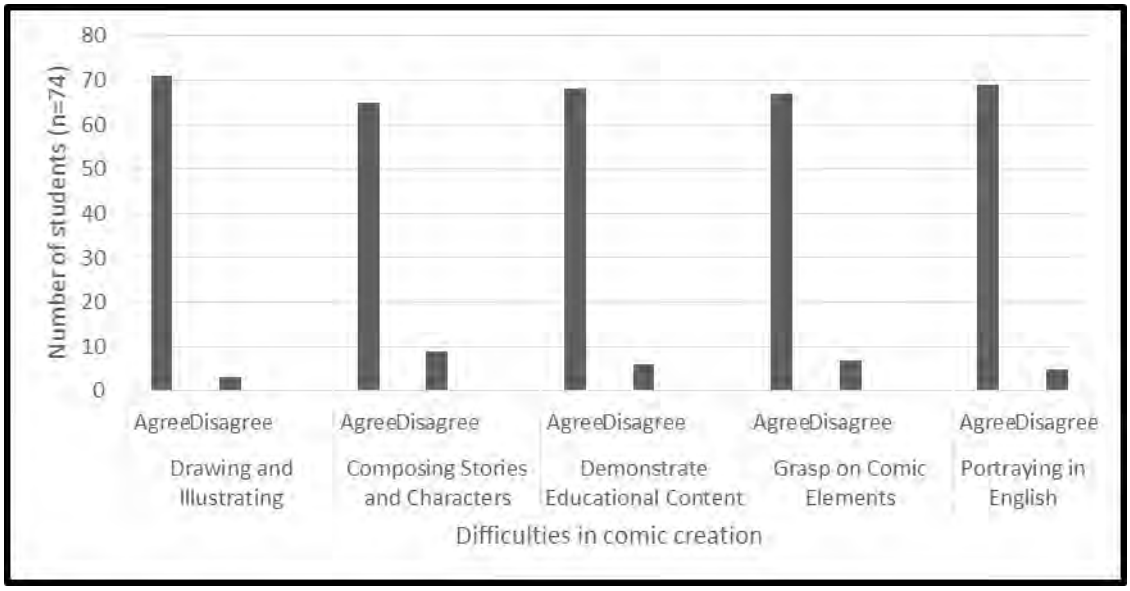


Figure 1.11. Respondents' perceived concerns towards LGC production.

Next, about 90% of them have restricted knowledge in elements of a well-crafted comics. Lastly, 87% of the respondents agreed that composing stories and characters are also a challenge in LGC production. Based on the results, it demonstrated the importance of a comprehensive guideline that correspond to different aspects of LGC production to be used in a student-centred learning environment.

1.3.3 Implication of Findings on the Study

The overall findings appears to support that educational comics are a helpful medium in enhancing learning. However, while there is a high potential in implementing LGC production in formal classroom, majority of the respondents required more insight to multiple aspects LGC. Thus, corresponding to the advantages of comics and the complexity of LGC production as perceived by the students, it was acclaimed that a further study should be carried out in understanding the methodical approach for learners to strategically produce LGC. Consequently, the problem statement of the research is presented in the next section.

1.4 Background of Problem

To articulate the systematic method of LGC production, several important issues arise. This section explores the current state of research in area of LGC and DST that led to statement of problem in this study.

1.4.1 Challenges of LGC Production

In general, pedagogical discussions about comic usage in university have focused primarily on reading, with less attention paid to the correlating prospective of LGC production (Comer, 2015). Accordingly, results from the previously conducted preliminary study have exhibited that learners faced challenges in different aspects of LGC production. In line with these findings, Vassilikopoulou, Retalis, Nezi, and Boloudakis (2011) affirmed that the practice of DST through production of LGC in authentic conditions of communication; has demonstrated several difficulties encountered by the learners. In concise, the obstacles majorly associate with structure of narrative, collaborative production of multimodal text, and effective connection between picture and text in comics. In another LGC classroom practices, Weber et al (2013) reported that; defining the subject to treat in the stories and the production of the comics itself were the difficult processes in LGC production. As a result, LGC production during face-to-face class session is viewed to be impractical and onerous (Melor, Hadi, & Mohamed Amin, 2012).

Despite being easily recognizable with panel sequences, speech balloons, and speed lines (Kukkonen, 2011), composing comic means more than writing text and making dialogue boxes (Smetana, Odelson, Burns, & Grisham, 2009). Additionally, there are reluctances of using comic as a design activity due to lack of knowledge about its

genre, process, and terms (Connors, 2011). Plus, educators cannot assume that all learners have knowledge of comics and how speech balloons work (Wallner, 2016). Therefore, to undermine these challenges confronted in classroom, it is crucial for learners to understand the key features of LGC. As learners must be guided in aligning LGC task as an effective problem solving and communication (Francis Pelton & Pelton, 2009), a solid, holistic method of LGC production should be established based on the core elements of LGC.

1.4.2 Key Elements of LGC

As previously initiated, LGC production operates as a DST method that allows learners to produce digital stories in a form of educational comics. Consequently, Kane (2013) acknowledged that; educational comic development must be well-grounded according to the roots of sequential art and graphic narrative history (comic), script (story), and pedagogy (learning). Equivalently, Keller and Oechslin (2013) also strongly established educational comics into visual (comic), narrative (story), and knowledge (learning) dimension. Thus, it is indicated that a purposeful LGC production strategy should incorporate comic, story, and learning elements as the underlying key features that represent the foundation of LGC.

However, investigation of literature disclosed that current LGC classroom practices were varying in adopting comic, story, and learning elements; and showed no cohesions among each other. For example, in the mentioned LGC empirical experiments, learning theories are ambiguously described (Williams, 2008; Maldonado & Yuan, 2011), comic principles are isolated (Graham, 2011; Upson, Mudd, & Moffat, 2014), and storytelling elements in the LGC practices (Engler,

2008; Meyers, 2014) are unparalleled against each other (refer to Chapter 2 for further details). Furthermore, few studies harness the affordances of technology for knowledge creation through learner-generated content (Lee, McLoughlin, & Chan, 2008). Consequently, there is a need for further study on the implementation of LGC production in supporting educators to meaningfully integrate technology into their practice (Melliou, Moutafidou, & Bratitsis, 2014) . In contrast, research literature on the use of comic authoring tools in education is limited (Kılıçkaya & Krajka, 2012). Hence, this implication led to the suggestion that; unifying the core components from the basis of comic, story, learning with DST and learner-generated content concepts for LGC production method should be further explored.

1.4.3 LGC Production Methods

Prominence on both process and end product emphasises the efficacy of learner-generated content pedagogical strategy (Pérez-Mateo, Maina, Guitert, & Romero, 2011). Although Kane (2013)'s model provides a dynamic paradigm of educational comics, it does not explicate LGC production process comprehensively. Plus, his framework is intended for educational comic development with the collaboration between educators and comic practitioners instead of learners. Conversely, learners need instructions about layout features, organizational formats, and conventions of comics such as panels, speech balloons, typography, and line (Pantaleo, 2012) since production of comics is a complicated task that involves a wide range of personnel, skills, and theories (Crutcher, 2011). Carefully designed composition of subjects and speech balloons to provide a continuous and fluid comic experience is hard to produce for people without the required experience and knowledge (Cao, Lau, & Chan, 2014). Equally, despite sharing similar attributes with comics, existing DST

models and frameworks exclude elements of comics (see Chapter 2 for further details).

Meanwhile, though several LGC studies have thoroughly discussed the methods of LGC production (e.g: Morrison, Bryan, & Chilcoat, 2002; Fay, 2007; Pantaleo, 2013; Dousay, 2015), they do not tailor a benchmark for assessing the produced LGC. Contradictory, a digital media production should permit students to self-assess their academic achievement by relating concepts to activities (Semary, 2011). Apart from that, the produced learner-generated content should be measured based on its value to others besides the creators themselves (Sener, 2007). Some learners saw value in the technical aspects of educational comics, while others enjoyed being both educated and entertained (Cirigliano, 2012). This is not surprising as entertaining educational comics can improve the mood and attitude of learners and ability to learn (Recine, 2013). Challengingly, it can be difficult to strike a balance between the learning and entertaining aspects of educational comics (Jüngst, 2010; Jee & Anggoro, 2012).

These issues denote that a method for LGC production should not only guide learners to grasp the gist of LGC; but also transfer their knowledge into an assessable digital educational comic which is both educational and entertaining to a certain extent. Nevertheless, despite its importance, research on theoretical guidance on a quality, systematic, developmental approach for designing, developing, and assessing LGC have been largely ignored.

1.5 Statement of Problem

Summarising the background of problem, regardless of the challenges occurred in LGC classroom practices, most scholars do not emphasise on a quality, theoretically supported, and strategic LGC production methodology that accommodate to interrelated key elements and production methods of LGC. Essentially, there is a lack of conceptual models and methods that comprehensively tailor the crucial theories, elements, techniques, technological, and systematic processes of LGC production.

1.6 Research Gaps

Drawing upon the discussion in the previous section, following research gaps are identified:

i. Existing LGC classroom practices, DST models and frameworks do not clearly specify which core components and elements of comics, story, and learning that hold the concepts of learner-generated content and educational comic.

ii. A systematic and authenticated LGC production guideline for the design and development of LGC products is highly scarce.

iii. Most of the LGC production strategies exclude educational comic assessment techniques.

1.7 Proposed Solution

With respect to the problems and research gaps, it is proposed that; to produce LGC systematically, it is vital for learners to refer to a LGC production model that incorporates techniques, technologies and applied theories and concepts of learning, storytelling and comics. Consequently, in order for learners to construct their own knowledge representations in a form of LGC product, they must initially learn its symbol systems (Reeves, 1998) which comprised of the means used in a particular media to select, highlight, structure, and present information (Salomon, 1979). Therefore, graphical models are among the tools in visualizing conceptual models (Sargent, 1986) where the components' function, structure, and behaviour are illustrated in diagrammatic representation (Coyne, Rosenman, Radford, & Gero, 1987). Plus, design requires a representation framework that confines the essence of the concepts which support design processes (Gero, 1990). Furthermore, since structured development process contributes positively to the validity and quality of a model (Winter & Schelp, 2006), the LGC production method must also be empirically evaluated. Therefore, it signified that; an extensive study on a conceptual production model of LGC that functions as a systematic method which includes the fundamental components for learners to design and develop digital educational comics should be carried out.

1.8 Research Objectives

In conjunction the proposed solution, the main objective of the research is to propose a LGC production model that serves as a guideline for learners to design and develop digital educational comics. It incorporates techniques, technological, systematic, and

applied theories and concepts of learning, storytelling and comics. Thus, to accomplish the main aim, the following specific objectives are formed:

Obj (1) to determine the core components for LGC production model.

Obj (2) to construct a systematic LGC production model based on the identified components.

Obj (3) to evaluate the quality of the proposed LGC production model.

Obj (4) to assess the learning and entertaining aspects of LGC products developed through applying the proposed model.

1.9 Research Questions

Based on the objectives, this study seeks to answer the following questions:

i. What are the core components of LGC production model?

ii. How to construct a systematic LGC production model based on the identified components?

iii. How to evaluate the quality of the proposed LGC production model?

iv. How to assess the learning and entertainment aspects of the LGC products?

1.10 Research Scope

The focus of this study is to develop a LGC production model specifically in these limitations:

i. This research carried out comparative studies on LGC practices in scholarly literatures within formal education context only. In defining the problem

statement of this study, digital comic production methodologies by professional artists and design studios were excluded. However, during expert consultation phase, development of LGC production model principally involved participation of creative industry personnel.

ii. Due to limited study-period, user data collection was obtained from a single Malaysian university, limited to respondents in one faculty. The target users of the proposed LGC production model were undergraduate students in the respective faculty.

iii. This study concerned on evaluating the quality of the proposed model as a LGC production guideline rather than the educational outcome of the process and LGC product developed by learners. In addition, LGC product was assessed based on learning and entertainment aspects.

1.11 Contributions of the Study

This research intended to reassess the concept of LGC from a new perspective. The specific contributions of this study can be categorized into theoretical, functional, and practical contributions as below:

- LGC Production Model

This study attempted to propose a production model of LGC which integrates various elements of digital educational comics; including the concept of DST and learner-generated content. To date, an all-inclusive guideline for LGC production was yet to be studied and verified. Hence, the proposed model provided systematic and comprehensive guidelines for the planning, design, development,

and assessment of LGC product. The LGC production model should be reflective of the novelty and practicability of the relevant theories pertaining to comic and multimedia studies.

- Instrument to Validate LGC Production Model

An instrument for validating the LGC production model was developed by collecting and combining conceptual model evaluation dimensions from previous literatures which considered the criteria of an efficient process model. The instrument was found to be highly reliable based on the conducted pilot study. The dimensions considered the overall quality of a conceptual production model.

- Adaptive Instrument for LGC Product Assessment

In assessing LGC products, multilevel instrument was adapted from past literature. This adaptive version of instrument was purposely developed to demonstrate the standard features towards guiding the production of LGC which could be educational and entertaining.

1.12 Research and Theoretical Framework

To systematically conduct the study, the following research and theoretical framework were followed through. The research framework covered in this study consisted of five phases which were problem awareness, suggestion, development, evaluation, and conclusion. In the first phase, topic issues and research scope were identified by conducting a preliminary study of comic and LGC perceptions. Digital educational comic core foundation, LGC classroom practices, models, and frameworks of DST, pointers connected to learner-generated content features, and

design of digital media were scrutinized in clarifying the problem statement and research gaps. As the study seeks to provide for a holistic production method for LGC; theories, concepts, and techniques were analysed mainly in the areas of comic, DST, and learning in the suggestion phase. First, the concepts of conceptual model and learner-generated content are discussed. Next, the definition and principles of comic, how comics are consumed in education, and educational comics concepts are dissected. Then, usage of authoring tools in the implementation of LGC and DST are also discussed. Consequently, learning theories, learning approaches, and DST elements compliant to LGC production are reviewed. The goal of the analysis is to identify recurring components in LGC production that are yet scattered in the different streams of literature. In the development phase, the reviewed theories and concepts are used as the basis in specifying components and evaluation dimension of LGC production model, plus determining assessable aspects of LGC product. Expert consultation is carried out to recommend and ascertained explicit process and strategies of LGC production. Overall, the proposed LGC production model is developed by merging all the related components as previously suggested in literature and experts. The model is evaluated in a combination of two stages (i.e., user experience testing and expert review) in the evaluation phase. Finally in the conclusion phase, results from the evaluation phase are analysed, concluded, and reported in publications. Figure 1.12 illustrates the research and theoretical framework.

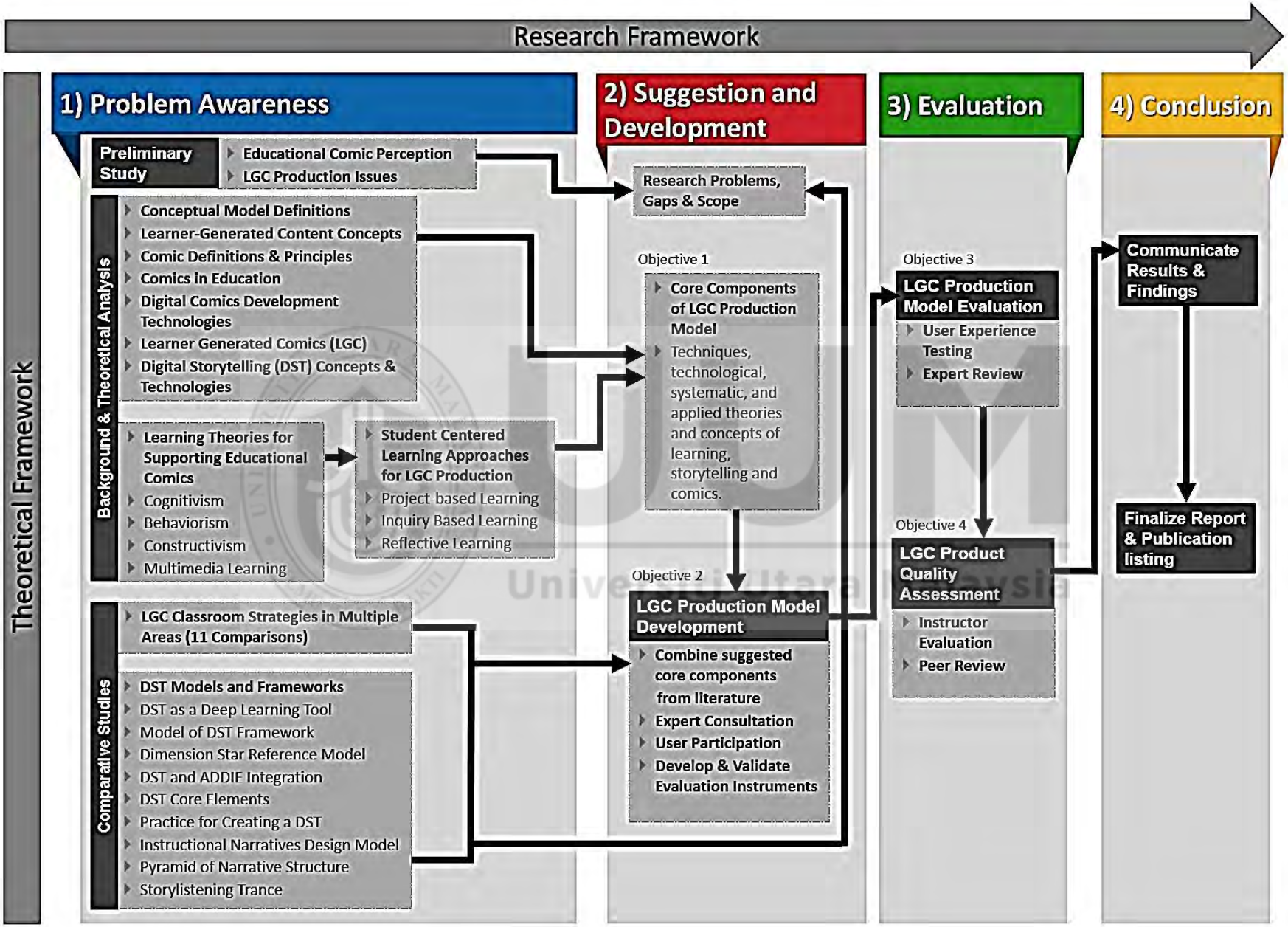


Figure 1.12. Research and Theoretical Framework

1.13 Operational Definition of Terms

Pertaining to this study, the following definitions, terms, and keywords were clarified.

a) Comics

The term “comics” is used in a very broad sense. The typical comic consisted of a sequence of at least two frames of imagery. A comic strip in a newspaper may comprise two to six panels, while an instalment in a magazine perhaps has a few dozen, and multi-volume series may run into the thousands. All of these are, in this context, regarded as “comics.” This term is also considered to cover serious book-length comics targeted for adults, which are nowadays often discussed and marketed under the label of “graphic novels.”

b) Digital Comics

Printed or hand-drawn comics are the precursor of “Digital comics” which stand for the electronic or digital version of comics. Digital comics are either scanned, illustrated, developed, edited or enhanced digitally with hardware and software packages such as drawing tablet, Adobe Photoshop, online comic generators and more.

c) Educational comic

Some researchers use the term “Educational comic” interchangeably with “Instructional Comic”. In this research, the term LGC (learner-generated

comic) product denoted to digital educational comic produced by learners in enabling them to achieve particular instructive goals.

d) Learner

A learner refers to a person who is learning; student, pupil, apprentice or trainee. According to Knowles, Holton, and Swanson (2014), basically, a learner is instructed on the objectives to work toward, how and when to use the specified resources, and realise how accomplishment of the learning goal is evaluated.

e) Story

Based on Oxford English Dictionary, a story or "narrative" is an account of imaginary or real people and events told for entertainment. In a nutshell, the DST (Digital Storytelling) term generally describes the process of story creation and presentation with digital means (Leonie Schäfer, Augustin, & Prinz, 2004).

f) Quality

In this study, the term "quality" of LGC production model represented how general, flexible, complete, usable, and understandable is the proposed model to be applied and utilized by LGC users in actual environment (refer to Chapter 3 for detailed characteristics).

g) Model

As described in Merriam Webster dictionary, a model is a descriptive concept used to envision something that cannot be observed straightforwardly. According to Vaishnavi and Kuechler (2007), a model is a set of propositions or statement express relationships among conceptual vocabulary of a problem or solution domain. Therefore, this study referred model as abstractions and representations of how things are and is used to describe tasks, situations, or artefacts (March and Smith, 1995; Hevner, March, Park, & Ram, 2004).

h) Production Model

Creative production refers to youths' designs and implementations of digital media (Peppler & Kafai, 2007). Relatedly, design is a specification of an object using a set of components (Paper & Wand, 2009). While, a tentative definition of a "methodology" might be a generalized set of methods and procedures used on projects (Veryard, 1985). The term "method" is defined as a set of steps (or guideline) used to perform a task (Vaishnavi & Kuechler, 2007); while a "guideline" provides a general proposition about system development (Offermann, Blom, Schönherr, & Bub, 2010). In addition, a production process is the system of process tasks, specifications, inputs, and flows that are employed to produce a product (Utterback & Abernathy, 1975). Thus, the term "production method" stands for to the systematic process and techniques of designing and developing any digital application. Therefore, based on the discussed terms, this study defined conceptual "Production Model" as the application of a systematic method that includes the process and techniques for producing digital media. Essentially, LGC

production model served as a guideline for learners to design and develop digital educational comics.

1.14 Thesis Structure

This thesis consists of seven chapters in total. The contents of each chapter are outlined as follows:

Chapter 1: As an introductory, this chapter addresses the background of study that triggered the research motivation. Results of preliminary investigation are then discussed as a justification of the chosen research topic. Issues, scenarios and problems in the research area were scrutinized that led to the formulation of research gaps, research objectives, and research questions. Finally, the research scope, significance, and operational definition and terminologies are also provided in this chapter.

Chapter 2: In this chapter, theories, concepts, and techniques are elaborated primarily in the areas of comic, DST, and learning. Initially, the concepts of conceptual model and learner-generated content are discussed. Then, the definition and principles of comic, how comics are consumed in education, and educational comics concepts are dissected. Next, usage of authoring tools in the implementation of LGC and DST are also discussed. Subsequently, learning theories, learning approaches, and DST elements compliant to LGC production were reviewed. The main goal of this chapter is to justify the components to be incorporated in the proposed model.

Chapter 3: This chapter explicitly explains the research methodology adopted in this study. It describes the research design and data collection approach applied in this study. Put simply, the overall research processes and the instruments used to accomplish the objectives of this study are elaborated.

Chapter 4: This chapter details up all activities conducted in constructing the proposed research artefact. In general, it demonstrates how the proposed model was systematically designed and developed. The step by step process of research artefact development is presented which included comparative study, expert consultation, and user participation. At the end of the chapter, a principal conceptual model is comprehensively designed and ready to be evaluated.

Chapter 5: The chapter reported the implementation and evaluation results from user experience testing. The purpose of this stage is to evaluate the proposed model and assess the prototypes produced by participants. This is because; the efficacy of the model is exhibited by observing and measuring how well it supports a solution to the problem. In addition, assessment of prototypes quality is used to support the proposed model's efficacy.

Chapter 6: This chapter explicated the expert review stage. Experts selection process, instruments for expert review, and results obtained from the experts' feedback were elaborated. The goal was to validate and finalised the proposed research artefact.

Chapter 7: This chapter provides conclusion of the study. It answers research questions and reviews the research objectives. Contribution, limitations as well as recommendations for future directions of the study are also presented.

1.15 Summary

This chapter focuses on the main idea of the research, which comprised research motivations, preliminary study, problem statement, research question, research objective, research scope, and contribution of study. Pertaining to the issues and problems in the research area, this study has suggested the application of LGC production model as a proposed solution. Therefore, the next chapter provides literature review of study.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This research addressed the issue of how LGC production model can support the implementation of DST with educational comic as a technology integrated classroom practice. In this study, theories and evidence from literature were synthesised in order to propose a practical model of DST that can be applied to LGC projects. The aim is not to replace existing theories or frameworks but to draw on them in order to present a systematic guideline that would be of value for learners to construct digital educational comics. Thus, this chapter focuses on reviewing the existing literature on the concepts of conceptual model, learner-generated content, definition and principles of comic, how comics are consumed in education, educational comics concepts, usage of authoring tools in the implementation of LGC and DST, learning theories, learning approaches, and DST elements compliant to LGC production. The review discloses the needs for a comprehensive production model on LGC.

2.2 Conceptual Model

A model can be any real or virtual artefact that represents other artefacts (Thalheim, 2014). Conceptual models represent key concepts that provide accurate, consistent, and complete representation of concepts (Churchill, 2007; Norman, 2014). As terminology may differ among the varied backgrounds of academics and professionals, conceptual model can be also referred as reference model which is an "abstraction that stresses the core terms or concepts which characterize an application domain" (Frank, 2006). Importantly, conceptual models are archetypally

diagrams or graphic depictions of systems that quickly and easily convey the overall functionality of a system (Heemskerk, Wilson, & Pavao-Zuckerman, 2003; Sokolowski & Banks, 2010). It requires a certain inner structure to provide all information about the artefact necessary for its evaluation (Pfeiffer & Niehave, 2005).

2.2.1 Types of Conceptual Model

Historically, Meredith (1993) classified conceptual models into conceptual description, taxonomies and typologies, and philosophical conceptualization. Within the practice of design science in information systems research, Hevner, March, Park, and Ram (2004) categorized models into abstractions and representations. These representations can be in a form object model, data model, business model, process model, and more (Frank, 2006).

2.2.2 Evaluating Conceptual Models

Conceptual model quality can be quantified by evaluating the model's syntactic, semantic, and pragmatic completeness, correctness, adaptability, and applicability (Rosemann & Schütte, 1999; Mišic & Zhao, 2000). In the related area of conceptual modelling, many quality indicators are proposed by prior researchers such as completeness, clarity, flexibility, and implementability (Lindland et al., 1994; Shanks & Darke, 1997; Moody, 2005). Moreover in information systems, Pfeiffer and Niehave (2005) suggested a structuralist approach for evaluating conceptual models. Building upon these ideas, Frank (2006) has clustered conceptual model evaluation methods in the perspective of economic, deployment, engineering, and epistemological. Therefore, these characteristics that represent a comprehensive set

of conceptual model evaluation criteria must be considered in measuring the quality of the proposed LGC production.

2.3 Learner-Generated Content

The paradigm transformation from instructor-centered to learner-centered approach is one of the most noteworthy shifts in the education field during the age of information (Bordbar, Allahyari, & Solouki, 2012). Essentially, Torres and Guerrero (2013) defined learner-generated content as an educational approach based on empowering students to produce their own contents. Student learning were developed and assessed through the generated learning objects; enabling implementation of diverse theoretical and practical skills, and deeper understanding of the subject matter (Dale & Povey, 2009). Basically, learning object is defined as digital resource that can be reused to support learning (Polsani, 2003; Nokelainen, 2006; Cechinel, Sánchez-Alonso, Sicilia, & Amador, 2011). It may contain one or many components, including text, video, images, or the like (Baruque & Melo, 2004).

Unlike instructor-generated content where the produced resources typically provide instructional or procedural information, learner-generated content increase emphasis on the learner and de-emphasizes teacher- to-learner knowledge transfer (Doubleday & Wille, 2014), thus allowing educators to move beyond transmissive approaches (Forbes, Khoo, & Johnson, 2012). Due to this advantage, the production of learner-generated content such as e-portfolios (Jong et al., 2010), e-books (Tsai, Shen, & Lu, 2015), blogs (Chang, Liang, Tseng, & Tseng, 2014), computer games (Baytak, Land, & Smith, 2011; Robertson, 2012; Denner, Werner, & Ortiz, 2012), videos (Omar,

Khan, & Toh, 2012), podcasts (C. G. Johnson, 2008), animation (Chang & Quintana, 2006), multimedia poster (Howell, Reinking, & Kaminski, 2015), models (Schwarz et al., 2009) as well as comics (eg: Engler, Hoskins, & Payne, 2008; Vassilikopoulou, Retalis, Nezi, & Boloudakis, 2011; Danzak, 2011) have been widely adopted in past studies.

2.3.1 Characteristics of Learner-Generated Content

According to Lee and McLoughlin, (2007), a learner generated content is classified into pre-packaged authoritative content, guided learning materials, and student performance content. The creation work can include authoring, editing, enriching, or updating the digital content (Helmstedt, 2011). Although technology played an important role in establishing learner-generated content (Narayan, 2011), the creation of learner-generated content should not rely on restricted media, tools or applications (Pachler, Bachmair, & Cook, 2010).

To detect meaningful learning within a learner-generated content approach, Torres and Guerrero (2013), identified several key features consisting of active participation, responsibility of learning process, reflection about learning, and personalization. Since learners are creators, where the role is reversed, the instructor‘s role was observed to be that of a facilitator or a guide, who provided just-in-time advice, motivation, and encouragement (Narayan, 2011). This support is important as effectiveness of this approach depends on learners’ ability to coordinate the effort spent on scaffolding learning and structural quality of the learning object (Van Dijk & Lazonder, 2016).

2.3.2 Evaluating Learner-Generated Content

In fostering learner-generated content, there is a requirement for reviewing, editing, and quality assurance of content (Mcloughlin & Lee, 2008). Consequently, Pérez-Mateo et al. (2011) proposed a quality criteria framework for learner-generated content, structured into content, format, and process clusters (see Figure 2.1).

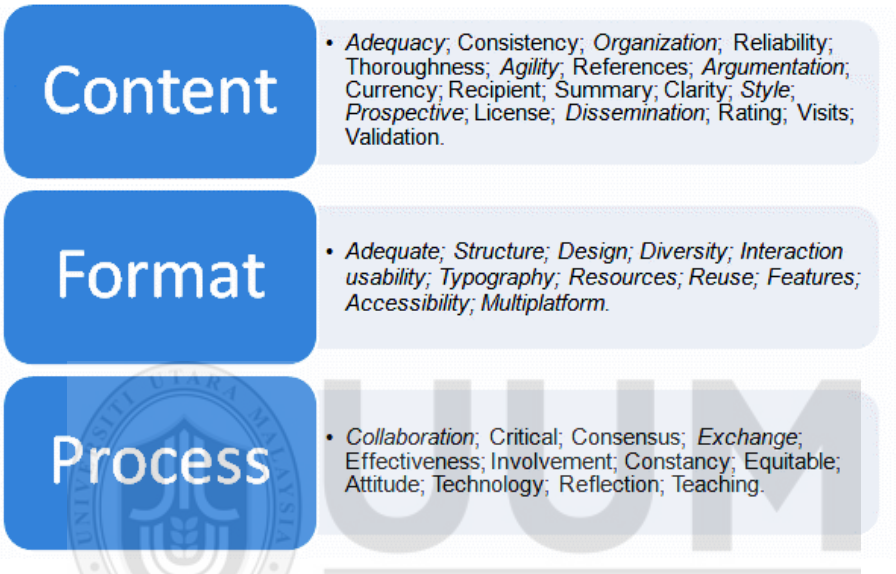


Figure 2.1. Quality categories and indicators for learner-generated content (Pérez-Mateo et al., 2011)

Conjoining learner-generated content concepts by Lee and McLoughlin, (2007) and Pérez-Mateo et al. (2011), evaluation of this educational approach nurtures on self-regulated learning through self-reflection, self-assessment and peer-review (Helmstedt, 2011). Methods of assessing learning object (the produced learner-generated content) has also been initiated in past studies (eg: Nesbit, Nesbit, & Li, 2004; Kurilovas, Bireniene, & Serikoviene, 2011; Sinclair, Joy, Yin-Kim Yau, & Hagan, 2013) converging on technological and pedagogical quality criteria.

Based on the discussion, it could summarized that the process and quality of the produced content are equally important in the implementation of learner-generated content. This is because the main aim of this approach is to nurture active learning engagement through a systematic process with measureable outcome. Taking these evidences in fortifying LGC production, the mentioned essential aspects learner-generated content should be considered.

2.4 Comic Definition & Principles

Unlike regular books, paintings, or movies, comics are collectively no better nor worse than other media, but simply different (Karczewski, 2013). Hence, the terminology of "comic" itself is a widely debated point in comic scholarship. For example, in the book of critical essays on comics by Varnum and Gibbons (2007), the definition of comic is compiled as "a narrative form consisting of pictures arranged in sequence,"(p. xvi). Beforehand, comic book creator Eisner (1985) specified comic as "sequential art" or "the arrangement of pictures or images and words to narrate a story or dramatize an idea,"(p. 5). McCloud (1993) later revised the term as "juxtaposed pictorial and other images in a deliberate sequence, invented to convey information and/or to produce an aesthetic response in the viewer," (p. 5). In contrast, (Cohn, 2012) was critical towards definition of comic as a language. As a substitute, he stated that comics are social artefacts communicated in visual language. Despite the contradictions between the authors, there is a significant consistency in their writings where comic appears to retain to several key features:

- A narrative
- Pictures, images or art
- Sequence

Using these mutual characteristics, Tatalovic (2009) categorized comics into single-frame cartoons, short comic strips, comic books, and graphic novels in terms of length and narrative complexity level. Additionally, it is important to clarify that picture books are not comics because their definition finds no adherence with the non-structural conception of comics (Cohn, 2005) despite sharing substantial common ground (Palmer, 2014).

2.4.1 Evolution of Digital Comics

Although comics are known as a modern day media, the succession of pictorial concept has been existed as far back as ancient Egypt where tapestries and hieroglyphs were carved or painted; which functioned as an early system to unfold story or historical event, symbolize, and record information (Perry & Aldridge, 1971; Martin, 2014). Only in the 20th Centuries, comic strips have been published as printed editorial cartoons (Sabin, 2001). Subsequently, comics have expended into variety of format ranging from newspapers, gags, comic books, digests to graphics novels (Perry & Aldridge, 1971, Sabin, 2001).

With the arrival of digital technology and displays, the medium of comics is undergoing a transition, such as pacing of digital comic sequences is affected by replacements of page turn, panel spacing and layout influenced by canvas scrolls (Goodbrey, 2013). Interaction with digital comic involves eye-tracking, voice control, facial expression recognition, gesture recognition, keyboard control, touch screen control, and handle control (Mei Lick & Su Luan, 2014). Spectacular reading experience is offered in interactive comics that incorporate rich multimedia elements from audio to animation (Steinke, 2004), as well as accepting mouse click, drag, text,

and touch input (Lai, Bjornerud, Akahori, & Hayashi, 2002; Rall, 2013). As a further remark, hypercomics expands the feature of interactive comic with non-linear story structure (Meskin, 2007).

Despite the technological progression, animated illustrations, music, and sound effects were found to be beneficial in multimedia stories while interactive elements such as hotspots and games are distracting in contrast (Takacs, Swart, & Bus, 2015). This drawback provides a direction for this study to focus on non-interactive comic as the primary outcome.

2.4.2 The Vocabulary of Comics

Principally, the presentation of narrative in comics follows a general set of visual conventions as shown in Figure 2.2. First, events are structurally arranged in framed panels, containing imagery of illustrated scenes (Dousay, 2015). Pictures can range from a maximum of realism, as in quasi-photographic, to a maximum of abstraction and iconicity, as in stylized cartoon drawing (Zanettin, 2015).

Comic layout is stylized for dynamic storytelling (Cao, Chan, and Lau, 2012). This is accomplished by visualizing rectangular panels in various sizes expressly for emphasis (Pilgrim & Trotti, 2012) and mood (Donovan, 2014). Depending on the intended emotional effect, the panel boundary may take a wild variety of forms with adjusted size and position of the individual panels (Rozema, 2015; Kilgore, 2015). For clarity, there should be visual distinction between background and foreground objects (Recine, 2013).

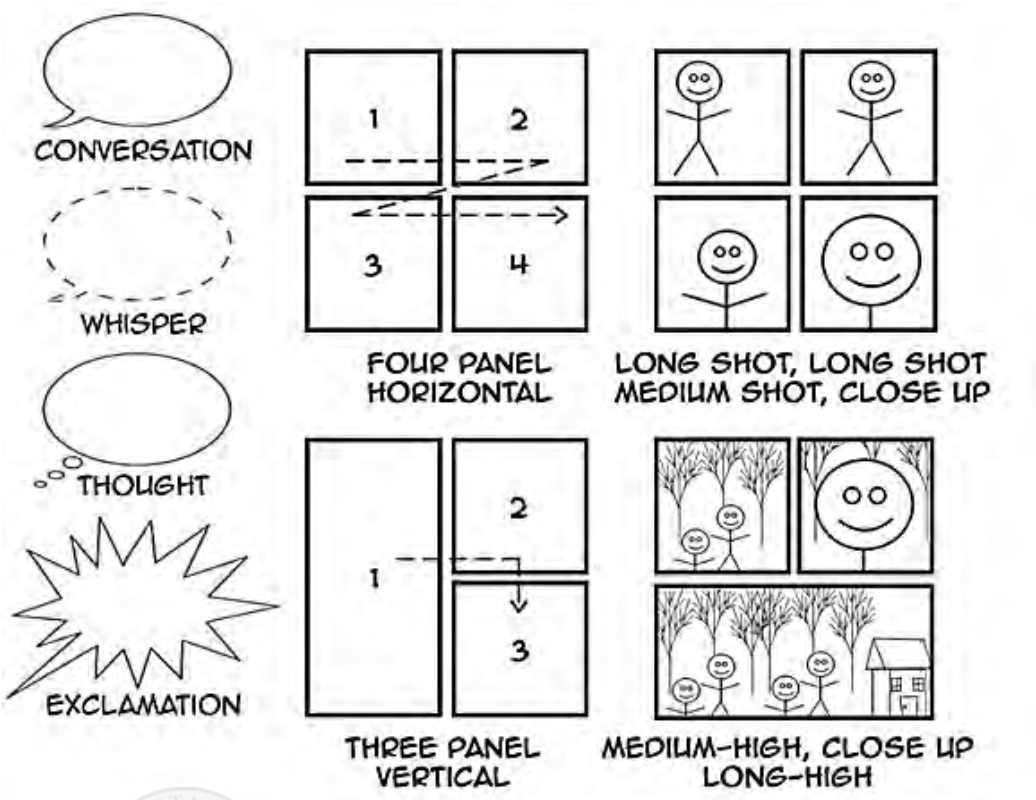


Figure 2.2 Comic Design Elements (Dousay, 2015)

Panel may be accompanied with shifted angles and strategic use of lines to convey action and speed (Mallia, 2010). Aside from arrows and overlapping multiples, motion lines such as speed-lines, guide-lines, motion blur, and contour-lines are used to communicate motion clearly (De Souza & Dyson, 2008). Demonstrating layout style applied in *manga* (Japanese comic), traditional western comic is distinguished as more rigid and grid-based (Cao et al., 2012) as illustrated in Figure 2.3.

Figure 2.3 Comic layout difference between manga and western artists (Cao et al., 2012)

Regularly, text is incorporated in comics where the character dialogue is placed within speech balloon or thought bubble while boxed captions are used to present narration (Pilgrim & Trotti, 2012), illustrated in Figure 2.4. Essentially, comics are basically descriptive icons which contains symbolic informative indices (Caldwell, 2012). In fact, the speech balloon has become the most identifiable symbols of comics around the world (Kurlander, Skelly, & Salesin, 1996; Bennett & Batiz, 2014) due to comic's common vocabulary for storytelling. In piecing information together into comics, the content structure is arranged into an interactive experience through the simulated speech represented by the speech balloons (Figueiredo, 2011).

Figure 2.4 Dialogue pacing is controlled in using overlapping balloons or conjoining lines (Alves et al., 2007)

Patterns are stored in memory through learning (Tamariz & Kirby, 2014) conventionality explained how styles and symbols in comics change over time. Therefore, artists have various imaginative methods in manipulating comics' component including onomatopoeia text and special effect lines to convey dissimilar emotional impact to their readers (McCloud, 2006). That is why, for example, some Japanese artists stated the inconveniency to express easily recognisable emotions without the use of symbols that are typical of *manga* (Trovato, Kishi, Endo, Hashimoto, & Takanishi, 2012).

Figure 2.5 A set of symbols commonly used in *Manga*.

Thus, it can be said that giving attention to these visual conventions is crucial for LGC production for effective storytelling.

2.4.3 Comic Production Approaches

With relevance to LGC production model, the basis of comic development should be initially examined. Exploring how meaning is made through the relationship between image and text elements, focusing on comics is ideal in this era due to the culture's dependence towards visual for edification and leisure (Martin, 2011). Successful comic composition should efficiently direct the audience's attention through important contents, so that the audience can quickly capture its ideas and effects (Cao et al., 2014). Thus, several authors have a theoretical idea for how comics

operate. According to Cohn (2005), the major visual elements within comics can be classified as follows:

- wordless sequential images
- text integrated with sequential images
- text integrated with a single image
- text dominating non-sequential illustrative images
- a single image text with no images at all

Extending Eisner (1985)'s notion on the fundamental conception of comics, McCloud (1993) highlighted that the collaboration between images and text are the comic's key stimulus in communicating with its audience despite their separate history and strength (see Figure 2.6).

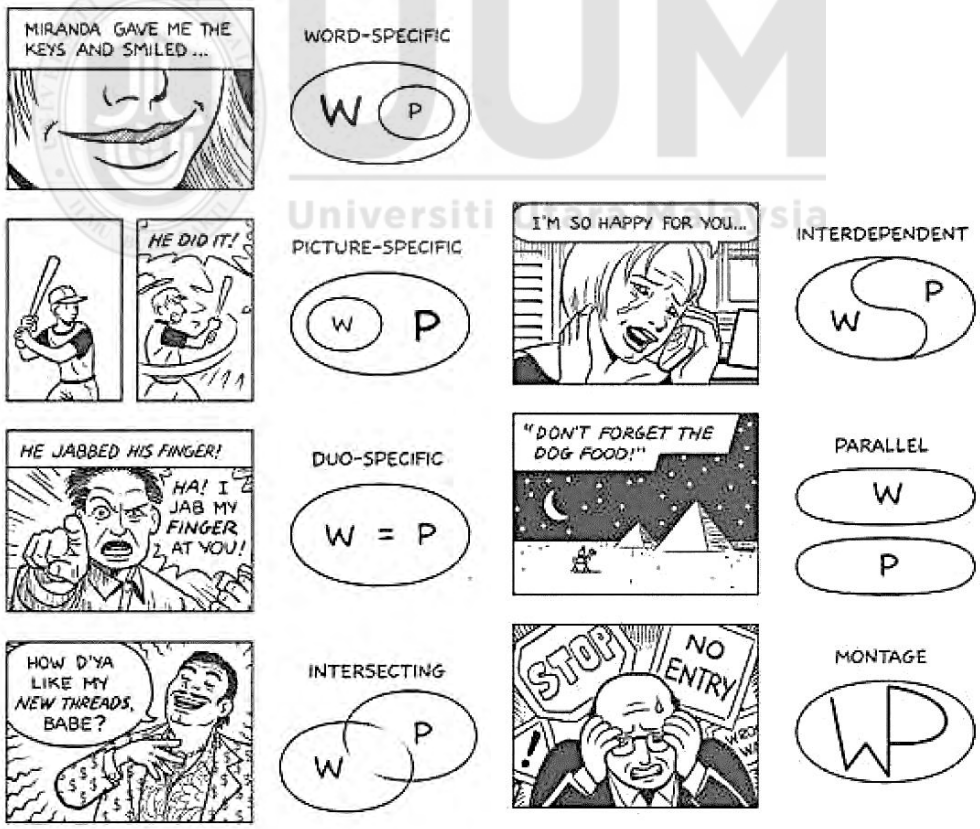


Figure 2.6 Categories of words and pictures combination in comics (McCloud, 2006)

McCloud (2006, p.30) introduced particular ways words and pictures interact in comics that leads readers to the goal of understanding as follows:

1) Word Specific – Words providing all the reader need to know, while the pictures illustrate aspects of the scene being described.

2) Picture Specific - Pictures providing all the reader need to know, while the words accentuate aspects of the scene being shown.

3) Duo Specific -Words and pictures both sending roughly the same message.

4) Intersecting -Words and pictures working together in some respects while also contributing information independently.

5) Interdependent -Words and pictures combining to convey an idea that neither would convey alone.

6) Parallel -Words and pictures following seemingly different paths without intersecting.

7) Montage – Words and pictures combined pictorially.

Mentioning McCloud's approach, Phillips (2012) highlighted that when readers learn to tune into these interactions and not only focus on isolated visual elements, their ability to create meaning is greatly increased. Meanwhile, Borodo (2014) agreed with Eisner and McCloud assertion that comic characters do not merely interact and communicate meanings through speech balloons but, equally importantly, through eye gaze facial expression, gesture or posture (refer to Figure 2.7). Apparently, character gestures in comics are understood to mean the same as the corresponding real life gestures (Fein & Kasher, 1996).

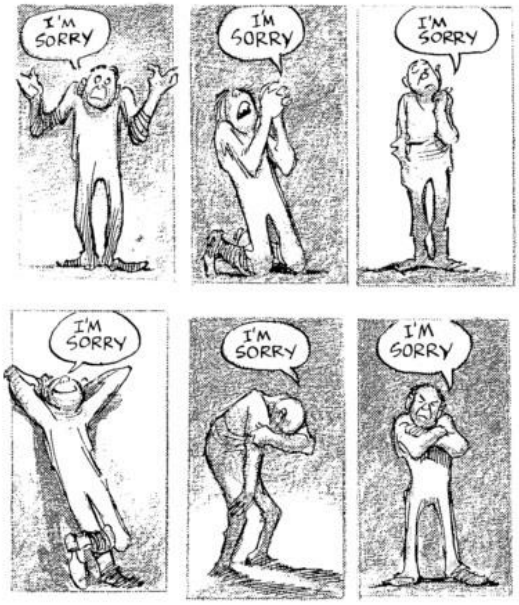


Figure 2.7 Posture, gesture and facial expression occupy primary position over text in comics (Eisner, 1985)

The relationship between signs and gestures provides the ability to recruit multiple levels of representation such as iconic and abstract (Perniss, Ozy, & Morgan, 2015) which are shown in comics. Figure 2.8 depicts users' level of agreement when judging posture according to a set of predefined emotion categories.

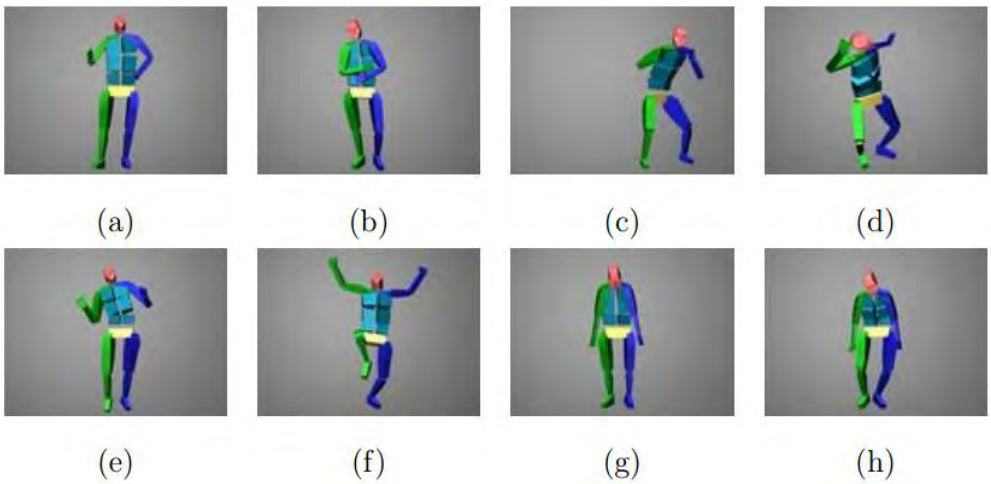


Figure 2.8 Posture Higher intensity postures- (a) Angry (b) Upset (c) Fear (d) Surprise (e) Happy (f) Joy (g) Sad (h) Depressed (Kleinsmith, De Silva, & Bianchi-Berthouze, 2006)

Although McCloud (1993)'s ideas remained to be challenged or fortified from academic perspectives (Pratt, 2009; Cohn, 2010), his comic principles such as panel transitions, words and picture combination, and several more continued to be incorporated in computer based application studies published in scientific journals (Decortis & Rizzo, 2002; Shamir, Rubinstein & Levinboim, 2006; Vaccarella, 2013; Dittmer & Latham; 2014). Essentially, McCloud's canonical taxonomy has gradually provided actionable approach of communicating message using sequential visuals. Therefore, the next subsection discusses the relationship between comics and visual communication theories.

2.4.4 Comics and Visual Communication

The theory of perception in visual communication concludes that human's sensual organs associate meanings with the images they see (Lester, 2006). In the context of sequential art, visual communications occurred as comics are designed to inform and persuade that comprise the understanding and ability of both visual and verbal (Schwarz, 2006). In kindred states of verbal deficit, comics through utilizing facial movements, eyebrows, eyes, eyelids, lips, jaws and cheeks "amplify meaning" and articulate the emotional aspect of human experiences that usually circumvent even the nuances of verbal language (Quesenberry & Squier, 2016). The miniature representations of comics pages are kinds of symbolic pictograms that give value to their signs, express a concept, and enclose an implicit definition (Groensteen, 2007). Hence, both modalities attach meaningful elements together (affixing), substitute them within each other (suppletion), and repeat them (reduplication) to varying effects on the meaning of an expression (Cohn, 2012) (see Figure 2.9). These

conventional stylized representations which are intertextuality recognized or pictograms; such as a saw to represent sleep, or stars to represent pain in humorous comics (Zanettin, 2008).

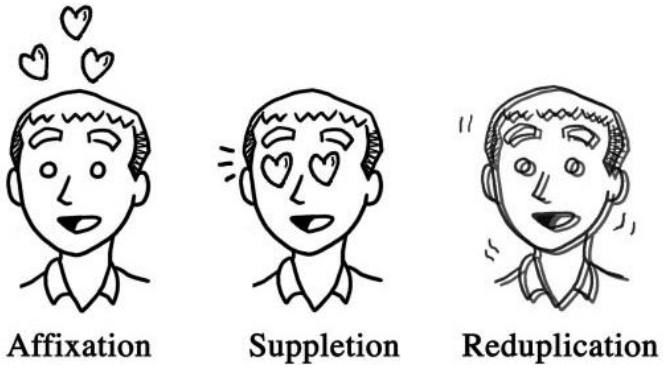


Figure 2.9 Morphological processes in graphic commonly used in comics (Cohn, 2012)

Visual appearance can be used to suggest the internal traits of the character in order to function as shorthand for understanding and predicting the character (Haake & Gulz, 2008). Shape, size, pose, and proportion are used to express character's role, physicality, and personality traits (Islam, Nahiduzzaman, Why, & Ashraf, 2011). Identity and aesthetic sensibilities could also be expressed through the character's appearance, clothes, and fashion which may include height, hair style and colour, skin colour, facial form, tattoo, and scar (S. J. Kim, Kim, & Mattila, 2012).

Similar to McCloud's works, Saraceni (2003) discussed comics from semiotic perspective where in the blend between words and pictures refers, then, to instances where the verbal and the visual are merged together in the same sign, which is therefore both symbolic and iconic. Reader similarly relies on common-lore metaphors based on repeated associations of signs and symbols that have become conventionalized within the context of the panel (Dicks, 2015). Unlike textual

narratives, comics engages with the reader not only through the images but also through visual attributes of the word (Venkatesan & Saji, 2016) (refer to Figure 2.10). Hence, sounds are represented by onomatopoeic words, non-lexical strings of alphabetic symbols and punctuation marks (Zanettin, 2008).

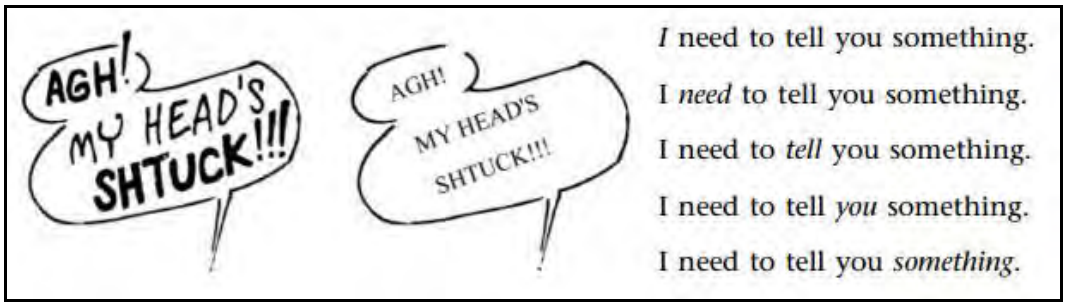


Figure 2.10 Words appearance contributes to their meaning (Saraceni, 2003)

Recently however, literature associated with cognitive and linguistic domains have emerged that offers newfound formalization towards the comic medium. This theory is known as the 'Visual Language' proposed by Cohn (2012) that combined aspects of theoretical and corpus linguistics with cognitive psychology and cognitive neuroscience. He clarified that, in visual language, drawings and sequential images are structured the same as spoken or written language. Cohn (2014b) further provided evidence for the interactions of narrative, meaning, page layout, and framing where familiarity in these structures contributes to a larger fluency in the visual language used in comics as illustrated in Figure 2.11.

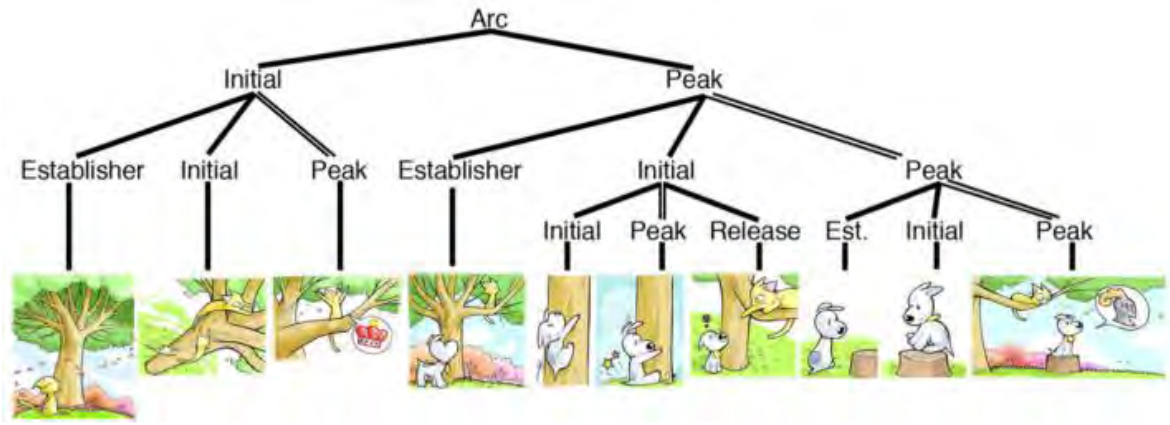


Figure 2.11 Visual narrative structure of sequential art (Cohn, 2014b)

According to Cohn, narrative structure functions to order meanings where the visual narrative grammar consists of several core categories:

- Orienteer - provides superordinate information, such as a setting.
- Establisher - sets up an interaction without acting upon it.
- Initial - initiates the tension of the narrative arc.
- Prolongation - marks a medial state of extension, often the trajectory of a path.
- Peak - marks the height of narrative tension and point of maximal event structure.
- Release - releases the tension of the interaction.

Much like design, comics are meant to accomplish a specific goal, providing the same narrative experience to its' audience (Evensen, 2015). Thus, the next subsection discusses the essential feature of narrative in comics.

2.4.5 Comics and Narrative

Narrative is defined as “formal system that the reader interprets as an interesting representation of a series of logically and chronologically related events, caused or experienced by actors,” (Lefèvre, 2000, p. 1). To understand the story, the comic's visual elements must be carefully interpreted in contrast with word-based novels (Bosma, Rule, & Krueger, 2013). This is because within a single comic panel, the reader is required mentally decide the cause, effect, and object position represented (Lefèvre, 2000). From the moment various pictures are grouped together in a series or sequence, the viewer or reader is prompted to look for relations among them (Lefèvre, 2011).

To understand how readers navigate comic page layouts, Cohn (2014b)’s “assemblage” principle described that content can be framed in panels across base framing categories and additional modification of aspects of layout (see Figure 2.12). The preferences when seeking to build units of structure in as smooth a reading path as possible is listed below:

- grouped areas are preferred to non-grouped areas
- smooth paths are preferred to broken paths
- one should not jump over units
- one should not leave “gaps” in reading

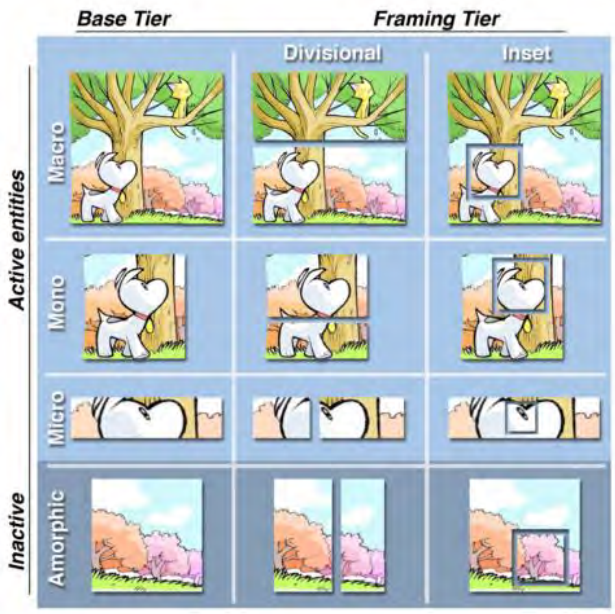


Figure 2.12 Attentional framing matrix in sequential art (Cohn, 2014b)

There is no doubt that narrative comics account for the largest percentage of the market (Bennett, 2014). However, a story-based graphic approach still has its' limitation. For instance, Short, Randolph-Seng, and McKenny (2013)'s pointed out that comics need multiple pages to deliver a content compared to single page traditional text with bullet point. Moreover, Jüngs (as cited by Caldwell, 2012) argued that narrative does not methodically transfer knowledge. These criticisms advocate that extended study is required on construction of loose narrative structure that allow balance between story and learning.

When it comes to literary genre, stories such as horror, science fiction, superheroes, adventure, history, reportage, memoir, biography, and more were told in comics (Forceville, El Refaie, & Meesters, 2012). Looking at story themes; it was found that Malaysian students seemed to prefer cheerful and adventurous comics about friendship, teamwork and happiness (Ronaldi & Nor Aziah, 2012). Hence, this leads to the next subsection which focuses on the role of culture in comics.

2.4.6 Comics and Culture

Comics are a significant part of today's culture. Western and eastern origin affects the comic's storytelling, art style, emotion, gesture and pose. For example, although comic panels are arranged in a typical grid pattern, Japanese reading conventions, manga pages, and panels are read from right to left whereas American superhero comics are viewed in reverse (Forceville et al., 2012). Amusingly, an updated portrayal of language, culture, and society are usually illustrated is comics (Fay, 2007).

To communicate with audience, character facial expression should ideally be able adapted to different cultural backgrounds. Application users do this by changing the gesture or facial expression of the character (Kurlander et al., 1996) where a number of scholars have adopted the twelve wheel of emotions (happy, sad, approving, disapproving, proud, ashamed, grateful, angry, impressed, confused, remorseful, and surprised) in their ongoing work (Trovato et al., 2013). Findings revealed that there were cultural differences in interpreting characters' facial expressions (Koda, 2008) as illustrated in Figure 2.13. For non-human characters in comics, verbal description of emotional states can be replaced by drawings of bodily postures and facial expressions anthropomorphized animal characters that readily communicate feelings to readers (Keen, 2011).

Figure 2.13 Twelve facial expressions of Western (upper)and Asian(lower) character (Koda, 2008).

Consequently, to overcome the complexity of constructing affective agents, Bennett and Šabanović (2014) explored deriving minimal face features to convey information through schematic facial expressions as illustrated in Figure 2.14. In relevance, repetitive images and recognisable symbols are used very commonly in comics and form their pictorial vocabulary (Saraceni, 2003).

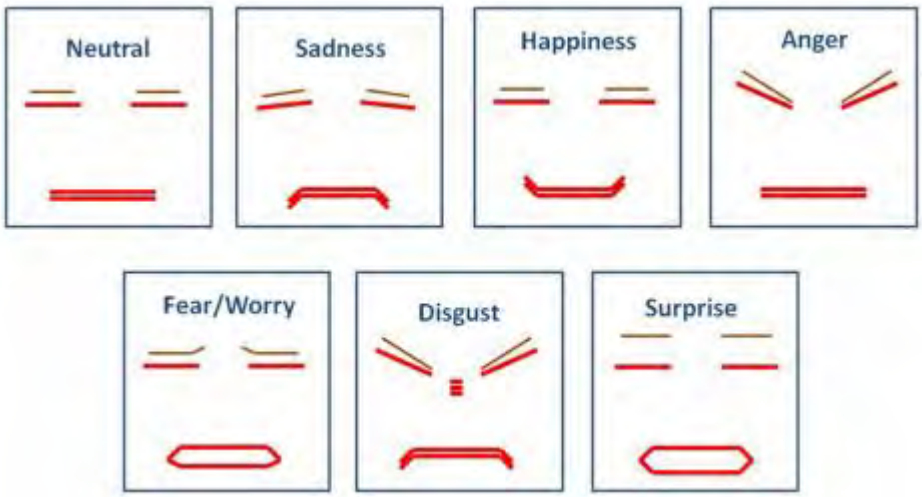


Figure 2.14 Schematic Facial Expressions (Bennett and Šabanović, 2014)

In the case of Malaysian culture, preference towards cartoon drawing style was analysed by Ronaldi and Nor Aziah (2012) which disclosed that majority of the respondents prefer cute characters showing big head, smiling, with soft and contrast colours (yellow, orange, brown, purple, red, and green). Favouritisms were also noted in terms of actions with a lot of subsidiary picture elements such as background, visual effects and as well as supporting characters.

2.4.7 Implications of Comic Definition and Principles to the Study

A number of comic principles consist of format, vocabulary, development approaches, aspects of narrative, culture, and more have been vigorously discussed in this section. Consideration of these principles as core comic components is crucial to the development of LGC production model. Furthermore, in view of the fact that LGC is a type of comic that functions as a learning tool, the next section centralizes on how prior scholars utilized comics in educational setting.

2.5 Comics in Education

Recent advances in comic authoring tools enable ubiquitous attempts for educators and students to design their own personalized comics. This opens an opportunity for academic community to design educational comics without artistic restrictions. Thus, this section examine the educational value of comics, characteristics, and categories of educational comics.

2.5.1 Comics as a Cognitive and Affective Tool

Until recently, 'visual pedagogy' promoted teaching such as the picture/text combination found in comics and graphic novel formats (Fischbach, 2014). Recent years have witnessed a growing appreciation towards comics which are now capable to address almost any subject from fiction to non-fiction, without age boundaries (Gibson, 2010). According to Carter (2013), the relevance of comic in the classroom was justified based on several bases such from political, theoretical to research as listed below:

- popular culture base
- multi-literacies base
- multimodal base
- the multi-cultural base
- young adult literature base
- arts-integration base
- reading comprehension and motivation base
- media literacy base
- technology-integration base
- standards-driven base

Figure 2.15 illustrates an example of an educational comic which visually explains how the web browser works. Comprehension is achieved because comic's lively illustrations accompanied by limited text and panels interplay capture the story's content at full extent. (Mayville, 2012; Jennings et al., 2014).

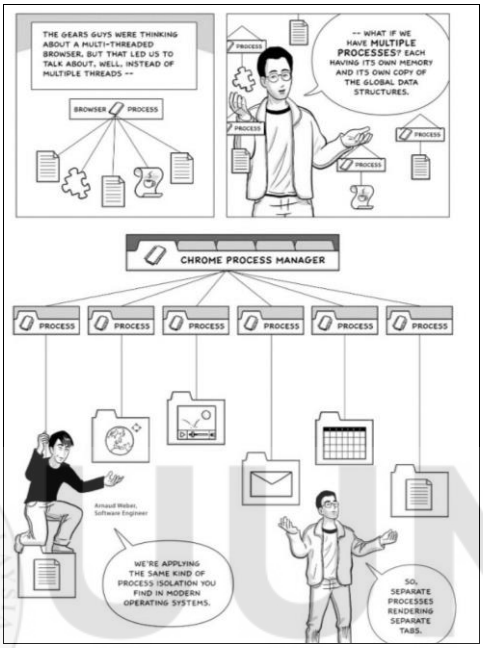


Figure 2.15 Educational comic by Google

Predominantly, comic books, comic strips and graphic novels have demystified diverse educational benefits in classroom settings. For example, Williams (2008) reported that students practice moderate level of synthesis and thinking skills through by reading and reflecting through comics. This was exhibited earlier in Leckbee (2005)'s experiment where learners related to the character archetypes. Then, they were instructed to compare themselves with the comic character by composing fictional diary entries.

Dowdy (2011) further explored comics' potential of motivating students through-out literacy process. Moreover, comics have contributed more than visual aids for

language and TESOL learners (Baker, 2011; Recine, 2013) where linguistic items are acquired in incessant sequence without altering the readers' point of view. Besides piquing students' interest and motivation, supporting learning goals such as verbal and written communications, building, problem solving, and enhancing critical thinking skills were also developed catalysed by innovative use of educational comics (Cho & Lawrence, 2012).

On the other hand, comic is also considered as convenient graphical device to summarize other medium such as video (Boreczky, Girgensohn, Golovchinsky, & Uchihashi , 2000) and emergent narrative in games (Alves, Simões, Vala, Paiva, McMichael & Aylett , 2007). In addition, Busarello, Ulbricht, Bieging, and Villarouco (2013)'s hypermedia comic learning object has assisted learner's content assimilation and grant emotional appeal to deaf students in studying descriptive geometry respectively. As a result, visual communication techniques in comics are increasingly included in the digital tool-set of information designers (Rall, 2013). These evidences are among the massive accomplishments of comics in education.

2.5.2 Characteristics of Educational Comics

Alaba (2007) defined educational comic as a "form of cartoons in which a cast of characters present an educational story in a sequence of closely related drawings designed to entertain and educate the reader," (p. 1). Conversational language in comics was able to transform rigid information into soft or simple words to make educational content accessible and understandable (Lin & Lin, 2016). According to Kane (2013), there are three interlocking components of educational comics which

are 1) Process – How graphic narratives are made, and how they evolved; 2) Content – The script/words/text used to tell the story; and 3) Visual Form – The illustrations/pictures/cartoons used to tell the story. The script, the art, and the history of the medium presented spheres are the same size because all are of equal importance (see Figure 2.16).

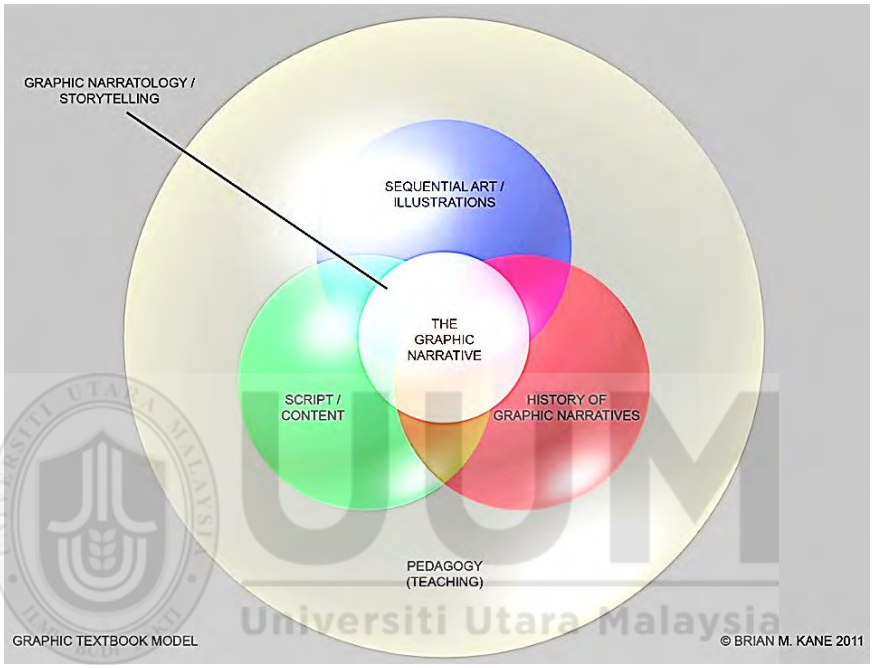


Figure 2.16 Graphic Textbook Model (Kane 2013)

Although Kane has generated a principled foundation of educational comics, his model is constricted to the collaboration between instructors and comic developers in the creation of e-textbooks incorporating comic elements. Very limited is known about the applied adoption of Kane's model for LGC production as it is not empirically tested and polished as a structured method in classroom environment. Therefore, the next subsection discusses the categories of educational comics introduced in prior literature.

2.5.3 Categories of Educational comics

While stories in comics are often fictional, all forms of fiction are based on or at least partially inspired by truth (Fong, 2012) where stories takes place exclusively through the informal curriculum which influences a learner's conceptual understanding of a given topic. According to Eisner (1985), educational comic is a subset of comics that specifically variously designed to extend student learning and foster engagement beyond the confines of the classroom. Figure 2.17 shows how difficult scientific concept in biology is visualized in a form of comic. The arrangement of panels, position of balloons, and explanatory text is carefully arranged to allow readers to grasp the comics' educational content. He further classified two types of educational comics which are 'technical' and 'attitudinal'. Technical comics teach learners the procedures, process, and tasks which involve the reader to experience them in sequenced form. Attitudinal comics function as a visual narrative in conditioning learners' attitude toward a task. Readers are influenced by the comic's message when character behaviour is then imitated.

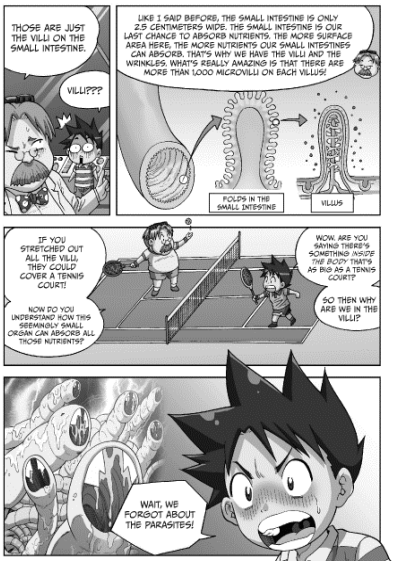


Figure 2.17 Educational comic by Korean Publisher

2.5.4 Implications of Comics in Education to the Study

This section has thoroughly discussed the utilization of comics in educational setting. While educational comics are able to instruct learners to content comprehension, the didactic constituents in non-academic comics is utilized by collaboratively analysed to build knowledge. On the whole, there is seem to be a tendency among researchers to explore the potential of constructive learning through educational comic production. These educational comics which are generated by learners, then finalized into a digital form is called LGC (learner-generated comic). Therefore, the next section expands the discussion on LGC.

2.6 LGC

LGC approach utilizes comic authoring tools for production of educational comic as the learner-generated content. As a complex interactive medium, comics are a unique graphic stories where human brains carefully respond to visual communication (Upson & Hall, 2013). Learning how to decode comic conventions involves developing an understanding of the conventions of the medium and gaining experience synthesizing image and text-based information (Hoover, 2011; Sturm, 2013). Learners need to analyse visuals besides text alone by practicing multimodal narratives interpretations because stories are told through multiple semiotic channels (Connors, 2013).

2.6.1 Educational Impact of LGC

Maliszewski (2013) asserted that the increasing acceptance of LGC production in classroom is due their contribution to active learning engagement. In agreement, Pantaleo (2013) added that learners' engagement was facilitated when LGC

combined multimodal print and digital texts by understanding comic conventions, art and design visual elements, and sophistication of reading and developing comics. Meanwhile, Meier (2012) stated that learners' curiosity were prompted when they were challenged to produce LGC. Thus, Reilly (2015) acknowledged that learners research topics that went beyond those they had studied in their regular classes. Deep learning was demonstrated when students critically foster their own understanding since the LGC products were meant to teach their peers (Sharpe & Izadkhah, 2014).

Besides that, Wake (2009) described how expository text were taught to pre-service educators and postgraduate students using storyboards, comics, and digital stories. In İnel and Balım (2013)'s LGC activity, students' attention was gained through visuals where they solved daily lives problem by their ideas into comic balloon convention. Borrowing the same technique, Kabapinar (2009) tested the effect of unnamed characters, speech balloon, and thinking bubbles as presented in Figure 2.18 during class reflection.

Figure 2.18 Worksheet presented in concept cartoon format

In addition, learners were able to draw on a range of resources including personal experiences and prior knowledge through LGC production (Noel, 2015).

2.6.2 The Use of Comic Authoring Tools for LGC

Authoring tools can be used flexibly by users for creating various kinds of knowledge representations (B. Kim & Reeves, 2007). They are classified into single purpose authoring tools, activity, course development and presentation, general presentation, test, and evaluation tools (Dağ, Durdu, & Gerdan, 2014). Many these tools also supports the creation of comic-style digital stories with educational purposes (Di Blas, 2015). In general, comic authoring tool provides comic graphics, background images, characters and other objects which can be combined to form a sequence of static images (Lazarinis, Mazaraki, Verykios, & Panagiotakopoulos, 2015). Hence, recently there is a growing number of scholars utilizing various comic authoring tools for LGC production.

For example, learners transformed their knowledge into digital educational comics using *Bitstrips* comic authoring tool (Burke, Hughes, Hardware, & Thompson, 2013; Higginbotham et al., 2013; Nisa & Al-Hafizh, 2014). Other classrooms have explored using *Comic Life* (Engler, Hoskins, & Payne, 2008) and Pixton (Meyers, 2014; Watkins, 2014). In Vassilikopoulou et al.(2011)'s *EduComics* project, a personalized learning through LGC activity were carried out using *ComicLab* tool. Besides that, *CBC4Kids's StoryBuilder*, allowed DST practice based on comic books conventions (Nicoletta Di Blas, Garzotto, Paolini, & Sabiescu, 2009).

Comic authoring tools enables memory commitment and processes abstraction when key information are detected and represented by learners (Bower, Hedberg, & Kuswara, 2010) . The finalized digital narrative may consists of a sorted collection of annotated photos similar to comics (Leonie Schäfer et al., 2004). Although comic authoring tools may limit the creative opportunities of the sequential artist, these pre-package tools are better suited for novice learners (Jackson, 2009). This is because they could analogously generate professional quality comic and concentrate on its' content, skipping the drawing process (Luczaj, 2010). Therefore, the next subsection previews the practice of LGC production; conversed by a past researchers.

2.6.3 LGC Production in Classroom

This section analyses the production of LGC in past literature to study how comic principles and storytelling techniques are adopted. Additionally, teaching and learning requirements, approaches, educational outcome, and assessment are also investigated.

2.6.3.1 LGC for Communication Theory

In Meyers (2014)'s research, students were given a LGC project to express how interpersonal exchange in communication theory works. A tutorial on *Pixton* comic authoring tool was presented before the assignment took place. Besides learning the basic steps to create new comic, character, add background, and send their finalized output for grading, students were also persuaded to try other useful features of *Pixton*.

Figure 2.19 LGC using Pixton Comic Authoring Tool (Meyers, 2014)

There were three main components in the LGC activity. First was focusing on the comic production itself. The instructor specified certain guideline for comic creation such as the maximum amount of panels. Storywise, there should be a variety, interesting yet unrestricted number of characters with active roles, backgrounds, and text. Next, students were asked to formally examine interpersonal exchange theoretically in a rationale paper. The feedback exposed that only one out of 25 students preferred formal paper report compared to LGC. Finally, a peer feedback session was conducted to share learning experience using *Pixton's* built-in commenting functions. In the debriefing session, the best selected comics were presented on the screen, conversing how comic elements and narrative creatively and successfully informed students about communication theory. In a nutshell, the students valued LGC production that tackled the main concepts in the subject by relating them to real life situations.

2.6.3.2 LGC for Visual Literacy

Watkins (2014)'s study explored comics as a form of visual rhetoric and multimodal communication. Students engaged in design by using multiple modes to create various informative media, such as hand-drawn, digitally drawn, juxtaposed,

sequential, and photographed stories. Students were firstly instructed to read the provided graphic novel before proceeding with the assignment. Students feedback include that the hardest part of the LGC project was making the switch from text based storytelling to visual based story telling. Mainly, planning process of the comic was more helpful than traditional drafting process. However, students' plans were more grandiose than their finished product. Several students responded that the toughest task in LGC production is fabricating theme, layout, and structure. This was because elements change and things are added or subtracted, making the documents comic more complex. Fitting certain panels and text on certain pages and making good or stylish pages were regarded problematic. It was difficult to ascertain they had enough text on each page, but not too much. Plus, ensuring that details were not duplicated between the written and graphical ideas became problematical. Apart from that, challenges involved figuring out how best to present the information what narrator, tone to use, getting the wording right and simple, and formatting the story to get punch lines to occur in the last panel of a row. Generally, the project permitted students to present technical instructions in a more informal way.

2.6.3.3 LGC for Medical Narrative

Green (2013) described an innovative course on comics and medicine for 4th-year medical students. In this course, students learn to read and create their own medical related stories using the comic format. After the comics exposed students to a set of medically relevant graphic narratives that provoke critical reflection about the experience of illness and the ways patients and their families interface with the medical system, they will equip students with critical thinking skills for reading and understanding comics that are relevant to medical practice. This way, students'

creativity are nurtured as they develop their own stories into original graphic narratives.

Figure 2.20 Submitted LGC artefact (Green, 2013)

These goals are achieved via a seminar-style course that meets twice weekly (two and a half hours per session) for two weeks. During each session, students engage in

three distinct activities: discussion of readings; an in-class exercise; and sharing-progress on their final projects. Specific session topics include (but are limited to):

- Why comics are relevant to medicine
- Elements of storytelling
- The relationship between images and words
- Exploring point of view
- Drawing comics
- Writing dialogue
- Social context of medicine
- Final presentations

Students finally produced their own original graphic narrative based on a personal experience from medical school. Despite the fact that most of the students have little confidence or experience drawing comics at the outset of class, these learners consistently produce works that reveal their wry humour and personal transformations as well as observations about modern medicine.

2.6.3.4 LGC for Social Studies

Pioneering LGC production in classroom setting, students in Morrison et. al (2002)'s experiment were able to develop their writing, comprehension, and research skills. In their LGC project, students explored a particular topic in social studies in two to three weeks duration.

Figure 2.21 Hand drawn LGC (Morrison et. al, 2002)

Upon familiarization of topic, students illustrate their own comic manually. Finally, the completed LGC were compiled in booklets and presented to the public in an open booth.

2.6.3.5 LGC for Exploring Empathy, History, and Story

Another early attempt of introducing LGC in university curriculum, Williams (2008) enlightened how LGC production allowed multi-disciplines practice from art to social studies. Several storytelling techniques were explored. It started from character and space creation. Personal stories were inspired from observation, own experience, and written journal. Aside from that, genre also assisted the students to prepare the narrative, following its conventions. The LGC activity was conducted in a workshop environment separated into small groups.

Figure 2.22 Students' graphic novels (Morrison et. al, 2002)

Williams (2008) also reported her findings in LGC secondary classroom project. It was a twelve week curriculum duration where students produced comics about human rights. Before the production, students read selected graphic novels in groups to explore art styles and comic design. Then, thumbnail storyboards were developed based on students' paper researching the subject. The finalized LGC displayed massive range of styles, designs, and techniques. Producing LGC had opened a path for students' active participation, self-exploration, and exposed to pertinent social issues. Experiences from Williams (2008)'s study confirmed that LGC is a powerful method for students to envision the future, cognised history, self-narratives, empathy, design, and technology.

2.6.3.6 LGC for Literary Composition I

Combination of words and pictures deliver meaning was scrutinised in Maldonado and Yuan (2011)'s LGC project which spanned for five weeks. Initially, storyboards were drafted to plan the narrative such as scenes, dialog, narration and additional characters. Once they were done, a digital version of the comics were generated using *Comics Lab* and *Comics Lab Extreme* tools on *Professor Garfield* website. Then, background, objects, facial expressions and body gestures variation for

characters were selected in the tool. Next, dialogue were inserted into speech or thought balloons. Finally, the completed LGC were exported as web pages.

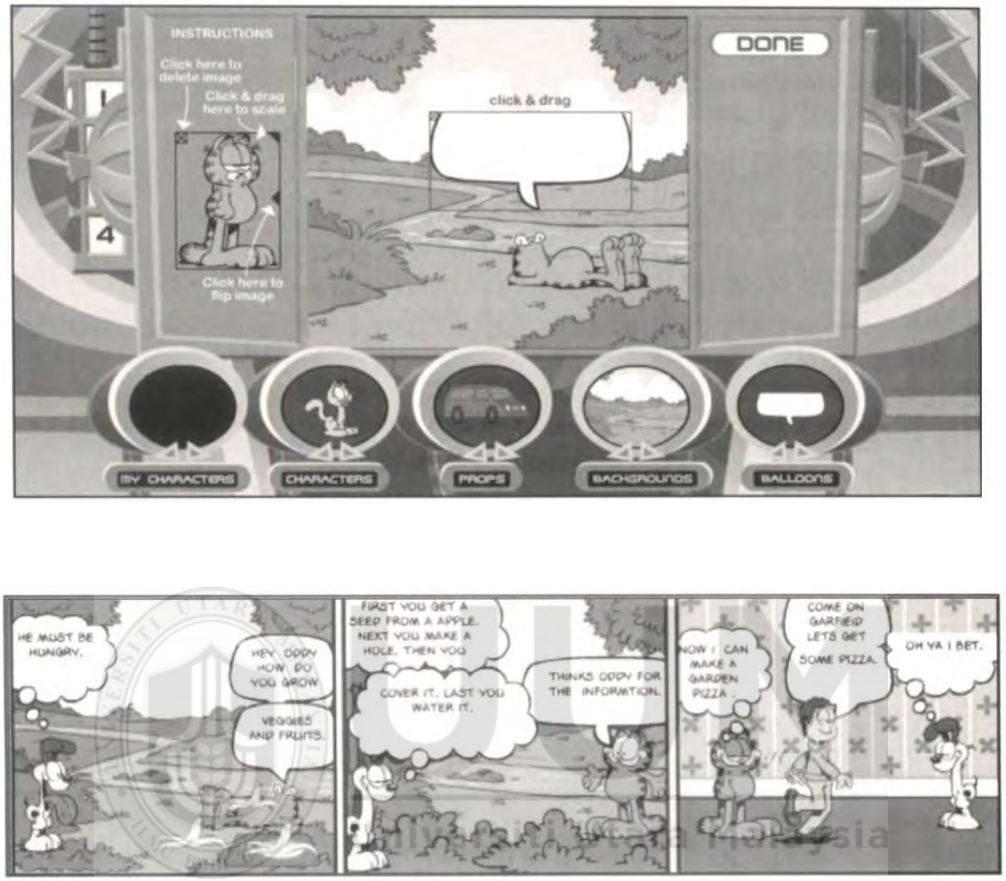


Figure 2.23 LGC using Professor Garfield (Maldonado & Yuan , 2011)

The outcome exhibited students had successfully performed the complex process of producing digital comics compared to traditional text. Based on this experience, Maldonado and Yuan recommended that students should be exposed to the foundation of sequential art before producing LGC using digital applications.

2.6.3.7 LGC for Literary Composition II

In response to the growing call for authentic learning and content creation in the information literacy setting, Upson, Mudd, and Moffat (2014) reported that librarians

at Emporia State University have created assignments and activities that utilize an iOS app called Comic Life to create photo comics. By applying authentic learning, students in a for-credit course created photo comics as information literacy narratives, while First Year Seminar students worked to build library guides. These activities encourage honest, meaningful reflection by students and allow them to demonstrate metaliteracy skills in an engaging and creative manner and can allow for both individual and group-created content. Students at Emporia State University have expressed high levels of satisfaction and engagement when participating in these activities.

2.6.3.8 LGC for Literary Composition III

Fay (2007) suggested that a LGC group should consist of three to four members, who were aware that grading will be in group and individual basis. Familiarity with fiction and creative thinking are important for a LGC production. Before converting the stories into comic form, panel map or outline were sketched first. The story should be able to gain readers' attention towards the topic. Although no experimental study was conducted, Fay proposed eight steps for LGC production:

1. Exploring sequential art
2. Establishing project groups
3. Choosing a topic
4. Researching the topic
5. Developing the story
6. Structuring the story
7. Adding the artwork
8. Sharing the finished product

Despite the comprehensive procedure, Fay did not provide an assessment mechanism to evaluate students' submitted comic.

2.6.3.9 LGC for Literary Composition IV

In Comer (2015)'s LGC production practice, three concepts (narrative gaps, narration, and focalization) were drawn as heuristics for rhetorical design; their application in students' memoirs illustrate the insights and skills that can result from a theory-driven approach to comic composition. Students were instructed to compose autobiographical comic which retell of one's personal history is, in part, an act of invention. They were concerned about both selecting a worthwhile story and presenting it graphically. The project help students make a compelling case for the potential of composing comics in achieving the core outcomes of critical literacy pedagogies. It was prompted that critical framework and creative practices, comic narratives offer students and teachers opportunities for serious play with significant rewards.

2.6.3.10 LGC for English Reading Comprehension

Engler, Hoskins, and Payne (2008) conducted a LGC pilot study to assess reading comprehension. After reading an academic topic, students were instructed to produce a digital comic summarizing their understanding. Students were merely told that it could be helpful for them to read a comic example before proceeding with the assignment. *Comic Life* tool was used to generate the comic (see Figure 2.24). The comic was a mix of summarising, paraphrasing, restating and quoting, the students were directed to work in groups to determine what each text balloon on the comic was an example of. Evaluation methods involved the observation from instructor,

peer feedback, and questionnaire. Positive results were shown in term of comprehension and assessment.

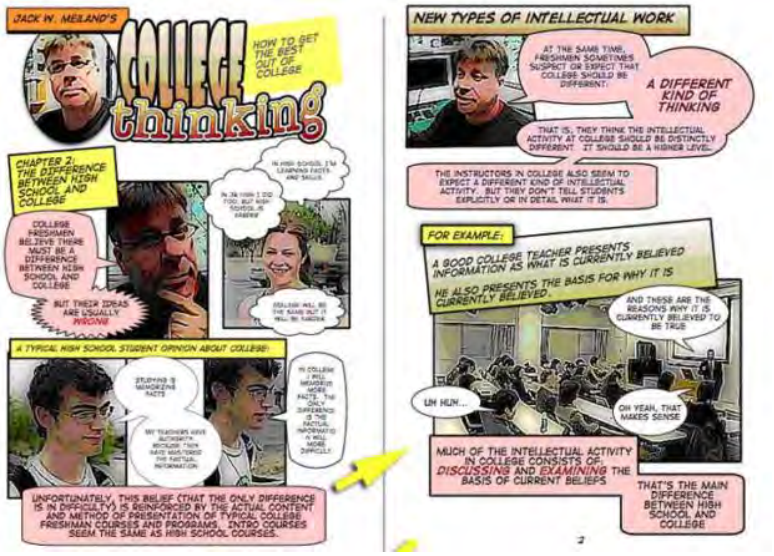


Figure 2.24 LGC using *ComicLife* (Engler, Hoskins, Payne, 2008)

2.6.3.11 LGC for ESOL

In Danzak (2011)'s LGC project, ESOL middle school students were required to share their families' immigration experience. There were four components (see Figure 2.25) and four main phases of LGC production. First, the concepts of comic and narrative framework were initially explored in read aloud session at the planning stage. Graphic organizers and family interviews were designed to obtain information. Second was the composing stage where students reflect and authored their personal stories in word processor.

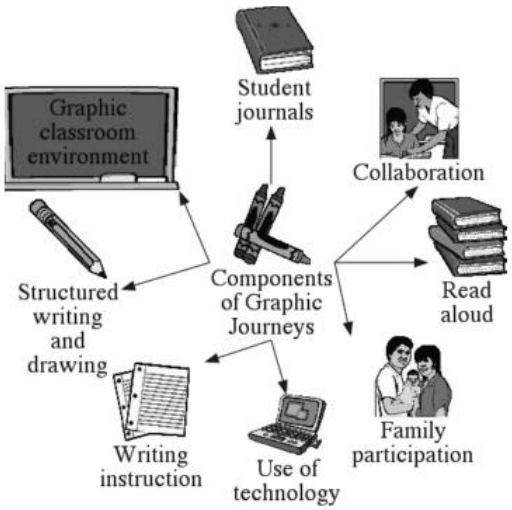


Figure 2.25 Component of LGC project (Danzak, 2011)

Third was the revising stage. Using *Comic Life* tool, scanned photos of students' families, clip art, other images, and text were inserted into the comics. Lastly, at the editing stage, students produced at average of five comic even though the instructor allowed 12 pages at maximum. They edited and removed errors before submitting the finalized LGC product as shown in Figure 2.26.

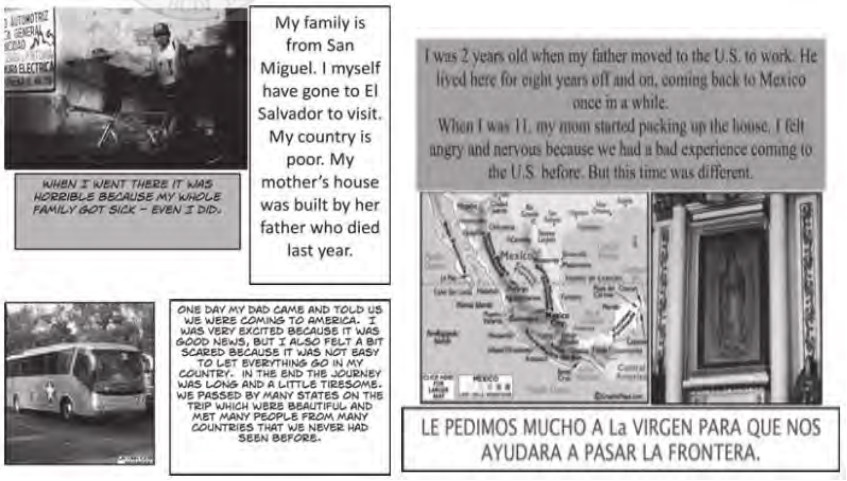


Figure 2.26 LGC product examples (Danzak, 2011)

Danzak (2011)'s conducted a book exhibition event where students presented their creative work to the public.

2.6.3.12 LGC for Social Gaming

Lapides et al. (2011) presented *Social Comics* which generated LGC in a casual video game environment. Merging sociability, physicality, and authoring game elements, players will act, driven by creativity.

Figure 2.27 Development of Social Comic (Lapides et al., 2011)

The main aim of the game was to create a comic strip and this is clearly established by the players with very little explanation. An early prototype of *Social Comics* used a motion capture system to track the position of the players' heads in real-time so

that the speech bubbles and their arrows would follow their associated character. Two speech bubbles appear in every panel of the comic, suggesting that at least two people participate in the authoring process. The text in the speech bubbles gave the players room to explore their creativity while still providing structure to the game. There was also no restriction on other people joining the game or giving suggestions to the players. Finally, players must use their entire body to pose in the panels, and can use props and hats to change their appearance.

A variety of comic stories and backgrounds were tested. The comics were primarily three panels long, but several six and eight panel comics were tested. The comic stories were written by the researchers, and varied from simple dialogue, to popular culture references. The backgrounds were images found on the internet that were of a setting or scene without any subjects in the foreground. The backgrounds were matched to the theme of each comic story. For example, an image of an operating theatre was used as the background of a story about surgery. Consequently, towards the aim of LGC production model construction, the prior educational practices of LGC production are analytically scrutinise in the next subsection.

2.6.3.13 Comparative Analysis of LGC Production in Classroom

A comparative analysis is conducted on the educational practices in LGC production. The analysis is based on brief descriptions and disadvantages on the LGC techniques applied in classroom setting. A qualitative approach is applied to generally compare the listed strategies as depicted in Table 2.1

Table 2.1 *Comparative Analysis of LGC Production in Classroom*

No	LGC Classroom Strategies	Descriptions	Limitations
1	Meyer (2014)	• Comic basic elements guide is provided. • Technical aspects of authoring tool are introduced. • The strategy uses shared learning experience approach where students connect core concepts through comic narrative.	• Assessment approach on LGC products is not explained. • Narrative technique is not elaborated.
2	Green (2013)	• Comic elements are introduced by reading several comics. • Complete simple stems narrative technique is used. • LGC final products are shared among the peers.	• Assessment approach on LGC products is not explained. • No authoring tool is used.
3	Morrison et. al (2002)	• Comic elements are comprehensively discussed. • LGC final products are shared among the peers.	• No authoring tool is used. • Narrative technique is not elaborated.
4	Williams (2008)	• Comic elements are introduced by reading McCloud (1993)'s text. • Narrative is composed by observation and personal stories inspired from experiences and written journal.	• No authoring tool is used. • Assessment approach on LGC products is not explained. • Learner-generated content concepts are not considered.
5	Maldonado and Yuan (2011)	• Storyboard is created before comic production. • Students repeatedly revised the dialogues	• Narrative technique is not elaborated. • Assessment approach on LGC products is not explained.
6	Upson, Mudd, and Moffat (2014)	• Authentic learning approach is applied. • Focuses on information literacy narratives.	• Comic principles are not discussed.
7	Fay (2007)	• A step-by-step approach is suggested to assist instructors involve students with LGC. • Focus on storytelling and educational topic.	• No authoring tool is used. • Assessment approach on LGC products is not explained.

No	LGC Classroom Strategies	Descriptions	Limitations
8	Engler, Hoskins, and Payne (2008)	• Reading comic before comic creation is optional. • The LGC is a combination of reviewing, paraphrasing, reaffirming and citing of the topic. • Technical aspects of authoring tool are introduced. • LGC assessment is done by covering the key points accurately and concisely.	• Comic principles are not discussed. • Narrative technique is not elaborated.
9	Danzak (2011)	• Comic elements are introduced by reading selected graphic novel. • Students compose reflection pieces. • Text and media are transferred from word processor to comic authoring tool.	• Assessment approach on LGC products is not explained.
10	Lapides et al. (2011)	• Authoring tool allows players to participate in live comic strip creation and in interactive authorship of new content.	• Intended to explore gameplay experiences instead of educational outcome. • Narrative technique is not elaborated.
11	Comer (2015)	• Comic elements, theories, process are adapted as a basis for literary composition.	• No authoring tool is used. • Assessment approach on LGC products is not explained.
12	Watkins (2014)	• Comic elements are introduced by reading selected graphic novel. • Students compose reflection pieces. • Pixton and Comic Life authoring tool are used.	• Assessment approach on LGC products is not explained.

From the comparative analysis, it was noticeable that, between the discussed LGC production classroom practices; the adoption of learner-generated content concepts, storytelling elements, and comic principles are unparalleled against each other and a benchmark for assessing the produced LGC is nearly absent. These limitations led to

the suggestion that; a substantiated, unified conceptual production LGC production which encompasses the fundamentals of comic, story, and learning has been overlooked. Deconstructing comics involves careful analysis and evaluation design elements that influence the story because the visual and textual elements are blended together (Dousay, 2015). Therefore, the primary foundations of Digital Storytelling (DST) are described in the next section.

2.7 DST

Compared to multimedia videos, research on the multimodal composition of DST have less attention paid to other media such as games, slides, websites, blogs, claymation, podcasts, including digital comics (Dalton et al., 2015). Hence, this section discourses the shared characteristics between of DST and LGC in supporting the implementation of LGC production.

2.7.1 Definition DST

Principally, DST refers to a technology enhanced activity of using digital tools for story creation (Schäfer et al., 2004; Williams, 2014). Since a story is regarded an essential feature in comics (Gerde & Foster, 2008; Caldwell, 2012), LGC production can be classified as a DST approach because it allows to learners to produce digital stories in a form of educational comics. Stories are able to transfer meaning in greater speed than the intellect alone since audiences' emotions are also bonded into them (Suwardy, Pan, & Seow, 2013). Pioneering in the field of DST, Lambert (2002) established that creators must not only determine which emotions to include in their digital stories, but also what sequence to present them in helping the audience understand the story. Thus, careful pedagogical design around story

planning, digital story production and reflection are crucial in order to achieve positive learning experience with DST (Bromberg & Andrade, 2013).

2.7.2 Educational Role of DST

It has been scholarly proven that DST is a powerful tool to integrate instructional messages with learning activities to create more engaging and exciting learning environments (Smeda, Dakich, & Sharda, 2014). For example, DST accelerates engagement, project-based learning, and technological incorporation (Barrett, 2006; Blas et al, 2011). In Malaysia, learners were very positive towards DST because it helped them developed 21st Century skills comprise of ICT literacy, critical thinking, and problem solving, communicative, and collaborative skills (Thang & Mahmud, 2013). Integrating with the content area, DST allows learners to self-reflect on their thinking (Gakhar & Thompson, 2007). Furthermore, DST project is mainly intended as a tool for communication, observation, analysis, and metacognition Schuck and Kearney (2006). In the effort to communicate the narrative to the audience through technology, the digital story's creator also learns how to incorporate their perspectives, beliefs and needs, in order to better present the story (Bratitsis, 2017).

Despite the time-consuming nature of DST, the experience of creating a digital story was well accepted by the majority of the learners (Alcantud Díaz, Vayá, & Gregori-Signes., 2014). Up to now, it could be concurred that DST and LGC share analogous educational benefits, aside from narrative. It is these are two traits that link DST and LGC respectively.

2.7.3 Narrative Types in DST

Chesi et al. (2013) defined storytelling as the act of conveying of events in either words, images, or sounds that potentially promotes knowledge, communication, reflection, critical thinking, construction, and collaboration. A good story has fleshed-out characters, detailed settings, goals, obstacles, causality, dramatic elements, and designed based on that the author knows (Gruen, 2000). Thus, telling a story requires reconstructing a plot, ordering the events to build to a climax, and characterizing the actors, and their motivations in a form that helps making instructional meaning from it (Campbell, Schwier, & Kenny, 2006). Hence, researchers have attempted to classify narrative techniques applied in DST.

First, Robin (2006) differentiated digital stories into personal narratives, historical documentaries, and experiences. Similarly, Caminotti and Gray (2012) affirmed that educational storytelling techniques are consisted of experiences, role-play and cases studies. On the other hand, Hwang (2014) categorized scientific biographies storylines into genius, revolutionist, content, and nature of science. Earlier, the range of genres of educational stories can be grouped into personifications, detective stories, histories, and social (Strube, 1996). According to Andrews, Hull, and Demeester (2010), there are four main storytelling instructional methods which are case-based, problem-based, scenario-based, and narrative-based instruction. Consequently, the genres of traditional digital stories, learning stories, along with social justice and community development stories help to frame the DST (Garrety & Schmidt, 2008).

Widely recognized as traditional drama, a longitudinal study on narrative by Aristotle determined that stories is driven by plot which climaxes into final resolution (Cavazza & Pizzi, 2006). Audiences generally engaged to epic, dramatic, and epistemic plot devices (Ryan, 2008). Meanwhile, to cater technical topics, Papadimitriou (2003) previously explicated that narrative were created when learners inserted historical or biographical perspective, visualized a concept, and added educational content.

Nevertheless, without scaffolding, learners tended to create only plain digital story composed only of settings and consequences and lacking elaborate transitions between events (C.-C. Liu, Wu, Chen, Tsai, & Lin, 2014). To implement DST, the instructor should address the purpose of the assignment, the expected quality of the product, time commitment, co-construction of knowledge (Saunders, 2014). Pedagogical design encompassing planning, production and reflection in a DST project is emphasized (Bromberg & Andrade, 2013). Additional studies need to be carried out to investigate the critical conditions (learning task, learning support, and learning resources) to promote high level of reflection in DST practice (Ivala, Gachago, Condy, & Chigona, 2014).

2.7.4 Implication of DST to the Study

From the discussion, much has been exposed about the educational roles and narrative forms adopted in DST. In summary, these narrative types can be classified into monologue style, auto-biography, usage of agent and persona, a scenario, problem or case-based, and metaphor or analogy; which could be applied in LGC production. Although a number of educators have acknowledged DST capabilities, a

well-planned framework is still a necessary to be reviewed (Smeda & Dakich, 2010). These evidences from literature clearly implies that proposing a comprehensive LGC production model supported by the elements of DST is imperative. Therefore, the next subsection converses DST frameworks and models established in past studies.

2.7.5 DST Framework and Models

This subsection reviews existing DST models by analysing the steps, flow, or elements of developing digital narrative. Educational goals and evaluation techniques are also examined in the selected literature.

2.7.5.1 DST as a Deep Learning Tool Framework

Barrett (2006)'s model addresses that DST expedites the conjunction of four strategies comprised of student engagement, reflection for deep learning, project-based learning, and integration of technology (see Figure 2.28).

Figure 2.28 Researching and Evaluation DST as a Deep Learning Tool

His model illustrates of the integration of DST into different classes that help educators perceive the pedagogical potentials for this new medium and learn the best practices for engaging students in reflective and active learning by producing meaningful products.

2.7.5.2 The Model of DST Framework

In Figg and McCartney (2010)'s framework, sequenced DST activity category guides the development of various types of digital narrative (see Figure 2.29). These types could be a location story, digital version of records, story starters, photography, and conceptual dictionaries. Shape upon the abilities familiarised at the preceding level, each sequence shows composing and digital imagery techniques.

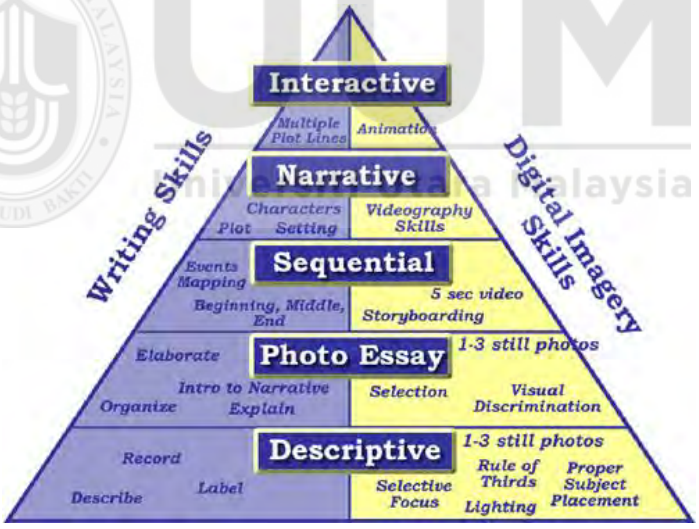


Figure 2.29 Figg and McCartney (2010)'s DST framework

2.7.5.3 Dimension Star Reference Model

Based on her doctoral research's finding, Schäfer (2004) introduced twelve dimensions or elements of DST in her PhD thesis. The elements were represented in what she called Dimension Star. As shown in Figure 2.30, her Abstract Layer Model

displays the relation between dimension of each layer and different level of complexity in categories of digital storytelling. The five categories of DST proposed by Schafer which are related to the Abstract Layer Model are media repositories, story structures, conversational storytelling, emergent stories and lastly, dynamic story.

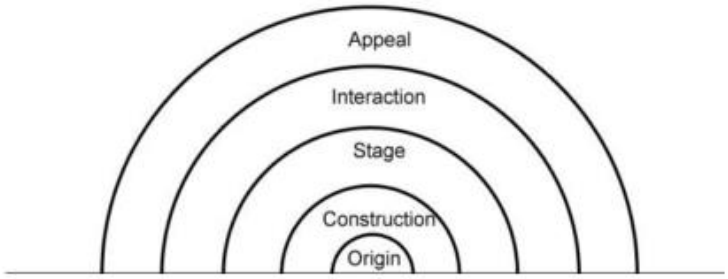


Figure 2.30 Dimension Star Model (Schäfer, 2004)

2.7.5.4 Learner-Generated DST

Kearney (2011) described a DST framework that structurally present DST issues and future cycles. As shown in Figure 2.31, the framework is divided into three categories: resources- digital facilities that learners interact with; tasks- activities the learners participate in; and supports- usually teacher-mediated procedures assisting learners' engagement with resources and tasks. Arrows in the representation depict the sequence of activities and interactions between these three categories. Kearney (2011) however stressed that; although the pedagogical framework provides a guide to structure learning experiences for learner- generated DST tasks, account still needs to be taken of learners' specific characteristics and needs.

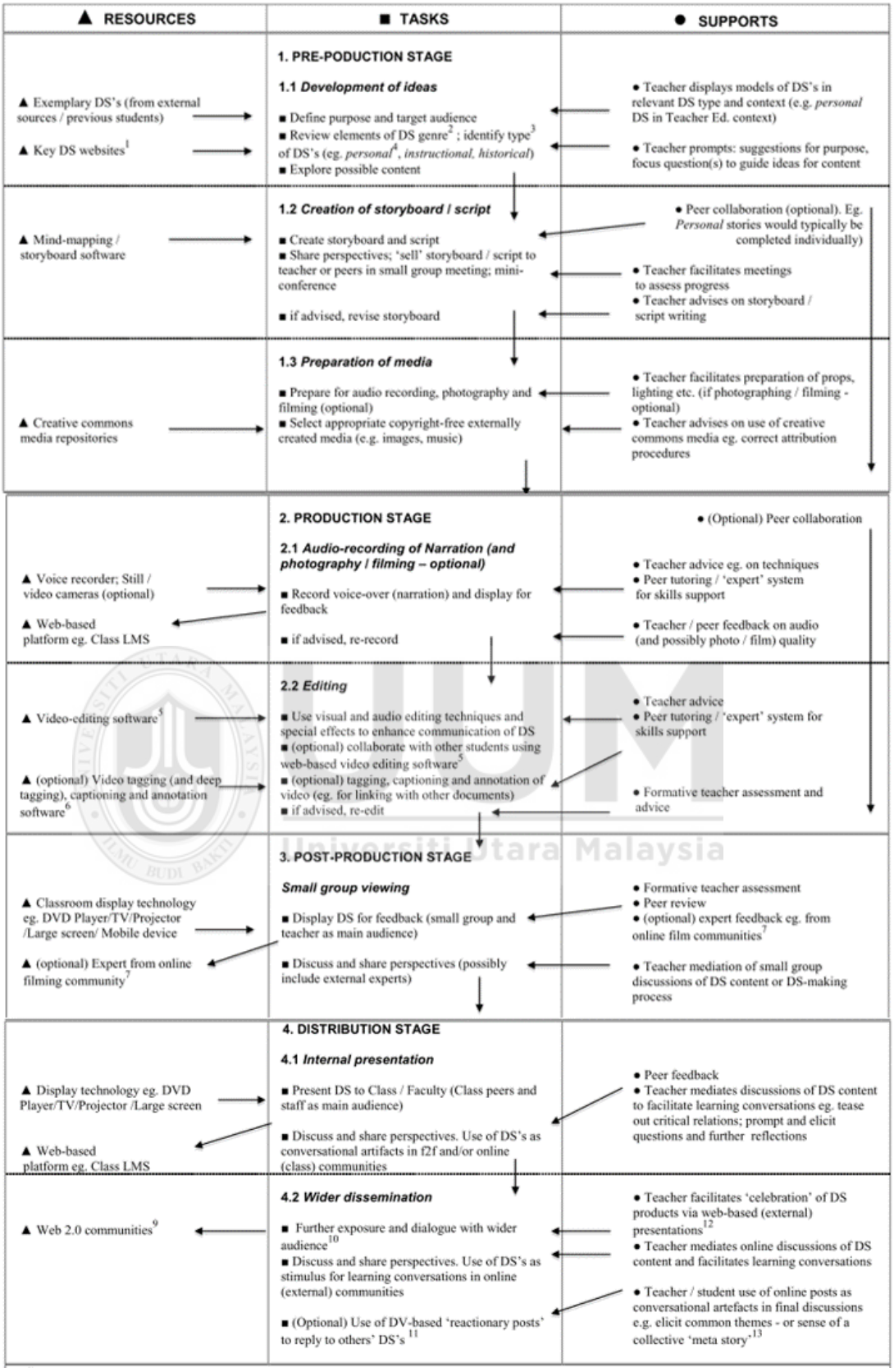


Figure 2.31 Learning design for student-generated DST (Kearney, 2011).

2.7.5.5 DST and ADDIE Integration Model

As depicted in Figure 2.32, Robin (2008) witnessed a dramatic growth in the educational use of DST, as a convergence of affordable technologies interacts with a contemporary agenda for today's class-room.

Figure 2.32 DST for education (Robin, 2008)

Later, Robin and Mcneil (2012) extended their model that provide a practical guidelines by categorizing its' elements within the ADDIE instructional design framework and are presented as starting points that educators should consider when they begin to integrate digital storytelling in their classrooms (refer to Figure 2.33). The guidelines provide educators to teach students all phases of the DST process, including analysis, design, development, implementation, and evaluation of digital storytelling projects that focus on educationally meaningful topics.

Figure 2.33 DST based on ADDIE framework (Robin & Mcneil ,2012)

2.7.5.6 DST Core Elements

In order for the digital storyteller to construct a digital story, there are sets of elements introduced by experts who will guide the aspiring digital storytellers during the construction process. Nevertheless, there is more than one experts and each expert comes with varieties of elements though some are redundant. Therefore, Kuan et al. (2012) proposed the core elements of DST by analysing the commonalities of the elements in order to find the core elements of DST as illustrated in Figure 2.34. The elements in common were clustered based on the similarity of an element's definition in explaining its purpose in DST development. The elements that do not have any commonalities with any elements were isolated and not consider as core elements.

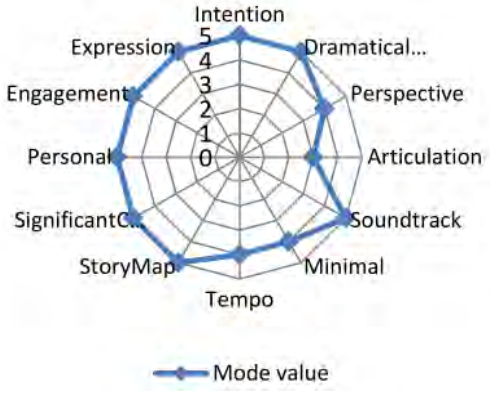


Figure 2.34 None Interactive DST Core Elements (Kuan et al., 2012)

From the reviews on the entire core elements proposed, the results plotted on the chart, and the mode value calculated; it can be clearly perceived that only thirteen elements proposed are accepted by the five experts as core elements of interactive DST. Two of the core elements proposed, which are Communication and Minimal are disposed by the researchers considering the undetermined review by the experts. This decision is made based on the standard of mode value set by the researchers on the analysis conducted on the reviews. This finding is very useful for reshaping a conceptual model representing the core element in accordance to the DST experts' feedback. The result of the review by the experts is of magnitude since it was aimed to obtain their respond and feedback on the core elements proposed.

2.7.5.7 Practice for Creating a DST Work

Through Miyaji (2012)'s model, which was repeated for three storytelling themes, students experienced to raise skills for their computer utilization, to enhance self-understanding, and to bring up skills for problem-solving, as shown by significantly high average rating scale values (see Figure 2.35).

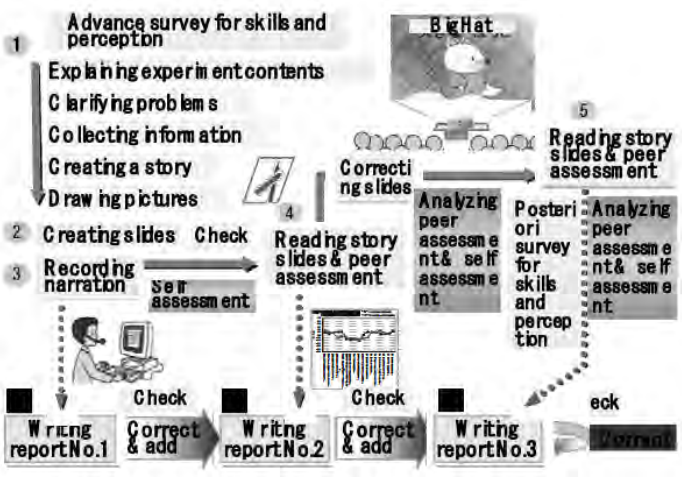


Figure 2.35 Miyaji (2012)'s DST framework

Second, activities that are significantly useful for improving attitude related to ability were confirmed. Third, for all three themes, students realized that both their own work and the work of their peers improved because of the exercise.

2.7.5.8 Storytelling Design Model

In Gaeta et al. (2014)'s proposed model, a script is a logic composition of various situations, based on phases of a Visual Story Portrait- beginning, call adventure, problem, middle transformation, solution, closure (see Figure 2.36). Each story situation has four parts or events comprise of advancer, learning, reflection, and assessment.

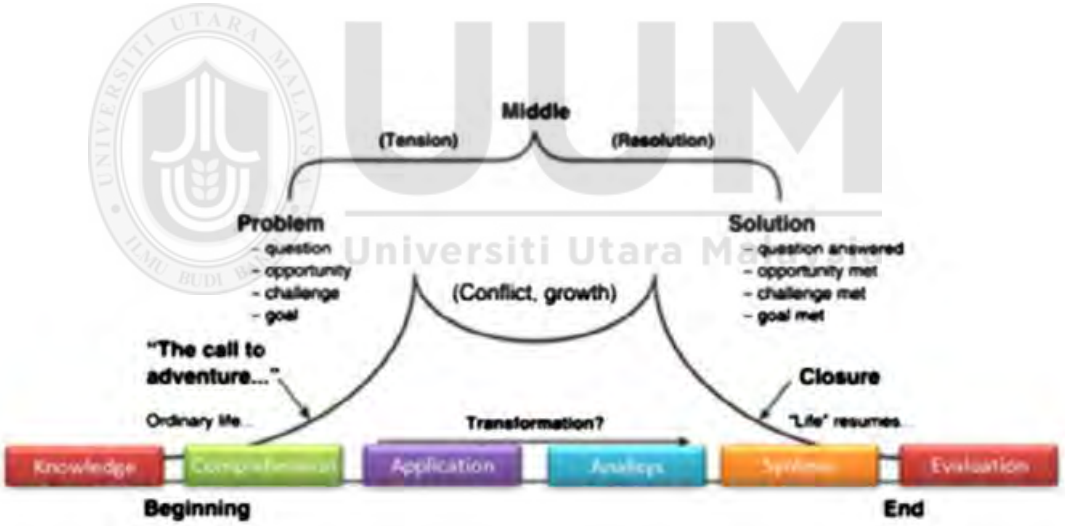


Figure 2.36 Mapping Visual Story Portrait situations, learning objectives and character transformations.

2.7.5.9 Adult Learners' Instructional Narratives Design Model

Smith (2013)'s model benefits practitioners by providing a simple means to design, develop, and deploy instructional content that is universally recognized by all

learners or listeners. Use of the model encourages learner engagement with the content through communities of practice to arrive at shared meanings. As illustrated in Figure 2.37, the model showed how instructional narratives expressly designed for the purpose of enabling learners to alter their perspective, make decisions, take action, acquire particular capabilities leading to a change in behaviour, can be designed and deployed to enable learning, retention and the transfer of learning to practice (performance contexts). This was accomplished through the development of a research based model for designing and deploying instructional narratives based on principles derived from narrative, development, communication, learning and instructional design theories.

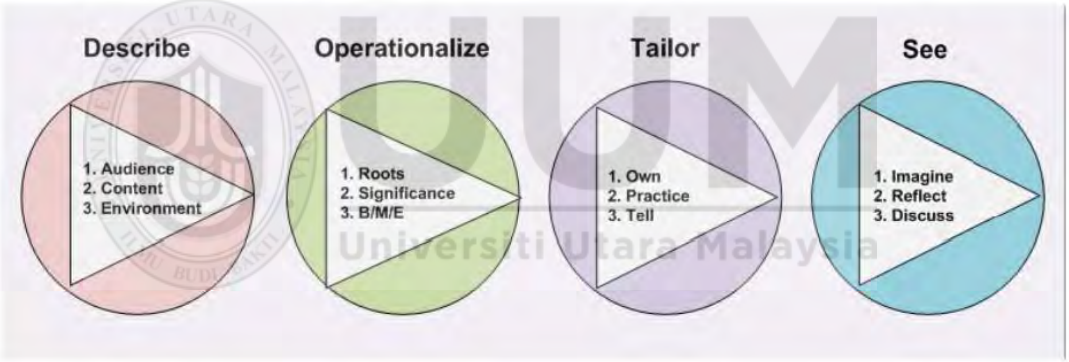


Figure 2.37 Instructional Narratives for Adult Learners

2.7.5.10 Comparative Analysis of DST Models

After all process model and DST elements are reviewed an explained, the comparative analysis about the focus model and elements is elaborated. Further comparative analysis is provided in Table 2.2.

Table 2.2 *Comparative Analysis of Elements or Process in DST framework and models.*

No	Name	Elements / Process	
1	Barret (2006)	• Student engagement • Reflection for deep learning	• Technology integration • Project-based learning
2	Figg & McCartney (2010)	1. Interactive 2. Narrative 3. Sequential	4. Photo Essay 5. Descriptive
3	Schäfer (2004)	• Concreteness • User contribution • Coherence • Continuity • Conceptual Structure • Stage	• Virtuality • Spatiality • Control • Interactivity • Collaboration • Immersion
4	Kearney (2011)	• Resources • Task	• Support
5	Robin (2008)	• Overall purpose of the story • Narrator's point of view • A dramatic question • Quality of the multimedia elements • Meaningful audio soundtrack	• Choice of content • Pacing of the narrative • Grammar and language • Economy of the story detail • Clarity of voice
6	Kuan et al. (2012)	• Intention • Dramatical Question • Soundtrack • Storymap	• Significant Content • Personal • Engagement • Expression
7	Miyaji (2012)	1. Advance survey skills and perception 2. Creating slides	3. Record narration 4. Reading story slides and peer assessment
8	Gaeta et al. (2014)	1. Knowledge 2. Comprehension 3. Application	4. Analysis 5. Synthesis 6. Evaluation
9	Smith (2013)	1. Describe 2. Operationalize	3. Tailor 4. See

The comparison revealed that storytelling elements and technological aspects are comprehensively discussed in DST literature. However, most of the models or framework do not elaborate the step-by-step process digital narrative development in details. Overall, aside producing digital narrative, both DST and LGC also promote critical thinking, reflection, and active student engagement.

2.7.5.11 Implications of DST Comparative Analysis to the Study

Based on the explanations above, it can be concluded that none of the DST process model include comic elements in the framework. This finding indicated that research on the theoretical integration between LGC and DST has been neglected despite their shared characteristics. Thus, it could be inferred that there is a possible direction of adopting DST techniques in the LGC production where both support the use of digital technology for constructive learning; emphasizing on students' comprehension. However, a central question remained on how to determine learning is theoretically occurred resulted by the production of LGC. Therefore, the next section explores how the basis of learning theories reflect the instructional feature of LGC in general.

2.8 Learning Theories

A learning theory denotes to a conceptual foundation on how people learn such as cognitivist, constructivist, and behaviourist learning theories. A descriptive learning theory formulates a mechanism for analysing the learning results while a prescriptive learning theory concerns with guidelines that describe what to do in order to achieve specific outcomes (Ullrich, 2008). Therefore, this section generally explores how these theories contribute to educational comics.

2.8.1 Cognitive Learning Theories

In a broad sense, cognitivism revolves around the psychological paradigm of how the human mind process information (Ullrich, 2008). In educational context, a key feature of Piaget's cognitive theory is in terms of the individual developing their own cognitive apparatus through their interaction with the environment; that each stage of development facilitated new types of thinking which enabled more sophisticated modelling of the world (Taber, 2013). Significantly, based on cognitive system, sentences and sequential pictorials in comics require the combination of meaning and narrative structure in building comprehension across a sequence (Cohn, Paczynski, Jackendoff, Holcomb, & Kuperberg, 2012).

As opposed to attitudinal educational comic that fairly reflects the behaviourist learning theory through sequenced visual storytelling by persuading and modelling learners' desired behaviour (Upson & Hall, 2013), the essence of technical educational comics relies on the cognitive learning theory. This is because; when exploring sensory, thinking evolves as schemes, imagery, language, and symbols that mentally represent the world (Hansen & Zambo, 2005). Unlike illustrations, the character in the sequenced pictures aids cognition with interconnected retention; as textual content was converted into standard comic presentation and the narration compressed information at maximum (Mallia, 2007).

2.8.1.1 Schema Theory

The schema theory is brain-based system of organized knowledge structure (Sweller, 1994). According to Anderson and Pearson (1988) schemata deals with the process of linking stored and new knowledge into the memory known as assimilation and accommodation (see Figure 2.38).

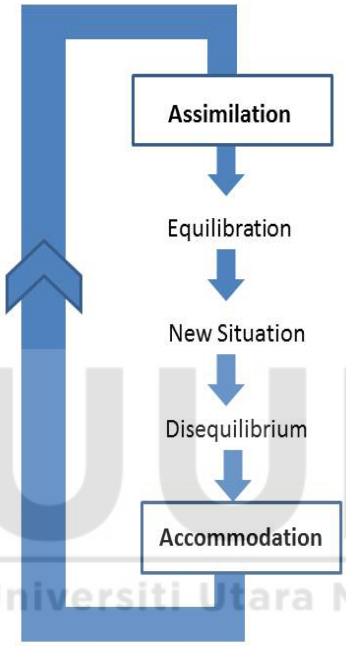


Figure 2.38 Schemata Development

Lee and Tsai (2004) have examined the impact of narrative on the schemas quality; where stories transmit experience and act as a mental model. This way, the context was clarified through ideas, objects, events, and processes. Thus, it could be suggested that narrative in educational comics enables a strategic content structure.

2.8.1.2 Multimedia Learning Theory

Based on cognitivism paradigm, Mayer (2001)'s theory's claimed that "students learn better from words and pictures than from words alone," (p. 63). This principle

focuses on how learning is resulted by the blend between text and images (Jabbour, 2013). Plus, on the basis of this cognitive theory of multimedia learning, students learn better when words are in conversational style rather than formal style. As both elements (images and conversational words) are contained in educational comics, it signified to the adoption of multimedia principles in educational comic. For example, using *PowerPoint* presentation, Chen (2012) had integrated multimedia modularity principle where instead of complicated texture or bullet points; to illustrate instructional content, students were lead into the comic narrative, thus enhancing their cognitive development.

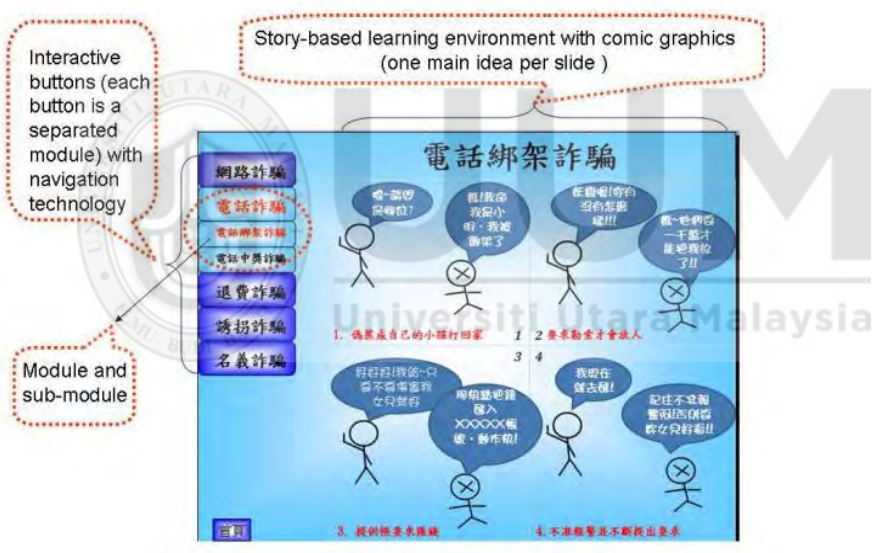


Figure 2.39 Integration of comic element in Multimedia Presentation (Chen, 2012)

Chen's research revealed that, by using anchored instructional theory to conduct a story environment with comics, it will effectively let students feel that the presentations could promote their understanding of the learning contents. Beforehand, Carney and Levin (2002) analysed the effect sizes and interpretations,

based on standardized-difference between an experimental (here, picture) and control (here, no picture) condition (refer to Figure 2.40).

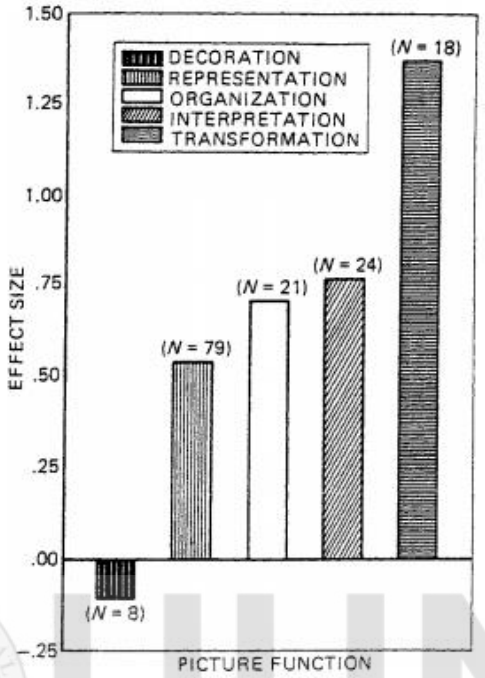


Figure 2.40 The Functional Effect of Images (Carney & Levin, 2002)

A challenge remained on how to maintain balance in image usage when applying multimedia principles (Jabbour, 2012) that reflects Mayer (2005)'s list of multimedia learning tasks from selecting words, selecting images, organizing words, organizing images to integrating words and images. Thus, to examine the functional effect of text and image presented in the comic, Carney and Levin (2002)'s picture analysis method could be replicated. In generally, it could be implied that the principle of multimedia learning supports the instructive outcome of educational comics.

2.8.1.3 Cognitive Load Theory

The premise of Miller (1956)'s cognitive load theory is the human brain has restricted capability to process information. This limitation suggested that enhancing retention towards a learning material could be reached by controlling students' cognitive load level. Methods of reducing cognitive load using visualizations include chunking, pacing, highlighting importance, removing seductive details, using non-dynamic line drawings with proximal colour- coded labels (Wilson, 2015), and images coupled with conversational words (Mayer, Fennell, Farmer, & Campbell, 2004). These strategies align with the information presentation techniques found in educational comics. Therefore, the next subsection describes how the learning approaches in constructionism paradigm support the application of LGC production.

2.8.2 Constructivist Learning Theories

Constructionism is an educational philosophy which advocates that learning is most effective when the learner constructs a tangible or meaningful product as part of an educational activity (Rob, Rob, & Jose, 2016). Instituted by Piaget (1968), the constructivism paradigm describes how learning happens, regardless of whether learners are using their experiences to understand a topic or following the instructions to build an artifact. Constructivist learning theory concentrates on the active process of constructing knowledge by comparing new fact or experience with known understanding, transforming them into different media (Ackermann, 2001). According to Jonassen and Reeves (1996), 'media' is the symbol system that educators and learners use to represent knowledge while 'technology' is the utilized tool to build and share their knowledge representations with others.

As described in Table 2.3, there are two foundational strategies of technology integrated learning.

Table 2.3 *Approaches of using media and technology in learning (Jonassen & Reeves, 1996)*

Approaches	**Description**	**Example**
Learning "from" media and technology	Tutor Tool where information or knowledge is encoded visually or verbally.	Instructional television, computer-based instruction, and integrated learning systems
Learning "with" media and technology	Productivity and Cognitive Tools in constructivist environment.	Cognitive tools and constructivist learning environments.

Cognitive tools require learners to think mindfully in order to use the application to represent what they know (Jonassen, 1994) and provide visual representations of tasks and facilitate learners towards their execution (Tambouris, Zotou, & Tarabanis, 2014). The classification in Table 2.3, denotes that LGC production belongs to learning "with" media and technology category; whereas LGC production model is the cognitive tool and LGC product is the symbol system to present knowledge. Creation of comic's storyline emulates the constructivism paradigm by exploring students' own understanding where the LGC would have the power to reach out to others in similar life situations and ages (Wilmot, Begoray, & Banister, 2014). Henceforth, the next subsection indentifies the corresponding learning approaches of conctructivist precriptive learning theories that relatively support the LGC production practice.

2.8.2.1 Project-Based Learning Approach

Established on the constructivist learning theory, project-based learning commonly trains learners to critically synthesize open-ended issues ensuing solutions,

performances, or products (Ravitz & Blazevski, 2014). In project-based learning, learners address a problem, but the central focus is on the learner-generated content output; based on the driving question (Belland, 2017; Basilotta Gómez-Pablos, Martín del Pozo, & García-Valcárcel Muñoz-Repiso, 2017). Learners brainstorm their notions through thought-provoking questions about the topic, concept, or object before generating, sorting, connecting, and elaborating them (Laprad & Hyde, 2017). This way, writing a comic's scenario becomes a powerful means of self-expressing and communicating ideas (Evangelia, 2013). Activities in project-based learning can be organized around a common interest defined by the learners themselves; while technology provides strategic support by specifying and explaining steps the learner should follow (Basilotta Gómez-Pablos, Martín del Pozo, & García-Valcárcel Muñoz-Repiso, 2017). Hence, it is clarified that; aside from DST, the practice of LGC production is also based on project-based learning approach.

2.8.2.2 Learning by Design Approach

Birth from constructionism, this approach is applied by learners through contextual knowledge construction from the course material and transferring them to the design of end products (Al-nory & Igoche, 2012). These products are commonly functional, aesthetically pleasing, and meaningful to the learner (Sarfo, 2012). Trusting and helping learners achieve expectations appear to be the most successful in aiding their learning (Kolodner et al., 2009) This is done through guided instructions, proceeding in small steps because when the scholastic conceptions are poorly designed in the product, it is assumed that learners partially understood the concepts (Van Breukelen, De Vries, & Schure, 2016). Hence, guided discovery learning by design method comprise of explicit modelling of design concepts ensues better product

outcome compared purely discovery method (Sarfo, 2012). By information seeking and experimentation, learners find answers to the raised questions and apply them in the design (Al-nory & Igoche, 2012). Additionally, in learning by design environment, cognitive tool must be made available by instructor in learners' design activities to achieve learning goal (Sarfo, 2012). Thus, it is proposed that LGC production model would be the advocated cognitive tool for learners to create educational and entertaining LGC products.

2.8.2.3 Reflective Learning Approach

Reflective learning is a process of reflecting on all sources of knowledge that can help to understand a situation, including personal sources and experience (Fullana, Pallisera, Colomer, Fernández Peña, & Pérez-Burriel, 2016). In DST sessions, the essence of reflective learning is re-inquiry and reorganization over the established knowledge for one's own understanding and meaning (Koong, Yang, Wu, Li, & Tseng, 2014) by creating a digital representation that reflects their comprehension of the content (Shelby-Caffey, Úbéda, & Jenkins, 2014). To enable a deep reflection, various reflective learning models grant checklists of staged activities and questions for the learner to use (Black & Plowright, 2010). Although learners' reflective competence could not be assessed by examination, it can however be measured through instruments that exhibit content validity with skills resulting from the lesson evaluations (Alsina et al., 2017). Therefore, a production model of LGC could also be evaluated based on how well the LGC products are generated by learners.

2.8.3 Implications of Learning Theories to the Study

Grasping the learning theories grounded on cognitivism and constructivism paradigm is essential in supporting the construction LGC production model. Advancing cognition through the production of LGC aligns the educational outcome of constructive learning approach and DST; which stimulates learner to achieve 21st Century skills from critical thinking, analytical, collaboration, communication, problem-solving, and decision making skills. In addition, attributes of these technology-enhanced student-centred learning approaches are capable to facilitate the implementation of LGC production and assessment of LGC products.

2.9 Conclusion

A number of concepts, theories including LGC production strategies, DST models, and frameworks have been reviewed. From the literatures, it is recommended that LGC production model should be aligned with various issues such as comic principles, storytelling elements, learning theories, tools for digital comic production, and others. Consistent with leaner-generated content concepts that emphasis on process, reflection, personalization, and assessment, appropriate learning approach, DST techniques, and comic principles must be carefully selected for constructing a quality LGC production model. This finally results in the identification of the focus of study. Figure 2.41 depicts the overall overview of the literature that has been reviewed throughout this chapter.

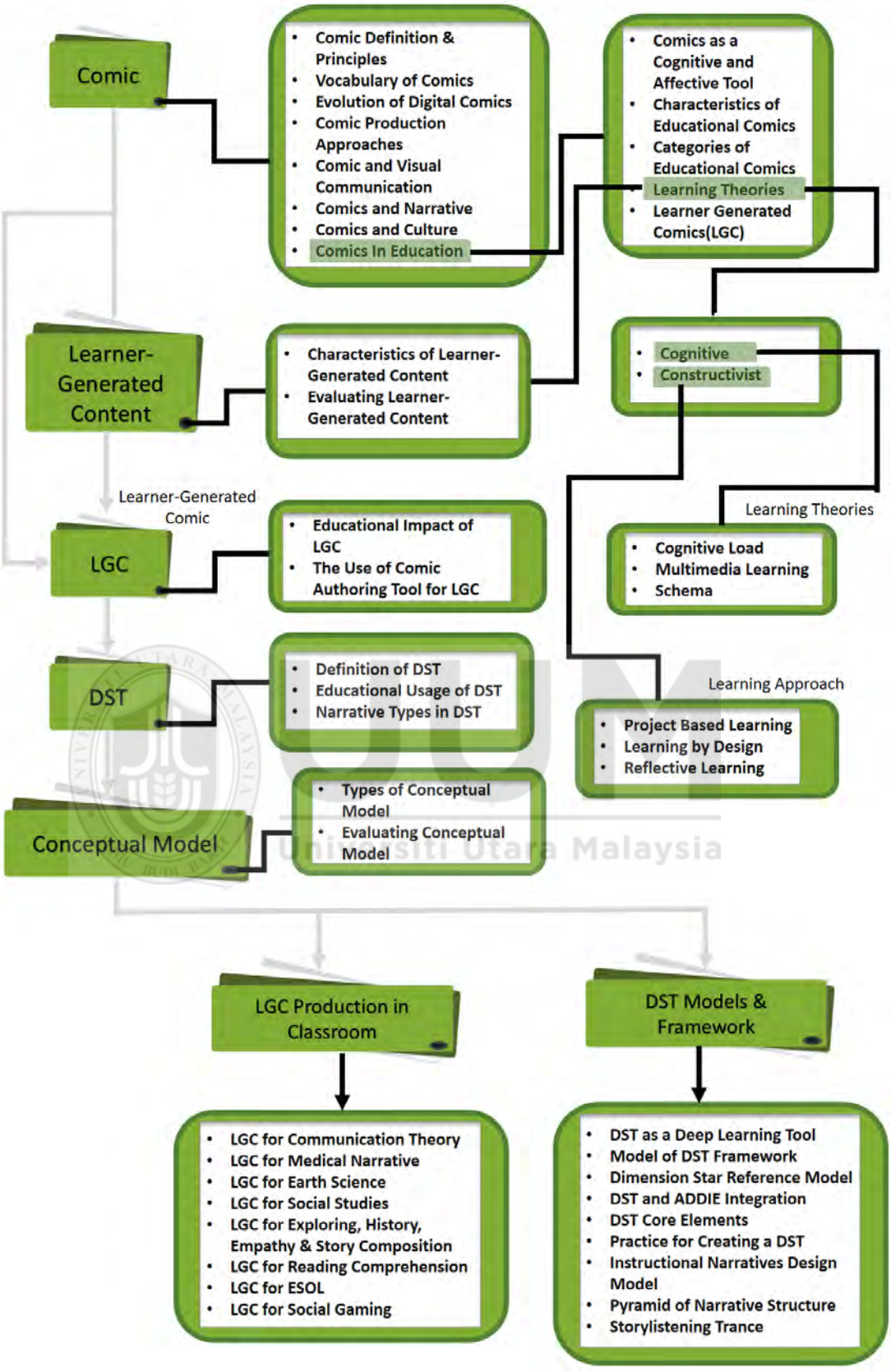


Figure 2.41 Overview of Literature Study

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design and methodological approach of the study. In particular, this chapter discusses the overall research processes and the methods used to accomplish the objectives of this study. Each phase in the methodology and the strategies to be applied are elaborated in details.

3.2 Design Science Research

This study employed the Design Science Research (DSR) paradigm in achieving the main research objective as outlined in Chapter 1. The ultimate goal of DSR is to construct an artefact in response to unsolved problems and satisfy needs (Alturki, Gable, & Bandara, 2013); thus improving situation of environment, institution, and society (Shiratuddin & Hassan, 2013). DSR is largely applied in the area of information system that concerns both people and artefacts (Gregor, 2006). Accordingly, prior works has shown that DSR methodology was progressively implemented in educational technology field (Marjanovic, 2013; El-Masri, Tarhini, Assouna, & Elyas, 2015; Carstensen & Bernhard, 2016).

DSR consists of two essential activities which are building an artefact for a specific purpose and determining how well it performs (March & Smith, 1995). Results from DSR should be understandable, highly focused, and when implemented, it solve a real, current problem (Kuechler & Vaishnavi, 2011). Therefore, in light of DSR

guidelines by Hevner et al. (2004) (see Table 3.2), it provided a clear reasoning for adopting this paradigm as described in the next section.

Table 3.1 *Set of DSR Guidelines*

Guideline	Description
Guideline 1: Design as an Artefact	DSR must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of DSR is to develop technology-based solutions to important and relevant problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods
Guideline 4: Research Contributions	Effective DSR must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	DSR relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
Guideline 6: Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	DSR must be presented effectively both to technology-oriented as well as management-oriented audiences.

3.3 Rationale of using DSR Methodology

The following justifies why DSR was chosen as the principle methodology of conducting this research:

i. Generally, DSR prioritizes a novel design artefact; particularly construct, model, method, or instantiation as the primary research outcome. In relation, the artefact of this study is the proposed LGC production model; which is classified as a conceptual process model.

ii. DSR caters for research problem pertaining to real-world practice and design issues. Hence, this methodology is relevant to this study because it encompasses existing classroom practice involving digital media design.

iii. DSR digests the rigorous approaches in development and evaluation of the artefact. The construction and evaluation of the proposed model comprise of extensive review of literature, content and comparative analysis, user participation and testing, as well as expert review.

iv. Since DSR also produces technology-based solutions for education, this methodology suits the context and domain of the study.

Based on the discussed philosophical grounding, the process involved, and the research outcomes, DSR methodology provides a strong skeleton in piloting this study. Consequently, phases of DSR from Vaishnavi and Kuechler (2007) is adapted to achieve the intended objectives. There are four main stages in accomplishing the goal of the study, (i) problem awareness, (ii) suggestion and development (iii) evaluation, and (iv) conclusion. The overall research methods are outlined illustratively in Figure 3.1.

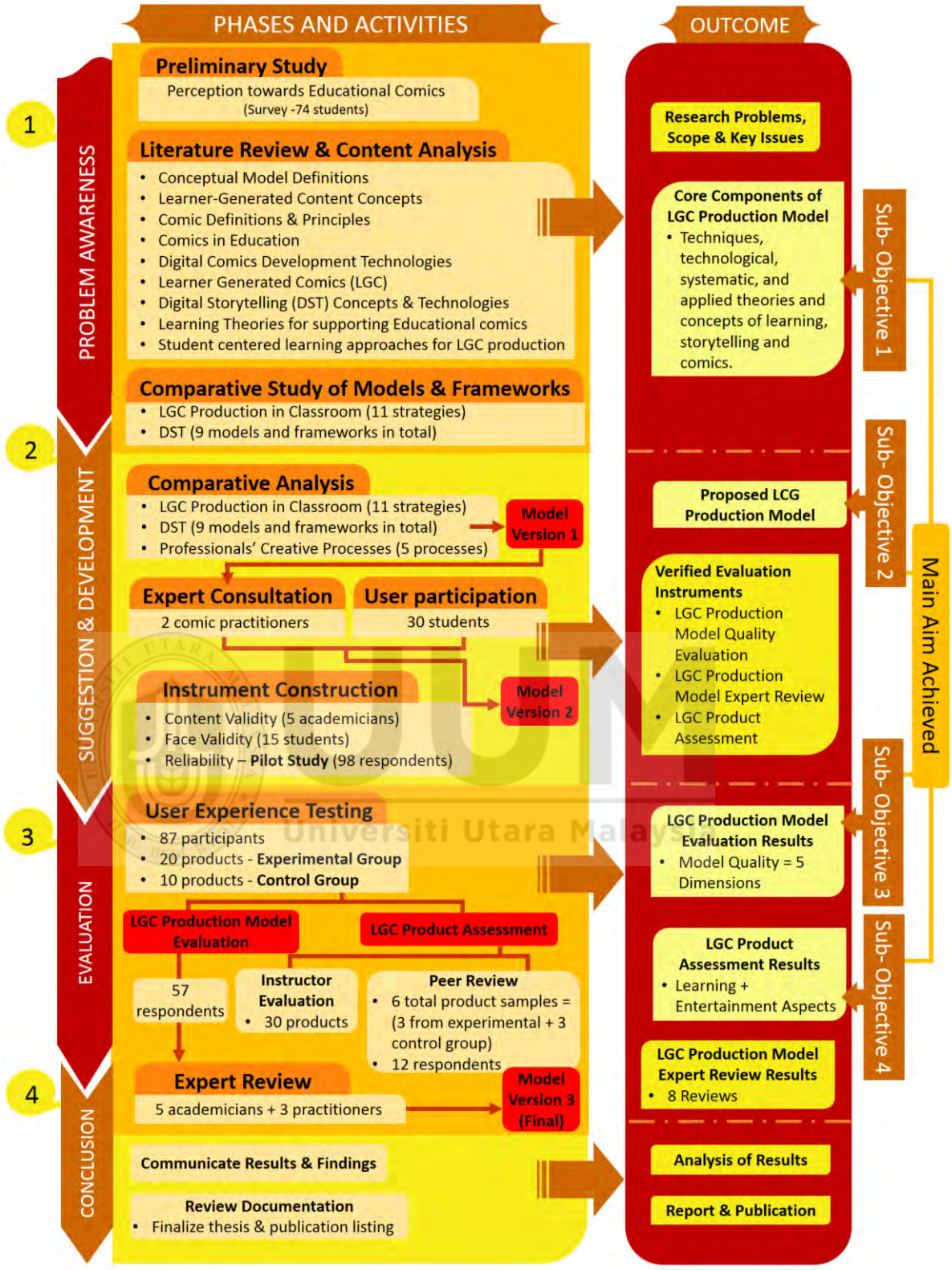


Figure 3.1 Phases in the Research Process

3.4 Phase 1: Problem Awareness

In DSR, the awareness of research problem is ascertained by construing issues and aspects from allied discipline (Vaishnavi & Kuechler, 2007). It involves problem and motivation identification, and objectives of a solution definition (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008). Hence, this study conducted three main activities to build awareness of the problem; comprised preliminary study, literature review and content analysis, and comparative study of models and frameworks (see Figure 3.2).

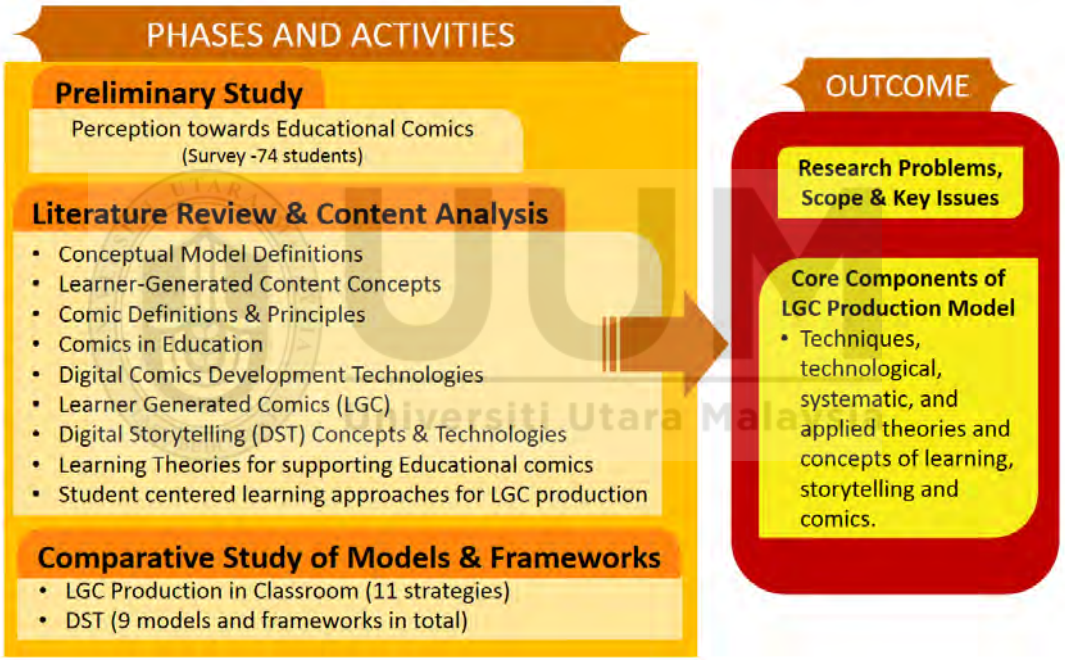


Figure 3.2 Problem Awareness Phase

3.4.1 Preliminary Study

The research area was firstly determined by conducting a preliminary study of comic, and LGC perceptions. The results were used to initially rationalise and motivate this study. The findings and discussion for this study are disclosed in Chapter 1.

3.4.2 Literature Review and Content Analysis

Content analysis provides a systematic and objective denotation to construct valid extrapolations from verbal, visual, or written data in order by quantifying and relating the categories to the context that produced the data (Kolbe & Burnett, 1991). Reviewing and analysing content recorded in prior literature is important to provide applicable solutions to the problem in DSR (Peffers et al., 2008). Thus, Figure 3.2 visualizes the themes covered in literature review and content analysis activities. Conceptual model, digital educational comic core foundation, LGC classroom practices, models, and frameworks of DST, issues connected to learner-generated content, and design of digital media were scrutinized in clarifying the problem statement, and practical gaps. The literature and content analysis are explicitly discussed in Chapter 2.

3.4.3 Comparative Study of Models and Frameworks

Two comparative studies were conducted in this phase; (a) LGC production practices (classroom strategies) and (b) DST models and frameworks. The purpose of this activity was to recognize the limitations of selected models and frameworks in catering the problem defined in this study. From this process, knowledge gaps were discovered. Apart from that, existing concepts and theories from literature review were also used as a basis to support and determine the key aspects and core components in issuance of LGC production model as the solution to the identified problem. The results of these comparative study are summarised in Chapter 2.

3.5 Phase 2: Suggestion & Development

The objective of this phase is to suggest key concepts needed to solve the problem (Takeda, Veerkamp, Tomiyama, & Yoshikawa, 1990) and construct the artefact as the solution to the problem (Peffers et al., 2008; Kuechler & Vaishnavi, 2008). As addressed in Chapter 1, a systematic, scholarly literature supported LGC production model is proposed as a solution for learners to design and develop digital educational comics. Therefore, as shown in Figure 3.3, this phase involved comparative analysis, expert consultation, expert consultation, user participation, and evaluation instruments construction activities.

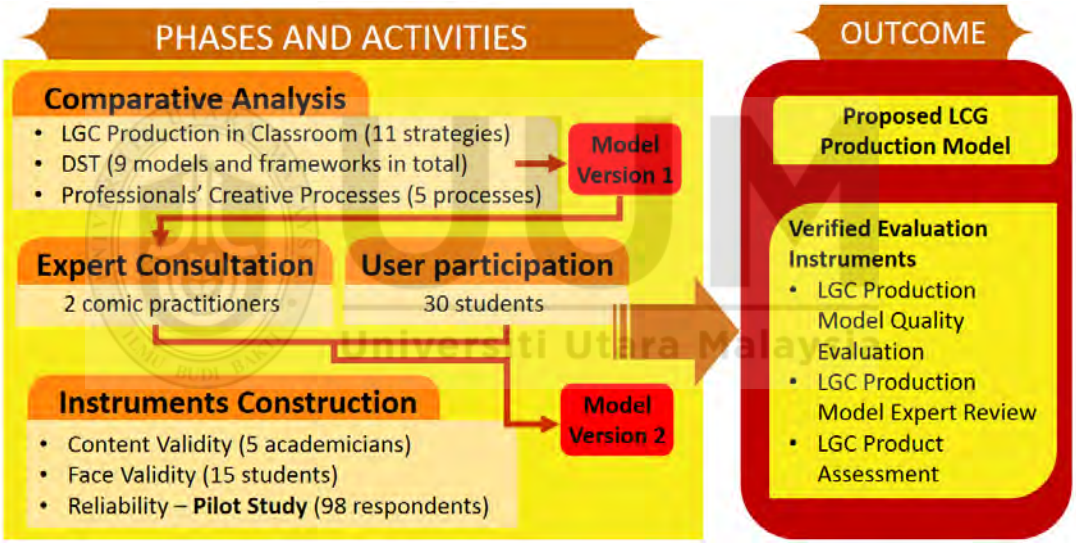


Figure 3.3 Suggestion & Development Phase

3.5.1 Comparative Analysis

Rooted from the concepts and theories explored in the previous phase, the components of LGC production model were extracted though in-depth comparative analysis of LGC classroom strategies, DST models and frameworks, and

professional creative process. The findings were integrated in the proposed model (as further discussed in Chapter 4).

3.5.2 Expert Consultation

Expert elicitation is a structured and transparent approach to address uncertainties (Knol, Slottje, Van Der Sluijs, & Lebret, 2010; Nolte & Prilla, 2013b). Thus, in this study, expert consultation activity was conducted to particularise and structure the proposed model's components. This is because formal discussion with the experts involves brainstorming of idea, approval of concept, and reviews on terminologies as reported in Chapter 4. This allows the experts to validate the components identified through comparative content analysis.

3.5.3 User Participation

User participation is a content collection approach for conceptual model development (Nolte & Prilla, 2013b). By gathering the procedure the users went through in producing LGC, the common method of digital educational comic development was attained. Consequently, the designed LGC production model was evaluated based on the instruments described in the next subsection.

3.5.4 Instrument Construction

To evaluate the research artefact, instruments consisted of structured questionnaires were constructed according to Zikmund (2003)'s instrument design method as shown in Figure 3.4. Three instruments were developed: (1) to LGC production model quality evaluation, (2) LGC production model expert review, and (3) LGC product assessment.

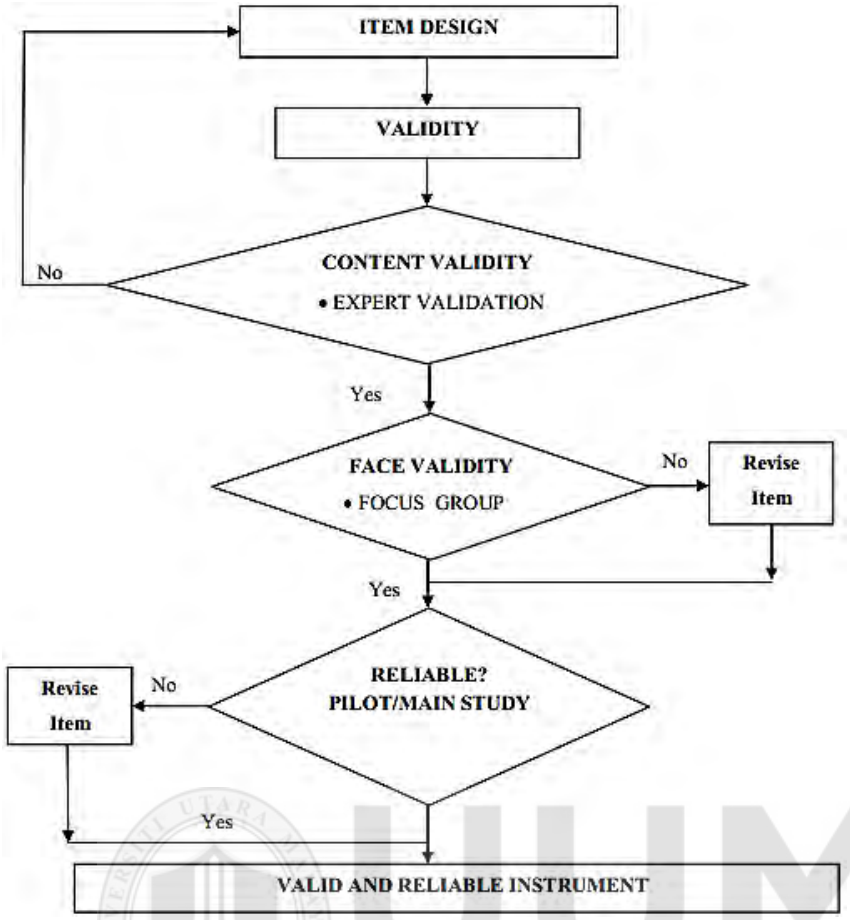


Figure 3.4 Questionnaire instrument design method (Zikmund, 2003)

The dimensions and item statements for the questionnaires were initially selected from literature. In determining the measurement scale for Instrument (1) and (3), semantic differential was adopted because it is an established measurement technique in information systems (Verhagen, Hooff, & Meents, 2015). This method was also chosen as it is a cost-effective method for obtaining data on emotional reactions that could be applied in many different situations or cultural contexts (Dalton, Christopher, Oshida, Hikichi, & Izumi, 2008). Mid-point scale was also used in Instrument (1) because it improves the reliability and validity of the ratings (Krosnick, Judd, & Wittenbrink, 2005).

3.5.4.1 Content and Face Validity

To validate the content of the questionnaire instrument items, five experts consisted of academicians in digital educational media design and development were officially appointed to review the instruments. Based on their knowledge, expertise, skills, and experiences in the above-mentioned field, they were required to rate the relevance of each items in the questionnaire (refer to Appendix B). The experts also indicated whether the items and keywords meet the appropriate standards of media production, accurately reflect the dimension category, capture the entire scope of LGC production domain, and other required details or suggestions. Their critiques were reflected where several associated items were either dropped or rephrased.

Contiguously, face validity was performed involving a focus group of ten students as the potential users in understanding the questionnaire. The questionnaire items were modified according to their feedback and agreement during the discussion.

3.5.4.2 Pilot Study (Reliability)

In order to test the reliability, consistency, and stability of the instruments, a pilot study involving 98 undergraduate students of UUM was conducted. They were regarded as a potential user of LGC production model. Before data were obtained, the respondents were given an explanation about the LGC production model as the chosen model for developing digital educational comic. During the data collection, the researcher also detected and recorded any content in the questionnaire that failed to be recognized or understand by the respondents.

Once the questionnaires completed, submitted, statistical test was conducted. Factor analysis and Cronbach alpha test were executed to measure the reliability of instrument. Firstly, the value of Kaiser-Meyer-Olkin (KMO) and Bartlett‘s test of sphericity was calculated. According to Behrens (1997), the condition of factor analysis are:

- KMO value must be greater than 0.50
- Bartlett‘s test of spherecity must have significant value of p less than 0.0

It is required that the instrument must be greater than 0.5 factor loading rule (Hair, Black, Babin, & Anderson, 2010). Then, data rotation process was done using varimax method. Finally, Cronbach‘s Alpha test was run to remove items which did not concur to the minimum value of 0.7 (Sekaran, 2003). Plus, to test instrument consistency, value of Cronbach’s alpha coefficient indicates that $\alpha > 0.7$ to be accepted as reliable (Sekaran, 2003). All of these conditions and procedures are very important to avoid measurement error during actual study. The following subsections explain the process of developing the instruments by selecting the related dimension and statement items from literature. Validated and revised versions of the instruments after content validity and pilot study activities are also presented.

3.5.4.3 LGC Production Model Quality Evaluation Instrument

Several frameworks for evaluating conceptual models have been established by prior researchers (eg: Wolff & Frank, 2005; Mehmood & Cherfi, 2009; Heidari & Loucopoulos, 2014) which may be classified into distinctive perspectives. In deployment perspective, conceptual models can be examined in association with its' objectives (Frank, 2006). Since LGC production model centralizes on the process of

LGC product design and development, the evaluation of LGC production model should focus on its validity and practicality. Hence, Matook and Indulska (2009)'s characteristics of conceptual model (refer to Table 3.2) was adopted into the instrument design. It embodies a comprehensive set of criteria that incorporates previous research in reference model field.

Table 3.2 *Characteristics of Conceptual Model (Matook & Indulska, 2009)*

Conceptual Model Characteristics	**Meaning and Definition**
Generality	Degree to which the model performs a broad range of functions and is usable in different cases ease.
Flexibility	Ease with which a model adapts and accommodates to changes of the requirements other than for those for which it was specifically designed.
Completeness	Degree to which all the components of the model are present under a predefined scope.
Usability	Ease with which a user or user firm can operate, implement, and apply the model.
Understandability	Degree to which the purpose, concepts, and structure of the model is clear to the users.

Thus, the proposed model was measured in terms of generality, flexibility, completeness, usability, and understandability. It was implied that these dimensions would represent the quality of LGC production model as a valid and practical tool for producing LGC products. Basically, this instrument was utilized to measure if the proposed model has meet the user's needs, requirements, and expectations (Jun & King, 2008).

Next, cognitive learning items from Dolmans and Ginns (2005) and Pintrich (1993) were adapted into the instrument to measure related constructive learning activities during LGC production. Then, evaluation items by Bonner (2008) were adapted into appropriate dimensions because the proposed attributes combined several techniques

from various works to assess methodologies and processes. Granted that Bonner (2008) claimed his measurement instrument could be employed as a tool in evaluating system development methodology, his work is relevant to be adapted in assessing LGC production process.

In addition, the items from Syamsul, (2011)'s mGBL engineering model evaluation instrument were also heavily borrowed to assess methodology and process. This was due to his instrument is grounded on a number of evaluation dimensions proposed by prior researchers to evaluate models and approaches which were extracted from different fields such as information technology, education and project management.

Furthermore, this study also considered Maes and Poels (2007)'s construct measurement instrument in evaluating LGC production process. The justification was, it provides a practical evaluation framework that combined conceptual model variables related to perceptions of pragmatic quality, semantic quality and usability, as well as satisfaction outcomes. Therefore, since the constructs are used to assess conceptual model, then they are significant to be adapted in LGC production model questionnaire items. In summary, the instrument for assessing LGC production model was designed in Table 3.3.

Table 3.3 *Original Version of LGC Production Model Evaluation Instrument*

Dimension	Proposed Items	Source
Generality	(g1) LGC enables me to summarize what I had learnt in the form of digital educational comic.	A
	(g2) LGC enables me to elaborate and organise my knowledge the form of digital educational comic.	B
	(g3) During the digital educational comic development, LGC enables me to relate my learning towards essential theories/ ideas/ information/ knowledge.	B
	(g4) During the digital educational comic development, LGC enables me to apply knowledge to the discussed problem.	A
	(g5) During the digital educational comic development, LGC enables me to apply knowledge to other situations/ problems.	A
	(g6) During the digital educational comic development, LGC enables me to reflect previous knowledge and connect it to new knowledge.	B
Flexibility	(f1) LGC is flexible for digital educational comic development with minimal planning.	C
	(f2) Using LGC fits well with the way I like to work.	C
	(f3) LGC enables me to develop digital educational comic according to my own taste and preferences.	D
	(f4) Changing requirements in LGC over time is possible.	D
	(f5) LGC is adaptive and responsive to changes.	C
	(f6) Deviating from the established activities and phases in LGC is possible.	D
	(f7) LGC is tolerant of minor errors and alterations.	D
Completeness	(c1) All the concepts and components included in LGC are strictly necessary for digital educational comic development.	D
	(c2) All the components in LGC are relevant for the representation of the digital educational comic development process.	E
	(c3) LGC gives a complete representation of the digital educational comic development process.	E
	(c4) LGC enables me to accomplish tasks in digital educational comic development more thoroughly.	C
	(c5) LGC allows me to intelligently check the relevance and completeness of my digital educational comic.	D
Usability	(us1) Using LGC produces the digital educational comic, for which it is intended for.	D
	(us2) LGC is effective in providing information I need on digital educational comic development.	E
	(us3) Using LGC enhances the quality of my digital educational comic.	C
	(us4) LGC provides communication and collaboration between group members to continuously assign tasks according requirements.	D
	(us5) Using LGC increases my performance and productivity.	D
	(us6) The advantages of using LGC outweigh the disadvantages.	C
	(us7) LGC would be an improvement to a textual description	E

of the digital educational comic development process.

Dimension	Proposed Items	Source
Understandability	(un1) Learning LGC is easy for me.	E
	(un2) LGC is clear and understandable.	E
	(un3) Using LGC does not require a lot of mental effort.	D
	(un4) LGC as a whole is workable.	C
	(un5) The phases and activities in LGC are easily followed.	C
	(un6) Complying with the phases and activities in LGC is easy.	D
	(un7) LGC is not cumbersome to use.	D

Legend:
A -(Dolmans & Ginns, 2005) **B**- (Pintrich, 1993)
C- (Bonner, 2008) **D**- (Syamsul, 2011) **E** - (Maes and Poels, 2007)

Feedback from the experts in content validity activity has suggested a few changes towards the items. Although most of statements were relevant, item (g5) with (g6), item (f4) with (f5), and item (u1) with (u5) were considered overlapping. Observably, item (us5) was regarded ambiguous to the scope of this study. Item (us6) was intricate for potential participants to measure while (un7) had negative statement. Compliantly, (us6) and (un7) were dropped from the pre-design of LGC production model evaluation instrument and overlapping items were combined and modified. Importantly, more accurate Malay translations towards the items were put forward by the reviewers. In general, most of the experts agreed that the proposed items assess has appropriately defined the dimensions.

Afterwards, views from face validity activity has highlighted several implications. Fore mostly, respondents required clearer Malay statements. Few of them found statements in item (f6) was rather vague. The keyword ‘tolerance’ in item (f7) seemed to be problematic. As a result, both of these items were dropped and confusing items were rephrased. Overall, as depicted in Table 3.4, only 22 items remained in the revised instrument. Another review cycle with experts were carried

out with 2 experts to approve the modified instrument before proceeding to pilot study.

Table 3.4 *Revised Version of LGC Production Model Evaluation Instrument*

Dimension	**Proposed Items**
Generality	(g1) LGC enables me to summarize what I had learnt in the form of digital educational comic. (g2) LGC enables me to elaborate and organise my knowledge the form of digital educational comic. (g3) During the digital educational comic development, LGC enables me to relate my learning towards essential theories/ ideas/ information/ knowledge. (g4) During the digital educational comic development, LGC enables me to apply knowledge to other situation/ scenario / context. (g5) During the digital educational comic development, LGC enables me to reflect prior knowledge and connect it to new knowledge.
Flexibility	(f1) Using LGC fits well with the way I like to work. (f2) LGC enables me to produce digital educational comic according to my own taste and preferences. (f3) I have the options to follow or deviate from the phases and activities suggested in LGC. (f4) LGC enables me to make alterations towards certain phases and activities in digital educational comic development process.
Completeness	(c1) All the concepts and components included in LGC are strictly necessary for digital educational comic development. (c2) All the components in LGC are relevant for the representation of the digital educational comic development process. (c3) LGC gives a complete representation of the digital educational comic development process. (c4) LGC enables me to accomplish tasks in digital educational comic development more thoroughly. (c5) LGC allows me to intelligently check the relevance and completeness of my digital educational comic.
Usability	(us1) Using LGC produces the digital educational comic, for which it is intended for. (us2) LGC is useful in providing information I need on digital educational comic development. (us3) Using LGC enhances the quality of my digital educational comic. (us4) LGC would be an improvement to a textual description of the digital educational comic development process.
Understandability	(un1) LGC is clear and understandable. (un2) Understanding LGC does not require a lot of mental effort. (un3) LGC as a whole is workable. (un4) The phases and activities in LGC can be followed.

A 9-point semantic scale was formed for the model evaluation questionnaire. Each score represented the level of agreement for each item with 1 was the lowest score and 9 was the highest.

Exploratory and confirmatory factor data analysis was conducted where Table 3.5 displays the outcome of KMO and Bartlett‘s test. These results were significant as they fulfilled the previously stated conditions.

Table 3.5 *KMO and Bartlett‘s test results*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.909**
Bartlett's Test of Sphericity	Approx. Chi-Square	1546.521
	df	231
	Sig.	.000

Factor loading value conditions were accomplished as all 22 items obtained greater than 0.5 score (see Table 3.6). Five principle components were also successfully extracted that explained 70.011% of the total variance.

Table 3.6 *Factor Loadings results*

Items	**Loadings**	**Items**	**Loadings**	**Items**	**Loadings**	**Items**	**Loadings**	**Items**	**Loadings**
g1	.765	f1	.592	c1	.670	us1	.676	un1	.701
g2	.680	f2	.648	c2	.629	us2	.719	un2	.799
g3	.602	f3	.644	c3	.576	us3	.743	un3	.790
g4	.706	f4	.669	c4	.630	us4	.738	un4	.721
g5	.708			c5	.709				

Rotation of data using varimax method is depicted in Table 3.7. Analyzing these results, it was mathematically suggested to replace item (f1), (c1) and (us3) in different clusters from the earlier proposed instrument. However, the researcher

decided to retain these items in their original group after consulting with statistical experts as their statement within still exhibit the specified dimension.

Table 3.7 *Rotation of Factor Loadings*

	Component				
	1	2	3	4	5
g1	.858	.139	.169	.098	.126
g2	.732	.373	.281	.065	.165
g3	.658	.185	.248	.222	.174
g4	.620	.225	.058	.485	.183
g5	.543	.356	.196	.405	.096
f1	.158	.479	.200	.237	.422
f2	.013	.292	.365	.236	.642
f3	.219	.310	.074	-.039	.790
f4	.238	.053	.304	.244	.756
c1	.318	.402	.565	.131	.315
c2	.310	.506	.426	.327	.077
c3	.317	.617	.277	.093	.398
c4	.212	.833	.176	.127	.285
c5	.323	.717	.034	.275	.126
us1	.250	.375	.672	.135	.157
us2	.321	.058	.616	.278	.375
us3	.037	.442	.382	.309	.493
us4	.176	.056	.771	.140	.226
un1	.224	.288	.399	.614	.067
un2	-.050	.165	.397	.672	.123
un3	.304	.329	.213	.701	.039
un4	.320	-.001	-.088	.767	.332

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Finally, Cronbach's Alpha test showed significant results as presented in Table 3.8 and

Table 3.9. These findings demonstrated that the instrument design was consistent.

Table 3.8 *Case Processing Summary*

		N	%
Cases	Valid	41	100.0
	Excluded[a]	0	.0
	Total	41	100.0

Table 3.9 *Reliability Test*

Dimensions	Cronbach's Alpha	N of Items
Generality	.898	5
Flexibility	.712	4
Completeness	.845	5
Usability	.839	4
Understandability	.860	4

The final version of the instrument is presented in Appendix C. In summary, from all the tests conducted, the proposed dimensions and items were feasible for evaluation of LGC production model quality.

3.5.4.4 LGC Production Model Expert Review Instrument

This instrument is used for selected academicians and practitioners to validate and finalize the proposed model through an expert review activity. Close and open ended questions are utilised. The first five items are based on conceptual design model experts review instruments constructed by Siti Mahfuzah (2011) and Nurulnadwan (2014). The questions ask about the (1) relevancy of the proposed phases which represent the main stages of LGC production, (2) necessity of the proposed tasks and the activities within them, (3) connections and flows of all of the components, (4) usability of the proposed model, and (5) readability of the proposed model.

The rest of the items are adapted from maturity model experts review instrument by Salah, Paige, and Cairns (2014). These instruments were adapted because their questionnaire items were specifically designed for model evaluation by domain experts. Hence, item (6) to (9) enquire about the necessity to add, remove or modify the phases, tasks, activities or descriptions proposed in the model. Next, items (10) to (12) inquire on how LGC production model could be made more understandable, practical, flexible, and useful. Finally, the last item is provided for additional comments by the experts. The items for LGC production model expert review instrument design are displayed in Table 3.10 and Appendix D.

Table 3.10 *LGC Production Model Expert Review Instrument*

No.	Question	Answer Choice / Type
1	Are the following proposed components relevant to represent the phases of digital educational comic development?	• Essential • Useful but not essential • Not necessary
2	Are the following proposed tasks (and the activities within them) relevant to represent all conceptual elements of digital educational comic development?	• Essential • Useful but not essential • Not necessary
3	The connections and flows of all the components are logical.	• Yes • No
4	The production model is usable to the development of digital educational comic.	• Yes • No
5	Overall, the production model is readable.	• Yes • No
6	Would you add any phases, tasks or activities? If so please explain what and why.	Open answer
7	Would you remove any phases, tasks or activities? If so please explain what and why.	Open answer
8	Would you refine/update the phases, tasks or activities? If so please explain what and why.	Open answer
9	Would you suggest any updates or improvement related to the model description? If so please explain what and why.	Open answer
10	Could the model be made more understandable? How?	Open answer
11	Could the model be made more practical and flexible? How?	Open answer

12	Could the model be made more useful? How?	Open answer
13	Please write your further comments below.	Open answer

3.5.4.5 LGC Product Assessment Instrument

As clarified in Chapter 1, an assessable educational comic should be measured based on what level it was able to educate and entertain its reader. This attribute was further supported by practitioners during expert consultation. Hence, LGC product assessment instrument contained two major dimensions; namely learning and entertainment. The intention, outcome, aesthetics, and enjoyment sub-dimensions were named based on the activity categories within the Assessment phase of the proposed LGC production model. Principally, naming the aspects within dimension were based on learner-generated content quality criteria associated with content and format by Pérez-Mateo et al., (2011) and Kay and Knaack (2008)'s coding scheme for learning objects assessment.

Item statements give attention on comic core elements. Hence, an ordinal scale review form by Cooper (2011) was adapted as it contains standards for the particular educational topic or subject and comic literary. Griffith (2010)'s assessment criteria for school library graphic novel was also adapted into the questionnaire. Besides that, educational comic attributes in Cirigliano (2012)'s experiment were also replicated in the instrument design. The first version of the instrument is exhibited in Table 3.11.

Table 3.11 *Original Version of LGC Product Model Assessment Instrument*

Aspects		Description	Source
(1) Learning			
		Intention	
L1	Learning Goal Alignment	• At what level the comic's ideas/questions/facts/pieces of information are relevant to the topic?	A*,C*, D*
L2	Agility	• To what degree the text element in the comic is presented in short, concise segments?	A*
L3	Typography	• To what extent the font shapes, colours and size facilitate and stimulate reading?	A*,D*
L4	Consistency	• To what degree the comic make use of certain pictorial consistency which adds significantly to the learning process?	A*
L5	Recipient	• To what degree does the comic promote a positive attitude toward the topic? • To what degree does the comic respect the reader by presenting positive race/gender/ethical, and/or cultural values? • To what extent do the comic's readability and interest level developmentally appropriate for universal audience?	A*,D*
L6	Reusability	• To what degree do the digital comic's native files work efficiently for different users in different digital environments and in different educational contexts over time? • At what level the native file self-contained, modular, traceable, modifiable, usable, standardized and properly grained, generic, and platform independent?	F*
		Outcome	
L7	Accuracy	• At what level the ideas/questions/facts/pieces of information in the comic is accurate, free of errors, and fact-checked?	A*,C*
L8	Reliability/ References	• At what level the quoted materials are visibly cited?	A*
L9	Argumentation/ Constructive Activity	• At what level the ideas/questions/facts in the story are sufficient in number and scope to support the targeted educational outcomes? • To what extent do the comic generates ideas/questions/facts/pieces of information about	B*,D*,E*

		the topic?	
L10	Thoroughness	• At what level the characters/personas interaction with the educational content are meaningful and permit the reader to have a much greater understanding of the concept/topic?	A*,D*,E*

Aspects		**Description**	**Source**
L11	Emphasis of Key Concepts	• To what extent the comic's pictorials facilitate the reader's involvement in, understanding of, and use/transfer of its educational content? • At what level the ideas/questions/facts/pieces of information in the comic are easily balanced, distinguished or discernable from fiction or fantasy?	B*,C*
L12	Prospective	• To what degree the story potentially open for sequel or continuation? • To what extent the comic ending trigger further questions related to the educational topic?	A*,D*
(2) Entertainment			
		Aesthetics	
E1	Visual Appeal	• At what level the comic's illustrations/photos/graphics are appealing? • To what degree the colour palette (e.g., pastels, primary colours, sepia tones) aid the reader in understanding the tone and mood of the story? • To what extent the comic contain a vivid and interesting writing style that actively involves the reader?	B*,D*,E*
E2	Layout	• To what extent do the pictorials and words complement one another? • At what level the contrast and effects are used effectively to aid focus?	B*,C*
E3	Clear Instructions	• To what extent the story pace, shot, direction natural & make sense to the reader? • To what degree the characters position are reasonably placed?	B*,C*
E4	Navigation	• To what degree the comic panels, speech balloons and captions placement ease and flow of the story? • At what level the white space between the text, frames, and illustrations help readers move through the comic, or are the pages too busy?	B*,D*
		Enjoyment	
E5	Organization	• To what degree does the comic have a beginning, middle, and end? • To what degree does the comic have a well-described setting?	A*,D*, E*
E6	Plot	• To what extent the plot exhibit good development, imagination, and continuity?	C*,D*

		• To what extent does the resolution bring the conflict to a satisfying end?	
E7	Characters	• To what extent the characters are believable and well developed? • To what degree the characters' pose, gesture & expression make sense in the story?	C*, D*
Aspects		**Description**	**Source**
E8	Feedback	• At what level the comic provide enough context and action to keep the reader moving through the story? • At what level the plot necessarily gives user adequate direction and information for progressing to?	B*,D*

Legend:
A*-(Pérez-Mateo et al, 2011) B* – (Kay & Knaack, 2008) C* – Cooper, 2011)
D* – (Griffith, 2010) E* – (Cirigliano, 2012) F*- (Chawla, Gupta, & Singla, 2012)

Few suggestions were provided by experts in content validity activity. Primarily, there was no necessity to categorize the aspects under learning into intention and outcome sub-dimensions. This was because both sub-dimensions are considered an integrated assessment criteria for learning. Similar critique was also given to the entertainment dimension. It was also suggested that by removing the sub-dimension names from the questionnaire, it would help respondents focus more on statements items. Apart from that, each items should be combined into single statement.

After modifications were made according to experts review, the instruments were further discussed in the face validity session. The respondents argued with the use of several keywords used in statements such as 'native files' and 'modular'. Thus, most changes were made by adding Malay translation to aid them in understanding the questionnaire content. As a result, a revised version of the instrument was constructed as shown in Table 3.12.

Table 3.12 *Revised Version of LGC Product Model Assessment Instrument*

Aspects		**Description**
Learning		
L1	Learning Goal Alignment	• At what level the comic's ideas/questions/facts/pieces of information are relevant to the topic?
L2	Agility	• To what degree the text element in the comic is presented in short, concise segments?
L3	Typography	• To what extent the font shapes, colours and size facilitate and stimulate reading?
L4	Consistency	• To what degree the comic make use of certain pictorial consistency which adds significantly to the learning process?
L5	Recipient	• To what degree does the comic promote a positive attitude toward the topic?
L6	Reusability	• To what degree do the comic's native / digital / source files are file self-contained, modular, traceable, modifiable, usable, standardized and properly grained, generic, and platform independent?
L7	Accuracy	• At what level the ideas/questions/facts/pieces of information in the comic is accurate & free of errors?
L8	Reliability	• At what level the quoted materials are visibly cited?
L9	Argumentation	• To what extent do the comic generates ideas/questions/facts/pieces of information about the topic?
L10	Thoroughness	• At what level the characters/personas interaction with the educational content are meaningful and permit the reader to have a much greater understanding of the concept/topic?
L11	Emphasis of Key Concepts	• Do the contents in the comic are easily balanced, distinguished or discernable from fiction or fantasy? At what level the comic emphasis on key concepts?
L12	Prospective	• To what degree the story potentially open for sequel or continuation? Does it trigger further questions related to the educational topic?
Entertainment		
E1	Visual Appeal	• At what level the comic's illustrations/photos/graphics are appealing and aid the reader in understanding the tone and mood of the story?
E2	Layout	• To what extent do the pictorials and words complement one another? At what level the contrast

		and effects are used effectively to aid focus?
E3	Clear Instructions	• To what extent the story pace, shot, direction natural & make sense to the reader? Do the characters position are reasonably placed?

Aspects		**Description**
E4	Navigation	• To what degree the comic panels, speech balloons and captions placement ease and flow of the story? Are the white space between the text, frames, and illustrations help readers move through the comic, or are the pages too busy?
E5	Organization	• To what degree does the comic have a well-described setting with a clear beginning, middle, and end?
E6	Plot	• To what extent the plot exhibit good development, imagination, and continuity? Does the resolution bring the conflict to a satisfying end?
E7	Characters	• To what extent the characters are believable and well developed? Do the characters' pose, gesture & expression make sense in the story?
E8	Feedback	• At what level the plot and action necessarily gives user adequate direction and information for progressing to?

The results of KMO and Bartlett's test were significant as they fulfilled the previously stated conditions (see Table 3.13).

Table 3.13 *KMO and Bartlett's test results*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.873**
Bartlett's Test of Sphericity	Approx. Chi-Square	857.613
	df	190
	Sig.	.000

Factor loading value conditions were accomplished as all 20 items obtained greater than 0.5 score (see Table 3.14). Four principle components were also successfully extracted that explained 66.289% of the total variance.

Table 3.14 *Factor Loadings results*

Items	Loadings
L1	.660
L2	.770
L3	.694
L4	.692
L5	.578
L6	.708
L7	.694
L8	.611
L9	.545
L10	.534
L11	.632
L12	.687

Items	Loadings
E1	.673
E2	.562
E3	.652
E4	.708
E5	.736
E6	.715
E7	.756
E8	.649

Afterwards, Cronbach's Alpha test disclosed significant results as presented in Table 3.15. These findings demonstrated that the instrument design was consistent.

Table 3.15 *Reliability Test*

Dimensions	Cronbach's Alpha	N of Items
Learning	.901	12
Entertainment	.879	8

From all the tests conducted, it demonstrated that the proposed dimensions and items were feasible for LGC product assessment. Therefore, the revised version of the instrument is presented in Appendix E. In summary, all instruments were rigorously developed before proceeding to the evaluation phase.

3.6 Phase 3: Evaluation

In DSR, Norshuhada and Sharizan (2013) recommended several approaches to validate artefacts, namely analysis, experience, example, evaluation, and persuasion. Hence, evaluation phase was conducted by the means of analysis through expert evaluation (shows general interest and practicability in practice) and empirical data obtained through user experience (shows comparison of different approaches in controlled setting). In line with the learner-generated content quality indicator (Pérez-Mateo et al., 2011), LGC production model evaluation should emphasis on both process and the characteristics of the produced content itself. This implied that the research artefact (LGC production model) must be evaluated based on its performance in an authentic setting (Rudmark & Lind, 2011). Plus, the generated products (digital educational comic) need be measured based on what they are supposed to do; to educate and entertain. Generally, the effects ‘‘with’’ a cognitive tool (the quality of the proposed model) and resulting effects ‘‘of’’ it on the learners (learners’ achievement based on their LGC product scores) should be scrutinized (B. Kim & Reeves, 2007). Hence, evaluation of the proposed model (Objective 3) and LGC products assessment (Objective 4) were achieved in user experience testing activity. Finally, as a decision making stage to finalise the proposed model, outlook from expert review were examined (see Figure 3.5).

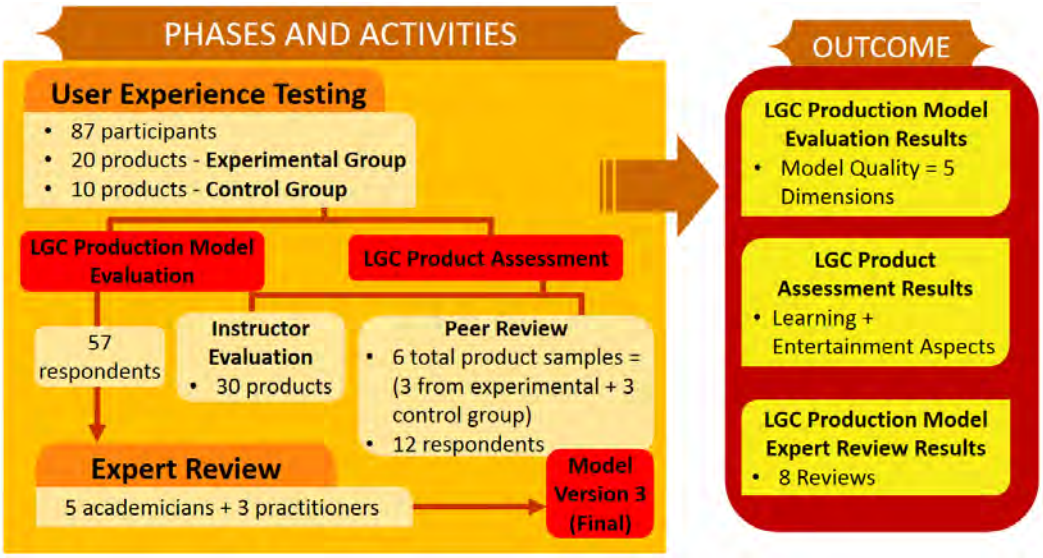


Figure 3.5 Evaluation Phase

3.6.1 User Experience Testing

The user experience testing adopted quasi-experimental non-equivalent control group design methods in order to evaluate the proposed model and assess the product prototypes produced by users. The justification and procedure are discussed in the next subsection.

3.6.1.1 Sampling

Unequivocally, the users of LGC production model are learners. Thus, in this study, students of an institution were selected as the participants in user experience testing activity. This was because the apparent homogeneity of university students enhances research validity where they tend to be similar on dimensions such as age and education (Peterson & Merunka, 2014). Accordingly, the designated participants were students from the same discipline and course.

For comparable results, the topics of the LGC products developed by participants should be notably equivalent. Hence, convenience sampling method was adopted because it enables comparability across different types of cases on a dimension of interest (Teddlie & Yu, 2007). In the experiment, participants were assigned into two groups; experimental and controlled group.

i. The experimental group that received the treatment (the LGC production model as a guideline) in developing digital educational comic. These participants were then assigned to evaluate the quality of the proposed model.

ii. The control group acted a comparison group that was not given the proposed LGC production guideline, so that their produced LGC products could be compared with the submissions by the experimental group.

Consequently, the Bachelor of Multimedia students were selected as the participants. They were taking WWW Programming course at the particular time, which meet the requirements set as the samples. There were 87 students sitting in the course at the point of the study, where 57 were the experimental group and the balance 30 were treated as the control group.

3.6.1.2 Hypothesis Formulation

As clarified in Chapter 1, the third objective of this study is to evaluate the quality of the proposed model; granted that it was hypothesized that the proposed model would be a valid and practical tool for users to design and develop LGC. In other words, the process or method proposed in the model were evaluated by users. In addition, the

fourth objective of this study is to assess the learner-generated content; particularly the LGG product.

Therefore, hypotheses were formed as depicted in Table 3.16. Supporting references to the hypotheses are also included. Based on Matook and Indulska (2009)'s dimensions of model characteristics, the first five hypotheses were formulated to evaluate the quality of LGC production model. The purpose of the remaining hypotheses is to test for statistically significant differences of LGC product (digital educational comic) scores between the sample groups; and further assess the LGC products in the aspects of learning and entertainment. These processes is intended to support the richness of the findings, besides the descriptive analyses.

Table 3.16 *Research Hypotheses*

Hypothesis		**Supporting references**
H_1	The proposed LGC production model is significantly general.	(Matook & Indulska, 2009), (Syamsul, 2011)
H_2	The proposed LGC production model is significantly flexible.	(Matook & Indulska, 2009), (Syamsul, 2011)
H_3	The proposed LGC production model is significantly complete.	(Matook & Indulska, 2009), (Syamsul, 2011)
H_4	The proposed LGC production model is significantly usable.	(Matook & Indulska, 2009), (Syamsul, 2011)
H_5	The proposed LGC production model is significantly understandable.	(Matook & Indulska, 2009), (Syamsul, 2011)
H_6	There is a significant difference in LGC product assessment scores between the experimental group and the control group.	(Creswell, 2013)
H_7	There is a significant difference in learning aspect scores between the LGC products by all groups.	(Creswell, 2013)
H_8	There is a significant difference in entertainment aspect scores between the LGC products by all groups.	(Creswell, 2013), (Ariffin, 2010)

3.6.1.3 Selection of Comic Authoring Tool

Initially, five comic authoring tools were analysed based on their functionality to generate diversified digital comics without manual illustration process. These tools were selected as they were publicly accessible and mentioned by scholars in their LGC studies (eg: Burke, Hughes, Hardware, & Thompson, 2013;. Meyers, 2014). Results of analysis are described in Table 3.17.

Table 3.17 *Comparison of Comic Authoring Tools*

Feature	**Bitstrips for School**	**Comic Life**	**Pixton for School**	**Make Beliefs Comix**	**Cambridge University Comic Builder**
Speech balloon control	✓	✓	✓	✓	✓
Unlimited pages	✓	✓	✓		
Panels and layout control	✓	✓	✓		✓
Custom character design and pose	✓		✓		
Background and prop addition	✓		✓	✓	✓
Free to use				✓	✓
Administrator function	✓		✓		
No internet connection required		✓			

Based on the results, both *Pixton for School* and *Bitstips for School* supply numerous ready-made items such as character sprites with adjustable poses and emotions, props and background. The latter tool was resolutely chosen in the user experience

testing as it encompasses digital comic authoring capabilities with inexpensive fee (see Figure 3.6).

Figure 3.6. *BitStrips for School* comic authoring tool was used to compose LGC products.

3.6.1.4 Procedure of User Experience Testing

To carry out the intervention, Nolte and Prilla (2013a)'s method for non-expert model interaction was utilized because the students were novice in using conceptual models and producing digital comics. Model expert facilitation was required (Nolte & Prilla, 2013a) where the researcher provided technical support such as comic examples, comic authoring tool tutorials, and references on instructional objective verbs (Krathwohl, 2002). A website contained instructions on how to get started, the proposed model, and samples were supplied to the participants in the experimental group as shown in Figure 3.7.

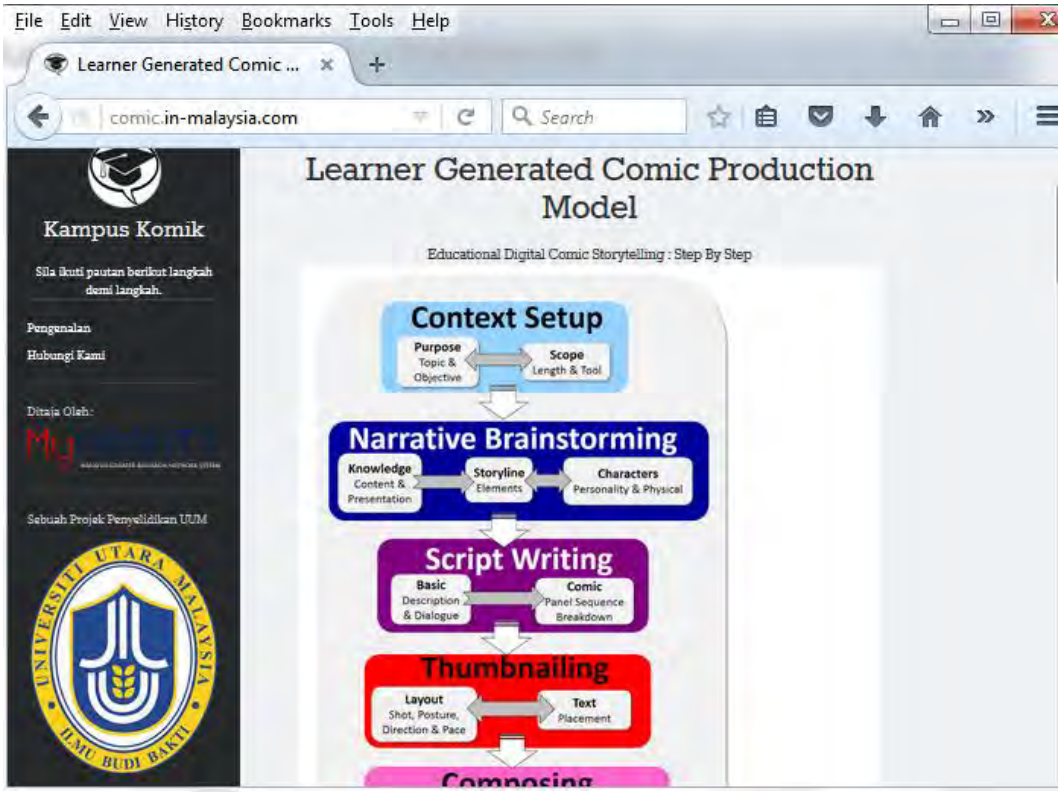


Figure 3.7. Support Tool for Model Interaction

Both experimental and controlled groups were instructed to develop LGC products that present their understanding on selected topics in web programming subject (refer to Appendix F). Based on what they have learned so far in official lecture and lab sessions, the participants may also refer to additional books and online resources on the topic to help them reflect and organize their overall idea about the topic.

During the intervention, the researcher observed the participants interaction with LGC production model. Divided into three members per-group, the participants began the project by discussing and generating ideas based on the activity stated in the LGC production model (see Figure 3.8). The researcher also observed the participants' comic thumbnails according to their narrative draft.

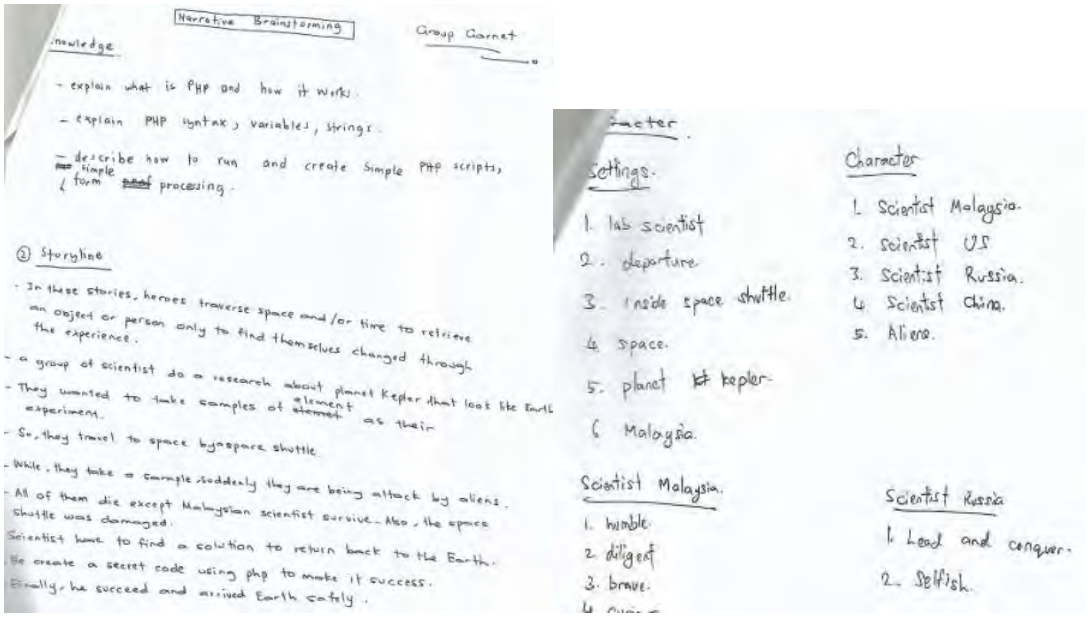


Figure 3.8. Examples of participants outline based on Narrative Brainstorming phase in LGC production model.

As reported by Engler et al.(2008), since students were unable to complete their LGC product within the remaining class time, the composing process using Bitstrips comic authoring tool were proceeded as home assignment.

Using instructor account in Bitstrips, the researcher inspected the participants' progress in finishing the LGC digitally. The researcher was able to monitor incomplete comic pages, character usage, access time, and more as displayed in Figure 3.9. The intervention ended after the participants submitted their completed LGC to the instructor. As satisfaction survey comparison is one of the evaluation items to measure the functionality of the artefact with the solution objectives (Peffers et al, 2006), participants from the experimental group were provided with questionnaire instrument to rate their experience in using LGC production model.

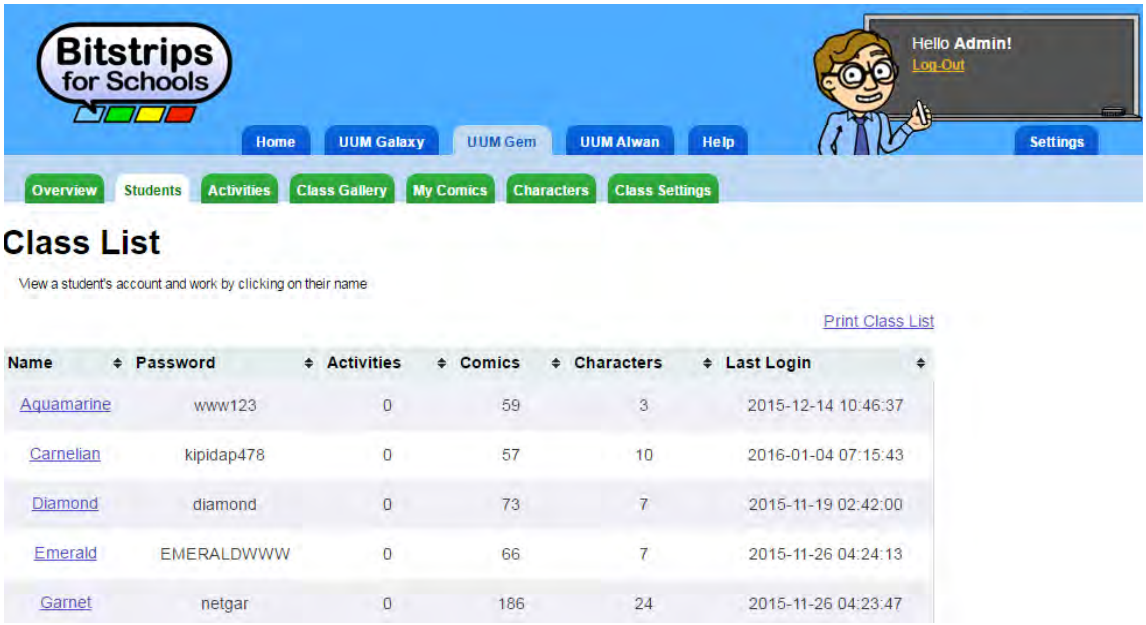


Figure 3.9. *BitStrips for School* instructor interface.

3.6.1.5 Instructor Evaluation

All submitted LGC products were evaluated by the instructor based on LGC product score assessment form instrument. The purpose was to compare the LGC products by experimental group and the control group results according to assessment scores provided by the instructor. From the filtered LGC products by the instructor, selected samples were further assessed in a peer review session. The results from the instructor evaluation activity is reported in Chapter 5.

3.6.1.6 Peer Review

The peer review activity comprising twelve student respondents to authenticate the findings. The justification was; the application of learner-generated content also emphasis on viewpoint of learners towards the produced learning material (Helmstedt, 2011). Plus, this activity was conducted to ensure the rigor and validity

of analysis by an active search for conforming and disconfirming evidence made through successive informal discussions.

Additionally, the peer review session was decontextualized by allocating respondents who did not participate in the experiment to assess the samples. This method was performed to avert oral interactions and interpersonal relationships among the respondents and participants which may influence the assessment (Mangelsdorf & Schlumberger, 1992). The session was conducted in a focus group setting where the respondents were also encouraged to verbally share their opinion on the LGC product samples they need to assess.

Overall, all feedback and form instruments filled by the participants, instructor, and peer reviewers were collected by the researcher for data analysis as discussed in Chapter 5. The selection of data analysis techniques, general descriptive analysis, and content analysis were reported. IBM SPSS version 20 were utilized to analyse the data and produced charts and graphs.

3.6.2 Expert Review

As a decision making stage for validating and finalize the proposed model, expert review was the chosen method for this study. To compound in trustworthy results, the experts investigated the features of the proposed model (Psomos & Kordaki, 2012). The results obtained from expert review were gathered to replicate several key questions of conceptual model evaluation (Wolff & Frank, 2005) as follows:

- Are the facts described by the model accepted as correct by the domain experts?

- Are the described instances on the desired level of detail?
- Is the model conforming to necessary standards?

3.6.2.1 Selection of Experts

Experts involved in the review process were selected based on the criteria described in Table 3.18.

Table 3.18 *Criteria of Expert Selection*

Category	Criteria
Academician	• Have PhD qualifications either in Human Computer Interaction (HCI) or Multimedia or Instructional Design or Art and Design related area OR/AND • Have been studying/researching either in comics, Human Computer Interaction (HCI) or Multimedia or Instructional Design or Art and Design related area for at least five years.
Practitioner	• Have at least five years of professional experience in comic industry.

3.6.2.2 Procedure of Expert Review

The review process started with the invitation via email to the identified experts. After the experts agreed and replied, the official appointment letter by the dean, and consent form were sent to them. Next, the experts received an illustration of the proposed model together with expert review form through email. The objective and scope of the proposed model were made clear to the experts where the target users are undergraduate students and the model of LGC production does not involve

illustrating comics; but focuses on educational storytelling with the utilization of comic authoring software instead.

The experts were instructed to observe and analyse the supplied illustration and description of LGC production model before carefully filling up the provided spaces in the review form. As explained in the aforementioned subsection, the expert review form instrument for LGC production model asks about the relevancy of the proposed phases and tasks, the activities within them, connections and flows of all of the components, as well as other aspects of the proposed model. The experts were required to note problematic features by inspecting the components and items relevancy in the model and predict potential problems when users interact with it. It took approximately four to ten weeks to accomplish the expert review process. The researcher also conducted a face to face meeting with four of the selected experts during the mentioned time frame (see Figure 3.10).

Figure 3.10. Several experts involved in the review process (photo printed with permission)

Finally, the profile of experts, analysis of results from this activity are elucidated in Chapter 5.

3.7 Phase 4: Conclusion

The final phase is the conclusion where the findings and results of user experience testing and review were construed; as explained in Chapter 6. The iteration of the proposed LGC production model were performed for the last time to visualize the final form of the production model in accordance to the experts' feedback. Once the last validation was done, finally, as the proposed model were completed, the direction and future research to promote improvement on the study were elaborated as part of the conclusion phase.

Figure 3.11 Conclusion Phase

3.7.1 Communicate Results and Findings

The claims in this study were justified through breakdown of results and findings. The answer of research questions and discussion of findings were highlighted. A final form of the scholarly indorsed artefact was presented. Summaries of research limitations and research contributions were fabricated. Discussion of future research and conclusions of the study were discussed in detail in the Chapter 6.

3.7.2 Review Documentation

Upon completing this phase, the ensuing outcome were established into academic publications and this research thesis.

3.8 Summary

This chapter has distinctly explained how DSR research methodology was adopted in this study. The research design, data collection approach, procedure, sampling techniques, and evaluation methods in applied in this study were described. In particular, the overall research processes and the instruments used to accomplish the objectives of this study were elaborated. The following chapter discusses the steps and findings in the development of the research artefact.

CHAPTER FOUR
CONSTRUCTION OF LGC PRODUCTION MODEL

4.1 Introduction

This chapter details up all activities that lead to the proposition of the research artefact. The chapter begins with explanation of the general approaches adopted for the design and development of the proposed model. Then, the LGC production model components were identified and an initial model are proposed.

4.2 Overview of Design and Development Approaches

Several approaches from Nolte and Prilla (2013b)'s conceptual model development lifecycle were adopted prior to proposing LGC production model as visualised in Figure 4.1.

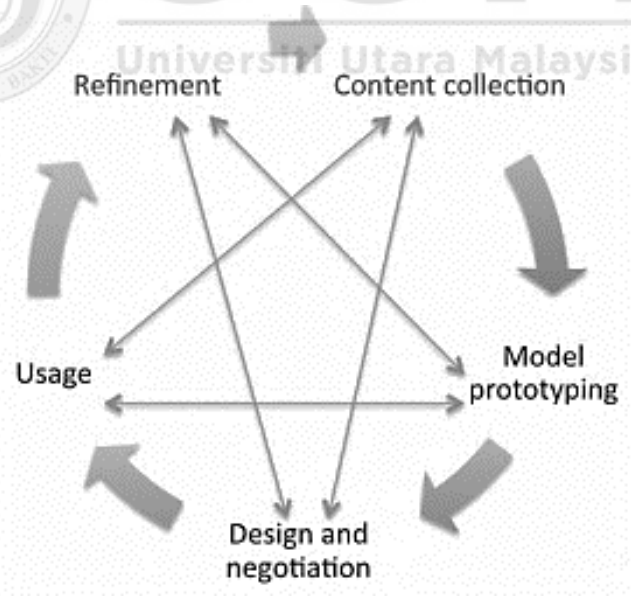


Figure 4.1. Conceptual Model Development Lifecycle (Nolte & Prilla, 2013b)

Based on this method, content collection was mostly conducted through comparative studies reported in this chapter and literature review in Chapter 2. Significantly, as a document-driven approach of designing model (Andreas & Frank, 2016), the comparative analysis combined semi-formal languages with co-occurrences. This means this study firstly defined the vocabulary used for abstracting the components for LGC production model before creating a linkage between elements extracted from literature.

As clarified in Chapter 1, the definition of LGC production model strongly denoted that the proposed conceptual model should be a simple and task focused (Johnson & Henderson, 2011) comprised of phases, phases are comprised of design steps, and design steps are comprised of design sub-steps (Winter & Schelp, 2006). Hence, in this study, LGC production model components are defined into phases, tasks, flow, and activities (as listed in Table 4.1). Phases are distinct general stages of the model that can be performed in order, while tasks can be described as constituent parts of the model that contribute to each phase. On the other hand, flow in the model defines the way and manner of progress from one phases, tasks, or activity to another. Activities in the model are specific steps or processes that are suggested to be conducted during the LGC production. These components are fundamental to be included during the LGC product development.

Table 4.1 *Approaches embarked on prior to proposing the LGC production model*

Components	Approaches
1. Phases	• Comparative study of LGC Classroom Strategies
2. Tasks	• Comparative study of DST models and frameworks • Comparative study of professionals' creative process
3. Activities	• Expert Consultation and Literature Review
4. Flow	• User Participation

All these model components were combined and made up as the LGC production model. Thus, the next section discusses how the proposed model was systematically designed and developed.

4.3 LGC Production Phases

The definition of "production" serves as a root for designing the "phase" component of LGC production model. Regardless the media output such as video (Bright et al., 2015; Fonseca et al., 2014), audio (eg: Dell & Reich, 1981; Levelt, 1992), and animation (May-chan, 2014), literature regularly have referred the term "production" as a process described in "stages". In general, production of digital content is structured into three main stages; pre-production, production, and post-production (Litchfield, 1998; Musburger & Kindem, 2009). Plus, examining current multimedia models of process and production, most of them are presented in steps and stages (eg: Sherwood & Rout, 1998; Liu, Jones, & Hemstreet, 1998; Martins & Pimentel, 2011).

Given this core concept, the generic fundamental component of LGC production model was initially defined as follows:

- Pre-Production
- Production
- Post-Production

Jeffery-Poulter (2003) however, reminded that traditional linear production methods with fixed goals and a defined completion point are usually mixed with the iterative, cyclical processes used in multiple platform production which involve the constant re-purposing and updating of content.

Nonetheless, in order to conceptualize the generic phases of LGC production model as stated in the previous section, eleven selected works on LGC classroom strategies by scholars were compared to characterize the overall steps required in LGC development. The processes with commonalities are classified and grouped into generic phases, described in Table 4.2. These phases are proposed to initially formulate LGC production model.

Table 4.2 *Comparison of development steps in LGC Classroom Strategies*

Stages	Phases	Meyers (2014)	Green (2013)	Comer (2015)	Morrison et. al (2002)	Williams (2008)
Pre-Production	Context Setup	• Learn software • Understand output requirements • Select topic	• Read comic examples	• Read comic examples • Understand comic conventions	• Select topic	• Read comic examples • Select topic
	Narrative Brainstorming	• Study and select content	• Reflect topic • Develop story elements	• Develop story elements (narrative gaps, narration, and focalization)	• Focus and organize topic • Develop story and character	• Develop story
Production	Scriptwriting	• Frame the story	• Write dialogue	• Develop narration	• Narration and dialogue • Script formatting	
	Storyboarding				• Design comic layout	• Design storyboard
	Composing	• Produce comic	• Produce comic	• Produce comic	• Produce comic (foreground and background elements)	• Produce comic
Post-Production	Publishing	• Upload comic	• Scan and digitize comic			
	Assessment	• Peer review • Present comic	• Present comic	• Present comic	• Present and discuss comic	

Table 4.2 continued

Stages	Phases	Maldonado and Yuan (2011)	Upson, Mudd, and Moffat (2014)	Fay (2007)	Engler, Hoskins, and Payne (2008)	Danzak (2011)	Watkins (2014)
Pre-Production	Context Setup	• Learn software • Understand comic convention	• Understand output requirement • Learn software	• Read comic example	• Read comic example • Learn software	• Read comic example • Under stand output requirement	• Read comic example • Understand comic convention • Learn software
	Narrative Brainstorming	• Develop story and character	• Select and reflect topic	• Select and research topic • Plan story element		• Discuss and reflect topic • Plan • story	• Select topic • Develop story
Production	Scriptwriting	• Narration and conversation		• Write script		• Write dialogue	• Write script
	Storyboarding	• Design storyboard		• Draft comic layout	• Design rough comic		• Plan comic layout
	Composing	• Produce comic	• Produce comic	• Produce comic	• Produce comic	• Produce comic	• Produce comic
Post-Production	Publishing	• Upload comic		• Scan and digitize comic	• Export and email comic	• Export comic	• Export comic
	Assessment		• Present comic	• Present comic	• Peer review • Present comic	• Present comic	• Present comic

Comparing comic development process implemented in the selected LGC classroom practices (refer to Table 4.2), a complete steps and flow were categorized and fabricated according to their commonalities. Accordingly, this study identified seven common phases plotted into the production stages, demonstrated in Table 4.3.

Table 4.3 *Classification of production phases based on steps in LGC classroom strategies*

Phases		**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**CS7**	**CS8**	**CS9**	**CS10**	**CS11**
Context Setup	Understand purpose and output requirements	✓			✓	✓	✓	✓	✓		✓	✓
	Familiarize with comic and/or software	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Narrative Brain-Storming	Select, reflect, and research topic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Outline story and/or character	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scriptwriting	Develop script		✓	✓	✓		✓		✓		✓	✓
Storyboarding	Create rough storyboard				✓	✓	✓		✓	✓		✓
Composing	Produce comic manually or digitally	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Publishing	Scan, upload and/or publish digital comic	✓	✓				✓		✓	✓	✓	✓
Assessment	Evaluate and/or present comic	✓	✓	✓	✓			✓	✓	✓	✓	✓

Legend ✓ means the study includes the particular tasks

(Notes: CS- Classroom Strategies)

CS1 - Meyers (2014)
CS2 - Green (2013)
CS3 - Comer (2015)
CS4 - Morrison et. al (2002)
CS5 - Williams (2008)
CS6 - Maldonado and Yuan (2011)
CS7 - Upson, Mudd, and Moffat (2014)
CS8 - Fay (2007)
CS9 - Engler, Hoskins, and Payne (2008)
CS10 - Danzak (2011)
CS11- Watkins (2014)

Generally, based on the comparative analysis, the following components for LGC production model phases were proposed (see Figure 4.2).

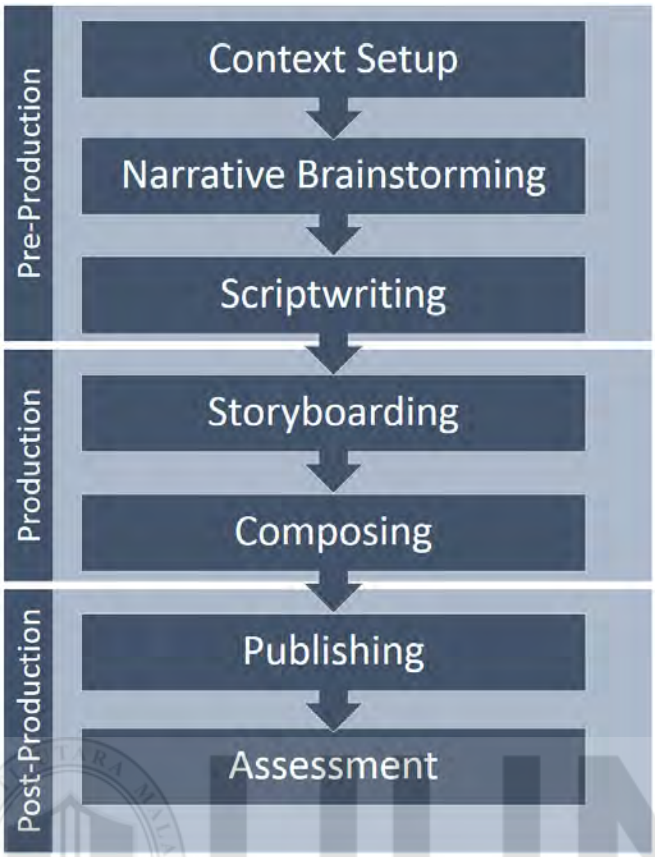


Figure 4.2 General Phases of LGC Production Model

In essence, Context Setup refers to the phase where the students identify the purpose, equipment, and requirements for their LGC they need to develop. This includes familiarizing themselves with comic conventions and digital tools for producing LGC. Narrative Brainstorming is the phase where the students establish their story ideas, research and select related educational content for their LGC. Next, the students polish their story through a script in Scriptwriting phase. Then, in the Storyboarding phase, the students sketch out their comic storyboard based on their completed script. The students then produce their LGC using comic authoring tools in the Composing Phase. Once the LGC are completed, in the Publishing phase, the students inspect the submitted comics to be readable in digital environment. Finally, Assessment refers to the phase where the students' LGC are critically evaluated.

Therefore, to continue constructing LGC production model on the established root, the next section discusses how the model's components were further expended.

4.4 LGC Production Tasks

As discussed in Chapter 2, LGC production model extends the ideas of existing conceptual model of educational comics by Kane (2013) as exhibited in Table 4.4. Analysing the components, it may be interpreted that the sequential art and graphic narrative history in the model could be grouped as the comic domain, the script represents the story domain while pedagogy associatively refers to learning domain.

Table 4.4 *Elements of Educational Comics according on Kane (2013)'s Graphic Textbook Model*

Component	Description	Domain
Sequential Art/ Illustrations	The illustrations/pictures/cartoons are used to tell the story.	Comic
Scripts / Content	The script/words/text are used to tell the story.	Story
History of Graphic Narrative	Process of how graphic narratives are made and how they evolved.	Comic
Pedagogy/ Teaching	Showcase strengths as excellent scaffolding tool and suited for problem based learning strategies.	Learning

Equivalently, Keller and Oechslin (2013) also strongly established educational comics into visual (comic), narrative (story), and knowledge (learning) dimension. Therefore, grounded by these domains as the core foundation of designing LGC production model, this section explains the process of extracting the elements of comic, story, and learning from literature.

A line by line analysis through existing DST model and framework's illustration, snapshot, and elaboration was firstly conducted. The justification for this process was because the gist of DST involves the production of narrative-based digital media where several of these studies concentrated within educational environment. In relevance, story is regarded as an essential feature in comics (Gerde & Foster, 2008; Caldwell, 2012) while the output from proposed model is digital media in form of comics.

Hence, it was suggested that these aspects support further development LGC production model through DST models comparative analysis. Nevertheless, provided that none of the DST models and frameworks were exclusively designed for comic production, only story and learning elements were recorded. As depicted in Table 4.5, communal story and learning elements from ten selected works were categorized into tasks for the proposed model.

Table 4.5 *Comparative Study of Story and Learning Elements in DST Models*

Domain	Tasks	**Lambert (2006)**	**Barret (2006)**	**Figg & McCartney (2010)**	**Schäfer (2004)**	**Kearney (2011)**	**Robin (2008)**	**Kuan et al. (2012)**	**Miyaji (2012)**	**Gaeta et al. (2014)**	**Smith (2013)**
Learning	Purpose	Idea		Types	Concreteness	Purpose	Types	Purpose	Goal	Purpose	
Learning	Scope	Proposal		Organize		Target audience				Content Detail	
Learning	Knowledge	Research Explore Learn	Self-directed Reflect	Reflect		Type Explore Content	Meaningful construction Research		Task Reflect	Advancer Reflect	Reflect
Story	Storyline		Plot Setting	Plot Setting	Structure	Personal Instructional Historical	Storymap Event	Constitution Title	Structure	Plot Situation	Plot
Story	Character	Personal Narrative	Character	Character			Intention		Character	Character	Character
Story	Script/ Storyboard	Write Script Storyboard	Dramatic Question The Gift of Your Voice	Events Mapping		Script Storyboard					
Learning	Modes	Put Images, Audio, Video Together	Economy	Visual Decimation	Collaboration	Display					
Learning	Medium			Selection	Control	Classroom display technology					
Learning	Learning	Share Evaluate	DST Rubric			Assess		Evaluate	Assess	Evaluate	Reflect
Story	Entertainment	Emotional Content			Immersion						

Since LGC is a learning object, the terms Modes and Medium were borrowed from Chawla, Gupta, and Singla (2012)'s study which describe digital format and medium of delivery. Consecutively, this comparative study identified the tasks that shared a common set of attributes and plotted them into appropriate phases, portrayed in Table 4.6. So far, only the tasks for Context Setup, Narrative Brainstorming, Scriptwriting, Publishing, and Assessment phases were determined for the proposed LGC production model.

Table 4.6 *Classification of tasks based on the proposed LGC production phases*

Phases	**Tasks**	**DST1**	**DST2**	**DST3**	**DST4**	**DST5**	**DST6**	**DST7**	**DST8**	**DST9**	**DST10**
Context Setup	Purpose	✓		✓	✓	✓	✓	✓	✓	✓	
	Scope	✓		✓		✓				✓	
Narrative Brain-Storming	Knowledge	✓	✓	✓		✓	✓		✓	✓	✓
	Storyline		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Character	✓	✓	✓			✓		✓	✓	✓
Script-Writing	Script	✓	✓	✓		✓					
Publishing	Modes	✓	✓	✓	✓	✓					
	Medium			✓	✓	✓					
Assessment	Learning	✓	✓			✓		✓	✓	✓	
	Entertainment	✓			✓						

Legend ✓ means the study includes the particular task.

DST1 - Lambert (2006)
DST2 - Barret (2006)
DST3 - Figg & McCartney (2010)
DST4 - Schäfer (2004)
DST5 - Kearney (2011)
DST6 - Robin (2008)
DST7 - Kuan et al. (2012)
DST8 - Miyaji (2012)
DST9 - Gaeta et al. (2014)
DST10 - Smith (2013)

Comparing and examining the story and learning elements in the selected DST models and frameworks, Table 4.7 describes the aim of the tasks involved in every phase as previously proposed.

Table 4.7 *Proposed Tasks based on Story and Learning Elements in DST Models*

Phases	**Tasks**	**Aim**
Context Setup	Purpose	Generating idea based on the given topic and clarify the educational goal of the DST project.
	Scope	Determine the audience, duration of the digital story and required tools.
Narrative Brainstorming	Knowledge	Research, reflect, select, and plan the presentation of educational content in the digital story.
	Storyline	Develop story elements such as structure plot, and setting.
	Character	Decide the voice or point of view of the digital story.
Scriptwriting	Script	Polish the script based on the story ideas or outline before producing the digital story.
Publishing	Modes	Gather the digital resources and publish digitally.
	Medium	Use accessible technology to launch the digital story.
Assessment	Learning	Evaluate the educational outcome of the DST project.
	Entertainment	Assess the emotional impact of the digital story.

Next, to obtain the tasks for Storyboarding and Composing phases, several interviews among professional comic artist reported in scholarly literature were analysed. Comic elements were gathered and grouped into tasks as shown in Table 4.8.

Table 4.8 *Classification of Tasks based on Professionals' Creative Processes*

Phases	**Tasks**	**Steve Englehart** (Klaehn, 2015a)	**Benjamin Marra** (Klaehn, 2015b)	**Norm Breyfogle** (Klaehn, 2015c)	**Eric Larsen** (Klaehn, 2016b)	**Jim Zub** (Klaehn, 2016a)
Story-boarding	Comic Panel	Convert from full script	Page & panel sequencing	Loose scripts to panel design	Plot or full script. Unified theme	Story map to script
	Layout	Pacing Mood	Fit forms together	Panel emphasize. Size, contrast, negative space	Clear story-telling, tone.	Page pacing
	Text		Words & pictures complement each other. Figure out how much space the words occupy.	Words & pictures complement each other	Word count. Character voice. Character specific balloon.	
Composing	Pictorial	Visual iconography	Legibility, clarity, & readability. Iconography	Body language, panel placement, perspective, motion lines, stretching, flattening, or slanting	Elements to focus. Perspective Speed & radiating lines	
	Lettering		Dialogue & monologue	Captions word balloons, & sound effects	Seamless, natural flow.	

Scrutinizing the comic development process from the published interviews, visual storytelling elements and techniques for efficacious and successful comic production were extracted. As a result, this comparative analysis prompted the aim of the tasks for proposed phases in LGC production model (refer to Table 4.9).

Table 4.9 Proposed Tasks based on Professionals' Comic Development Process

Phases	**Tasks**	**Aim**
Scriptwriting	Basic Script	Describe scenes precisely according to the story draft.
	Comic Panel	Estimate how many panels fit into single page and which dialogue or action occur in every panel.
Storyboarding	Layout	Sketch out the comic narrative by experimenting on flow, focus, tone and continuity.
	Text	Position words suitably and optimally.
Composing	Pictorial	Produce the comic by controlling clarity, mood, and

	intensity of the pictorials and text.
Lettering	Apply comic typography and balloons for fitting impact.

Overall, from the proposed phases and tasks, an initial model of LGC production was formulated as illustrated in Figure 4.3.

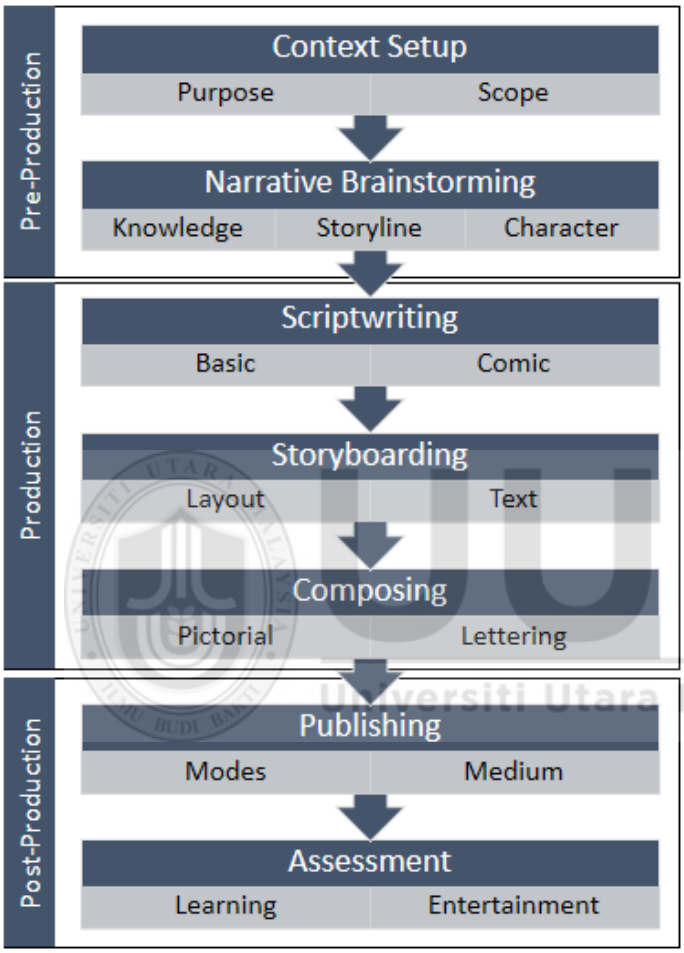


Figure 4.3 Initial Design of LGC Production Model (Version 1)

Therefore, the next section illuminates how the initial model was refined and extended through expert consultation.

4.5 LGC Production Activities (Expert Consultation)

To acquire the activities for LGC production model, input from literature and expert consultation were gathered. A semi-formal discussion was conducted involving two

practitioners who have more than ten years of experience in comic industry (see Figure 4.4). They have published various titles in the local market and organized comic production training for aspiring comic artists.

Figure 4.4 Expert Consultation with Comic Practitioners (photo printed with permission)

The experts were firstly asked to provide their opinions on the keywords used in the initial design of LGC production model (refer to Figure 4.3). The most important standpoint was; the storyboarding task should be replaced as “thumbnailing” as it is a more standard term used in comic production. Despite their similarity, the experts regarded thumbnails and storyboard function differently. In terms of presentation, as an intention to simplify the model visually, the experts recommended that the model would still be practical without displaying the three stages of production. These suggestions were used in refining LGC production model.

Apart from that, the experts were also asked about the differences between developing entertainment comic and educational comic. They agreed that there are variations between activities of developing both cases. For instance, when designing educational comics, topic or subject should be determined. The author must strategize how to present selected educational content by identifying the didactic goal or objective of the comic. The description and dialogue in the script should be written appropriately before breaking them down into panel sequences. The value of educational comics rely on how successful they are in exceeding its intention and the outcome that impacted the audience. However, to keep the audiences' interest, the educational comic should also be enjoyable and aesthetically appealing.

Reflecting these factors, visual storytelling techniques with comics such as camera shot, pacing, characters' direction, posture, gesture, and expression, symbolic icons, placement, shapes and sizes of comic balloon, sound effect, and panel have their own respective roles. Furthermore, compared to traditional printed comics, the author must recognise the standard format for digital comic presentation, native file for development, and the platform that support the particular format. Based on the aspects and techniques edified by the experts, the activities for LGC production model were defined (see Table 4.10). The aspects and technique were mapped based on the aim of the tasks as previously outlined in Table 4.7 and Table 4.9.

Table 4.10 *Identification of LGC Production Activities from Expert Consultation*

Phases	**Tasks**	**Activities**
Context Setup	Purpose	Clarify what is the general **topic** of the comic such as PHP programming, planets or acid and base. Identify the actionable educational **objective** of the comic whether to summarize, interpreted, argue, or more.
	Scope	Determine the required comic **length** which may encompass of panels or pages. Select and familiarize with the digital **tools** used for comic development.
Narrative Brainstorming	Knowledge	Choose relevant or important educational **content** from the **topic** to be included in the comic. Based on the **objective**, plan how the **content** will be organized, structured and **present**ed in the narrative.
	Storyline	Draft the narrative to frame the **content** using story **elements**.
	Character	Decide a character **personality** which would interestingly drive the story. Design the **physical** appearance of the character in the LGC.
Scriptwriting	Basic	Visualize the story with **description** that portray every scene such as action, location, and time. Write the characters' **dialogue.**
	Comic	Breakdown the script into pages and sequenced **panels**.
Thumbnailing	Layout	Sketch the panels' camera **shot**, character **posture**, **direction**, and **pace** based on the comic **script**.
	Text	Indicate the **placement** of words in the comic.
Composing	Pictorial	Construct the comic with character's **gesture**, **expression,** and **visual iconography**.
	Lettering	Exploit the words with **font**, **balloon, sound effects**' shapes, and sizes.
Publishing	Modes	**Export** comic into standard readable format. Preserve the **source** files for reuse or modifications.
	Medium	Assign the digital **platform** for the comic to be published.
Assessment	Learning	Define if the LGC has met its' **objective** as **intended**. Evaluate the LGC's **outcome** based on content accuracy and usefulness.
	Entertainment	Rate the **enjoyability** of the comic. Rank the LGC's **aesthetics**.

Consequently, examples for each activity determined in Table 4.10 were further put forward by the experts according to the best practices in comic production (see Table 4.11). The goal was to presume how the suggested activities could be practically implemented in LGC production.

Table 4.11 *Examples of LGC Production Activity*

Activity	**Outcome or Output**	**Examples**
Topic	Understand what the task or topic is really seeking.	• Why do earthquakes happen? • Why food taste differently? • How to fractions work? • What is the difference between Client and Server Side Scripting?
Objective	Decide how to answer the driving question of the given the comic.	• The comic will show what causes earthquakes. • The comic will compare the difference between acid and alkaline food. • The comic will explain how to solve several fraction problems. • The comic will demonstrate the interaction between client and server.
Length	The comic's amount of pages.	• Comic Strip • Loose or One Pager • Short comic /comic book • Graphic Novel
Tool	Digital software.	• Mind mapping app, Scanner • Royalty-free images • Comic software, tutorial
Content	List, sheet, or chart of information, details, key points, ideas, significant facts, definitions, concrete details, and quotes related to the topic.	• The steps of how two blocks of the earth suddenly slip past one another. • Comparison between acid and alkaline in foods • Describing fraction multiplication and divide fractions procedure. • Explain how browser interact with user.
Presentation	The narrative type to be applied in the comic.	• Monologue • Agent / Persona • Scenario / Problem / Case • Metaphor / Analogy • Auto-Biography
Element	Careful story draft consists of narrative elements	• Conflict, theme or events that drive the plot until the final resolution. • Hook, setting and point of view. • Unnecessary and repetitive scenes are

		removed.
Personality	Important character profiles that influence the story.	• Age, gender and profession • Hobby, interest, dreams and principles • Skills, advantages, fears and flaws • Backstory
Activity	**Outcome or Output**	**Examples**
Physical	Design of characters' physical appearance should stand out from each other.	• Proportion • Facial feature • Attires
Description	Action, location and time of scenes are described according to the story draft.	• Cycling • Park • Morning
Dialogue	Speech and thoughts of every character including the narrator.	The dialogue is optimally used to present factual and conceptual content, develop character personality, convey setting or forward the story.
Panel Sequence Breakdown	Basic script is transformed into comic script format.	Estimate how many panels fit into single page and which dialogue or action occur in every panel.
Shot	Types of camera shot must fit the panel's purpose.	• Long shots • Medium • Close-ups
Posture	Characters' pose and location should reasonably aid focus.	Give different visual prominence or depth for character, action or object that have significant role in the panel.
Direction	Arrange the characters to face or move to a logical direction in continuing panels.	The characters' location and orientation in different panels are consistent.
Pace	Diversify the panel's size and shape to slow or speed up the pacing and set the tone	The largest panel in the page is utilized for significant knowledge or highly dramatic moment.
Placement	Place the text that lead the audience's eyes smoothly across the page	The dialogue is divided into several balloons to display pieces of information.
Gesture	Communicate particular message with appropriate character gesture.	• Pointing • Tapping • Hands on cheek
Expression	Display emotion with characters' facial expression.	• Worried • Surprised • Angry
Iconography	Symbolize an action or emotion using visual metaphors or pictograms.	• Motion Lines • Star/Heart Eyes • Bulb
Balloon	Comic balloon tail and shapes must reflect their purpose.	• Speech • Thought • Whisper
Sound FX	To convey mood.	• boom

		• wham
Font	Capture character's tone, object and scenery's sound with apposite font type.	• Spooky • Robotic
Export	Convert single or multiple page comic into standard readable format.	• jpg • zip • pdf
Activity	**Outcome or Output**	**Examples**
Source	Native files for reuse or modification are preserved.	• psd • comiclife
Platform	Assign weather the comic be accessible in desktop, mobile or web.	• Windows, Android, IOS • Website, Online Portal, Social Media
Intention	The comic meets its topic, objective, and requirement as initiated by the instructor.	The comic has illustrated how earthquakes happen in 8 pages.
Outcome	The knowledge, factual and conceptual content in the comic are accurate & useful.	The comic describes earthquakes happen when two blocks of the earth suddenly slip past one another.
Enjoyment	The story and characters emotively capture interest.	The protagonist is caught in an earthquake and he survives.
Aesthetics	The comic's visuals are well-presented and adequate to read.	All visual elements in every pages are framed effectively with smooth and pleasant reading.

Therefore, the next subsection explains the process of determining the flow of LGC production.

4.6 User Participation

To capture the flow between the tasks and activities in LGC production, a participatory design session involving 30 undergraduate students was conducted. In the session, indistinct process initially suggested in the proposed model were detected. The participants (3 members per-group) were instructed to develop their own digital educational comic (10 LGC products in total) related to web programming topics. After their completed LGC were submitted, a formal discussion was conducted to reflect their experiences in LGC production (see Figure 4.5). The

participants were required to undergo an explicit reflection of their personal reaction towards the process in developing LGC.

Basically, the discussion adopted Prior, Ferguson, and Leaney (2016)'s reflection method as follows:

- Recount – what happened?
- React – how did you feel about what happened?
- Analyze – why it happened, or why you reacted as you did?
- Improve – what did you learn from what happened? What will you change to improve things?

Figure 4.5. Participatory design session with end users (photo printed with permission)

The students were required to critically reflect the process that structurally assisted them to produce LGC by responding to reflection topics (refer to Appendix G) summarized as follows:

- Positive and negative perception towards the completed LGC product.

- Suggested aspects to improve the LGC product.
- Suggested activity examples to improve the LGC development process.

Finally, the students' accounts towards the reflection topics were analysed and synthesized by the researcher. These responses were used to authenticate the proposed activities recapped from Table 4.11 as well as recognizing LGC production flow.

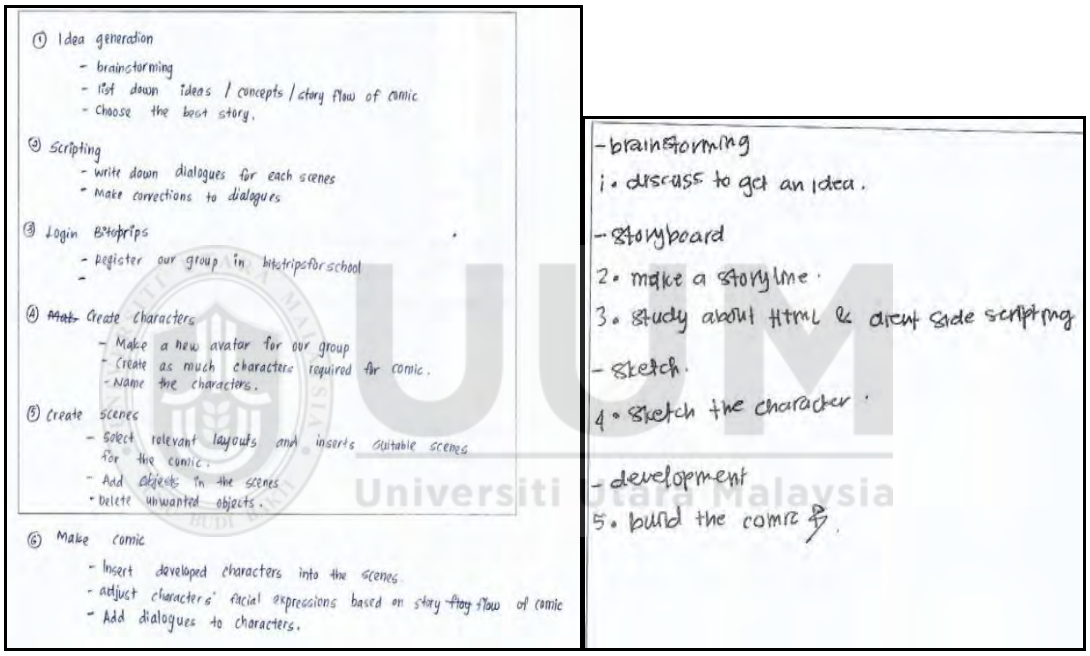


Figure 4.6. Examples of students' responses from reflection session.

Based on the outcome and students' feedback from the reflection session (Figure 4.6), it was discovered that, excluding the tasks within Scriptwriting and Composing phases, most tasks were non-linearly conducted. In other words, learners were not required to carry out the proposed task in sequence to complete a particular phase. Besides that, omitting certain activities such as pace and expression however may affect the comic narrative.

Moreover, several activity components should be elaborated such as stating number of pages for comic types, role of camera shots, example of posture, sound effects, and font usage. Plus, it is helpful to provide an overall aim of each phases. Finally, the aspects proposed in the Assessment phase were considered an important requirement in piloting the initial stage of LGC production. Hence, these findings were used to polish the description which originates from LGC production model diagram. Process model development guideline by Mendling, Aalst, & Der, (2010) was referred in generating the graphical diagram of LGC production. Basically, the proposed model is structured, uses as few elements in the model as possible, routing paths per element were minimized and uses verb-object activity labels.

As a result, grounding on comparative study of LGC classroom strategies, DST models, frameworks, documented interviews, and user participation, this study had formulated the overall components of LGC production model categorized into phase, task, flow, and activity. Therefore, the proposed LGC production model was refined and visualized as illustrated in Figure 4.7.

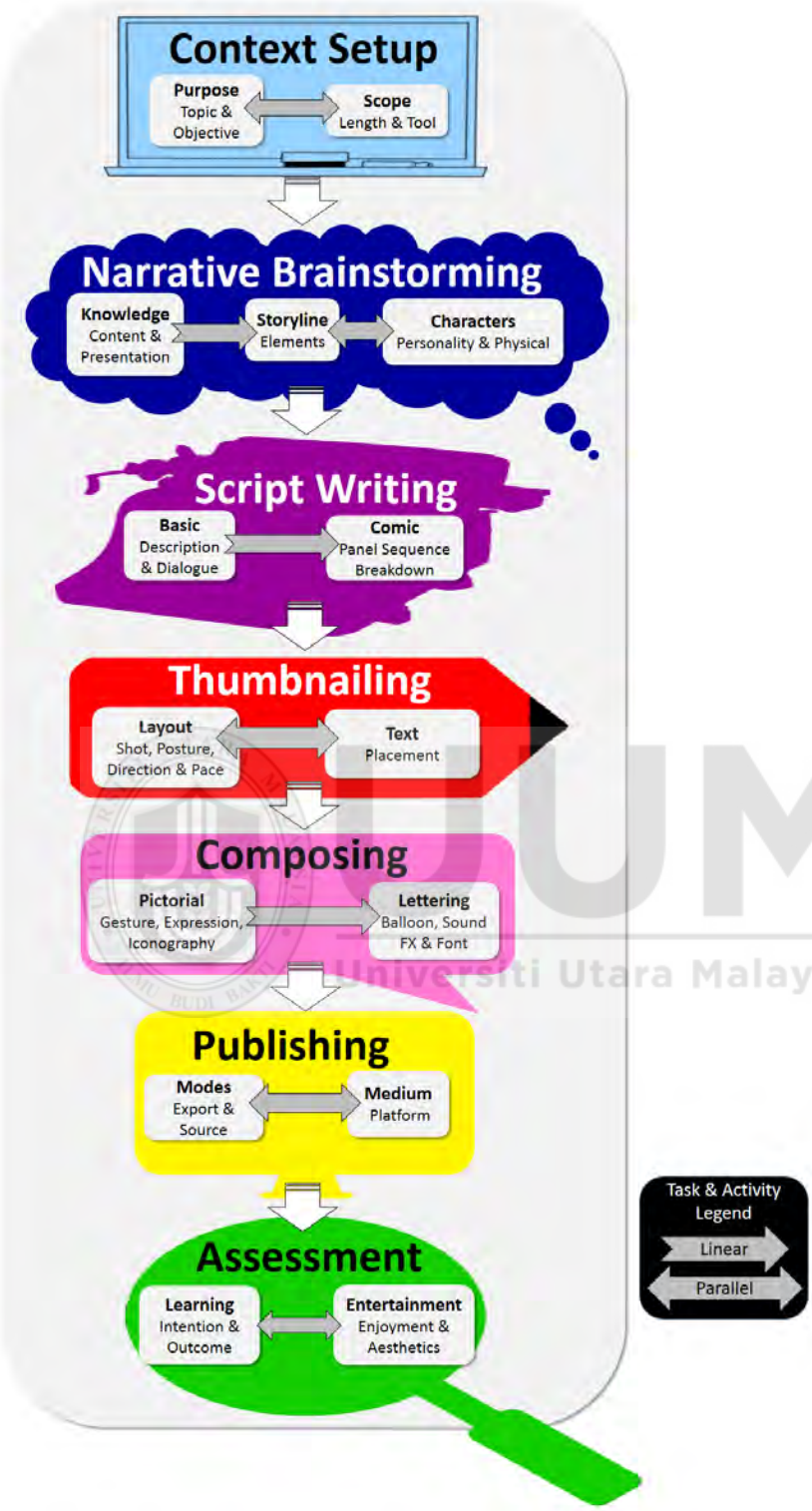


Figure 4.7. LGC Production Model (Version 2)

Since each process of a model must be described in terms of their aim and outcomes (Mangin, Mayer, Barafort, Heymans, & Dubois, 2013), Table 4.12 depicts the description for LGC production model encompassing phase, task, and activity.

Table 4.12 *Proposed LGC Production Model Description*

Phase 1: CONTEXT SETUP		
To clarify the goal and requirements of the project or assignment.	**PURPOSE**	
	Topic • Identify the focused topic given by the instructor.	• Why do earthquakes happen? • Why food taste differently? • How to fractions work? • What is the difference between Client and Server Side Scripting?
	Objective • Decide how to answer the driving question in the comic.	• The comic will describe what causes earthquakes. • The comic will compare the difference between acid and alkaline food. • The comic will explain how to solve several fraction problems. • The comic will show the interaction between client and server.
	SCOPE	
	Length • Determine the length of comic to be developed.	• Comic Strip - *2-to 5 panels* • Loose/One Pager -*Single page* • Short comic /comic book - *Up to 30 pages* • Graphic Novel - *May reaches 600 pages.*
	Tool • Specify software, hardware, media or tools to be obtained/ purchased/ downloaded/ for the comic development.	• Mind mapping app • Scanner • Royalty-free images • Software, tutorial, etc
Phase 2: NARRATIVE BRAINSTORMING		
To reflect and strategically structure the knowledge / educational content and frame the story.	**KNOWLEDGE**	
	Content • Gather, choose relevant and important factual and conceptual content to be included in the comic.	List/ sheet/ chart of information, details, key points, ideas, significant facts, definitions, concrete details, and quotes related to the topic.
	Presentation • Select a narrative type and plan on how to arrange, highlight, and present the knowledge/ educational content.	• Monologue • Agent / Persona • Scenario / Problem / Case • Metaphor / Analogy • Auto-Biography

	STORYLINE	
	Elements • Develop a conflict, theme or events that drive the plot until the final resolution.	• Hook, setting and point of view. • Unnecessary and repetitive scenes are removed.
	CHARACTER	
	Personality • Specify characters' basic background, positive, negative traits and their role in the story.	• Age, gender and profession • Hobby, interest, dreams and principles • Skills, advantages, fears and flaws • Backstory
	Physical • Design the characters' physical appearance that are stand out from each other.	• Proportion • Facial feature • Attires
To concisely write up the narrative and balance out the text and pictorials within the comic.		
	Description • Describe the action, location and time of scenes according to the story draft.	Explanation that mentally visualize the scene such as character in walking across a Timeline that depict the evolution of grid computing.
	Dialogue • Write the speech and thoughts of every character including the narrator.	The dialogue is optimally used to present factual and conceptual content, develop character personality, convey setting or forward the story.
	Panel Sequence Breakdown • Transform the basic script into comic script format. • Estimate how many panels fit into single page and which dialogue or action occur in every panel.	• Comic script that reaches the required comic length. • The text is condensed carefully without altering the message.
To visually assemble the comic narrative by experimenting and focusing on flow, focus, tone and continuity.		
	Shot • Frame the action or dialogue with suitable visual point of view in every panel. • Interchange the angle in continuing panels. • There is a variation of shots in continuing panels that provide dynamic flow.	• Long shots- *establish a scene.* • Medium - *show action.* • Close-ups - *show reaction.*

	Posture • Position the characters, objects or props. • Give different visual prominence or depth for character, action or object that have significant role in the panel.	• Walking • Standing • Sitting • Jumping
	Direction • Arrange the characters to face or move to a logical direction in continuing panels. • The continuing panel complies with 180 degree rule.	• The characters' location and orientation in different panels are consistent.
	Pace • Diversify the panel's size and shape to slow or speed up the pacing and set the tone.	• The largest panel in the page is utilized for significant knowledge or highly dramatic moment. • Unnecessary or distracting pictorial details are removed when highlighting factual or conceptual content
	Placement • Place balloons that lead the audience's eyes smoothly across the page. • Refrain the balloon from blocking major pictorial elements.	• The balloon is positioned close the speaker. • There is a clear path through multiple balloons. • The dialogue is divided into several balloons to display pieces of information. • Captions are minimally used to complement balloons.
Phase 5: COMPOSING		
To produce the comic by controlling and enhancing the mood, clarity and intensity of the pictorials and text.	**PICTORIAL**	
	Gesture • Communicate particular message with appropriate character gesture.	The characters interact logically with appropriate gesture.
	Expression • Display emotion with characters' facial expression.	The characters' expression illustrates the story mood and character's attitude.
	Iconography • Symbolize an action or emotion using visual metaphors or pictograms.	• Motion Lines • Impact Starts • Fight cloud • Star/Heart Eyes • Sweat drop • Bulb • Devil horns • Dashes

	LETTERING	
	Balloon • Point the balloon tail correctly to the speaker. • Demonstrate dialogue purpose with corresponding balloon shapes.	• Speech • Thought • Whisper • Shout / Scream • Linked • Overlapping
	Sound FX • Evoke mood with sound effects.	• *boom* • *wham* • *blam* • *slam* • *grab* • *snatch* • *jab*
	Font • Capture character's tone, object and scenery's sound with apposite font type.	• Bold, distinctive shape, size or colour of text for emphasis. • A readable jaggy font for spooky dialogue. • A typewriter-like font for a robotic voice.
Phase 6: PUBLISHING		
To compile and finalize the comic.	**MODES**	
	Export • Convert Single or multiple page comic files into standard readable format.	• jpg • png • gif • zip • cbr • pdf
	Source • Keep the native files for reuse or modifications.	• psd • ai • Bistrips
	MEDIUM	
	Platform • Assign either the comic is accessible in desktop or mobile	• Windows, Android, IOS • Website, Online Portal, Social Media
To review the quality of the comic.		
	Intention • Define if comic has met its educational goal and requirement.	The comic meets its educational goal and requirement as initiated by the instructor.
	Outcome • Indicate if the comic has provided accurate & useful knowledge.	The knowledge, factual and conceptual content in the comic are accurate & useful.
	Enjoyment • Review if the narrative is been fun and interesting.	The story and characters emotively capture interest.
	Aesthetics • Perceive if the comic is visually pleasing to read.	The comic's visuals are well-presented and adequate to read.

4.7 Summary

This chapter has inclusively discussed the design and development of LGC production model. Upon proposing LGC production model, the conceptual model development lifecycle was generally employed. Consequently, data collection for constructing the proposed model involved information from literature, experts, and potential users. The components were determined step by step starting from phases, tasks, activities, flow and description of LGC production model. Therefore, the next chapter focusses on the evaluation of the proposed model.

CHAPTER FIVE
EVALUATION OF LGC PRODUCTION MODEL AND LGC PRODUCT

5.1 Introduction

The previous chapter has formulated the initial model of LGC production which is the main artefact of this study. Executing DSR methodology, the efficacy of the artefact is demonstrated by observing and measuring how well the artefact supports a solution to the problem (Peffers et al., 2006). Hence, this chapter elucidates the findings and results of LGC production model evaluation and LGC product assessment from user experience testing activity which include instructor evaluation and peer review. Finally, expert review of LGC production model is also explicated.

5.2 Quality Evaluation of LGC Production Model

As previously hypothesized, the proposed LGC production model would significantly serve as a guideline for learners to design and develop digital educational comics. To verify this claim, the quality of proposed model was evaluated. This was attained through user experience testing activity.

5.2.1 User Experience Testing Results

In total, 87 undergraduate students studying Bachelor of Multimedia degree program at Universiti Utara Malaysia took part in the user experience testing (see Figure 5.1). As explained in Chapter 3, convenience sampling was adopted where collection of

data was gained from conveniently available members of the population (Sekaran & Bougie, 2016).

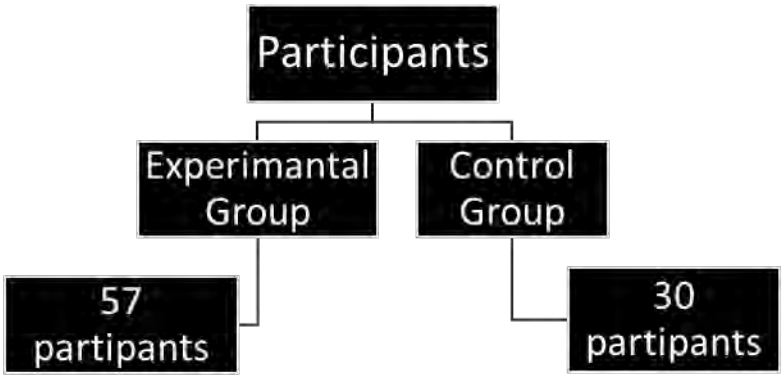


Figure 5.1. Participants in User Experience Testing

Accordingly, 57 participants in the experimental group were provided with the proposed model in developing their LGC product. This number is adequate for LCG production model quality evaluation since at least 30 datasets should be employed for obtaining reliable result in statistical tests (Sekaran & Bougie, 2016). Then, these participants were instructed to evaluate their experience towards the model by filling up the LGC production model quality questionnaire instrument (refer to Appendix C). The demographic profile of the participants is illustrated in Table 5.1.

Table 5.1 *Demographic profiles of participants.*

		Frequency	**Percentage (%)**
Gender	Male	20	35.1
	Female	37	64.9
Age	≤ 21	16	28.1
	22 – 24	37	64.9
	≥ 25	4	7.1
Race	Malay	37	64.9
	Chinese	15	26.3
	Indian	4	7.0
	Others	1	1.8

About 64.9% of the participants were female and the remainder were male with range of age between 21 to 25 years. Therefore, the next subsection reports the findings and results of LGC production quality evaluated by the participants.

5.2.2 Analysis and Findings

As explained in Chapter 3, LGC production model quality evaluation is categorized into five dimensions; namely generality, flexibility, completeness, usability, and understandability. Generality dimension assesses at what level LGC production model allowed its' user to utilize it in diverse educational purposes while flexibility dimension evaluates on how flexible the proposed model to its' users. Meanwhile, completeness dimension measures if the components proposed in LGC production model were entirely required to successfully to create LGC products. Usability dimension on the hand refers to how usable the proposed model for the users in constructing LGC products. Lastly, understandability dimension evaluates at what level LGC production model is comprehensible to its users.

Initially, it is preferable that data normality is assessed both visually and through Shapiro-Wilk test for lower than 100 sample size (Ghasemi & Zahediasl, 2012). Table 5.2 displays the results of data normality test for each dimension.

Table 5.2 *Test of Normality Results*

Dimension	**W**	**df**	**Sig.**
Generality	.873	57	.000
Flexibility	.964	57	.045
Completeness	.864	57	.000
Usability	.948	57	.015
Understandability	.921	57	.001

Lilliefors Significance Correction

Since the *p* value was less than .05, it was assumed that the data were not normally distributed. Aside from that, the frequency distribution for the data was graphically skewed (refer to Figure 5.2). Thus, in analysing the descriptive results for each items in a specific dimension, the median ($\tilde{x}$) score was featured.

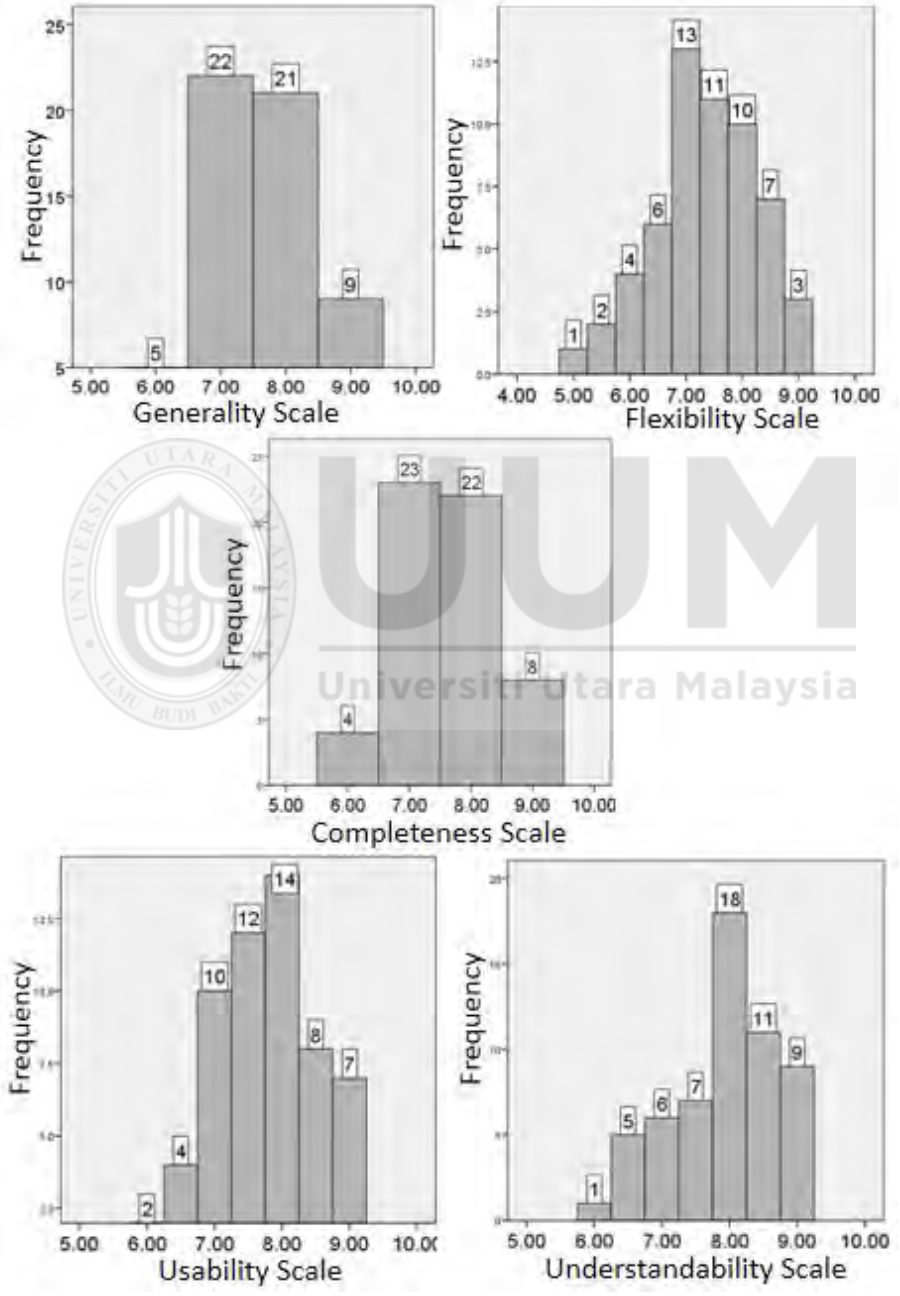


Figure 5.2. Participants Evaluation towards Generality, Flexibility, Completeness, Usability, and Understandability Dimensions.

To analyse and descriptively interpret the data from the 9-point semantic scale instrument items, a six scale measurements with the range of interval 1.33 from strongly disagree to strongly agree was formulated as the scale (see Figure 5.3). This number was achieved by dividing the range of scale with number of scale as suggested by Zulkarna in (2001).

Interval = *(Highest score – lowest score) ÷ number of scale*
= *(9-1) ÷ 6*
= *1.33*

List of Scale (Level of Agreement)

Highly Disagree	=	*1.00 – 2.32*
Disagree	=	*2.33 – 3.65*
Slightly Disagree	=	*3.66 – 4.98*
Slightly Agree	=	*4.99 – 6.32*
Agree	=	*6.33 – 7.65*
Highly Agree	=	*7.66 – 9.00*

Figure 5.3. Conversion of Numerical Scale for Data Analysis

Hence, this coding was adopted to report the findings of participants' perception towards each dimension in LGC production model. Principally, Table 5.3 shows the descriptive results for each measurement item. Item values greater than 6.33 indicates that the respondents agreed with the statement for each measurement item.

Table 5.3 *Scores for Each Measurement Item*

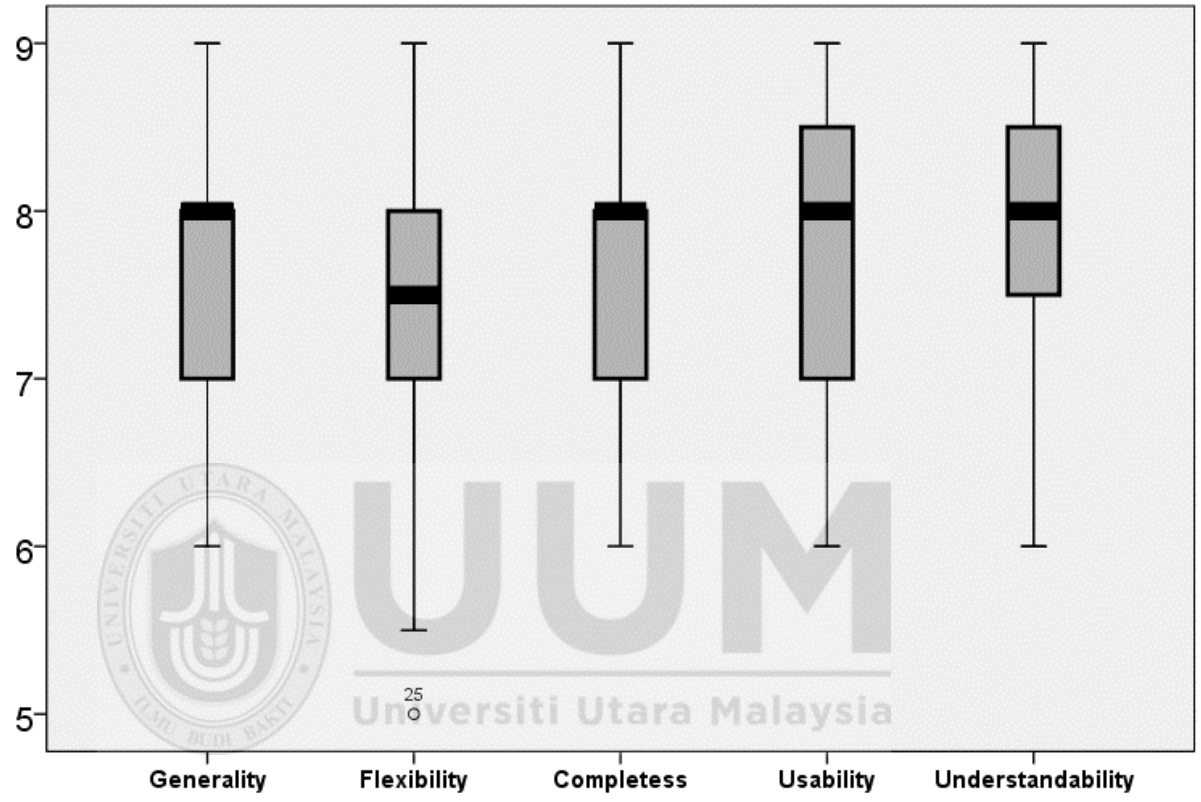
Item	Statement	Median ($\tilde{x}$)	Mean	Standard Deviation
Generality				
G1	LGC enables me to summarize what I had learnt in the form of digital educational comic.	7.00	7.46	1.151
G2	LGC enables me to elaborate and organize my knowledge the form of digital educational comic.	8.00	7.56	1.035
G3	During the digital educational comic development, LGC enables me to relate my learning towards essential theories/ ideas/ information/ knowledge.	8.00	7.67	.893
G4	During the digital educational comic development, LGC enables me to apply knowledge to other situation/ scenario / context.	8.00	7.72	.996
G5	During the digital educational comic development, LGC enables me to reflect prior knowledge and connect it to new knowledge.	8.00	7.60	1.178
Flexibility				
F1	Using LGC fits well with the way I like to work.	8.00	7.39	1.082
F2	LGC enables me to produce digital educational comic according to my own taste and preferences.	7.00	7.49	1.037
F3	I have the options to follow or deviate from the phases and activities suggested in LGC.	7.00	7.32	1.152
F4	LGC enables me to make alterations towards certain phases and activities in digital educational comic development process.	7.00	7.33	1.041
Completeness				
C1	All the concepts and components included in LGC are strictly necessary for digital educational comic development.	7.00	7.44	1.053
C2	All components in LGC are relevant for the representation of the digital educational comic development process.	7.00	7.61	.881
C3	LGC gives a complete representation of the	8.00	7.47	.966

	digital educational comic development process.			
C4	LGC enables me to accomplish tasks in digital educational comic development more thoroughly.	8.00	7.61	.940
C5	LGC allows me to intelligently check the relevance and completeness of my digital educational comic.	7.00	7.47	.966

Item	**Statement**	**Median ($\tilde{x}$)**	**Mean**	**Standard Deviation**
Usability				
Us1	Using LGC produces the digital educational comic, for which it is intended for.	8.00	7.56	.945
Us2	LGC is useful in providing information I need on digital educational comic development.	8.00	7.68	1.003
Us3	Using LGC enhances the quality of my digital educational comic.	8.00	7.86	.915
Us4	LGC would be an improvement to a textual description of the digital educational comic development process.	8.00	7.70	.944
Understandability				
Un1	LGC is clear and understandable.	8.00	7.96	.999
Un2	Understanding LGC does not require a lot of mental effort.	8.00	7.61	.978
Un 3	LGC as a whole is workable.	8.00	7.88	.927
Un 4	The phases and activities in LGC can be followed.	8.00	8.02	.834

Results exhibited in Table 5.3 reveal that there was a comprehensible positive tendency of agreement towards the statements stated in the items; since all $\tilde{x}$ values scored greater than 6.33. Plus, it is visually demonstrated that LGC production model was well accepted by the participants where the scale from 7 to 9 (Agreed to Highly Agreed) obtained high frequency ratio for the respective dimensions (refer to Figure 5.3).

Next, all data from the items were pulled together to describe more accurate reflection on participants' perception towards the dimension (Melnick, 1993) where they are visualized in Figure 5.4 and summarized in Table 5.4.



Scale: Highly Disagree = (1.00 – 2.32), Disagree = (2.33 – 3.65), Slightly Disagree = (3.66 – 4.98), Slightly Agree = (4.99 – 6.32), Agree = (6.33 – 7.65), Highly Agree = (7.66 – 9.00)

Figure 5.4. Boxplot of Generality, Flexibility, Completeness, Usability, and Understandability dimensions.

Table 5.4 *Descriptive Statistics of Composite Factors*

Dimension	**Summary Statistics**				
	Mean	Median ($\tilde{x}$)	Std. Deviation	Skewness	Kurtosis
Generality	7.5965	8.0000	.86313	.036	-.634
Flexibility	7.3509	7.5000	.92463	-.309	.213
Completeness	7.5965	8.0000	.82071	.081	-.516

Usability	7.7368	8.0000	.79116	-.160	-.573
Understandability	7.9211	8.0000	.78370	-.508	-.429

Scale: Highly Disagree = (1.00 – 2.32), Disagree = (2.33 – 3.65), Slightly Disagree = (3.66 – 4.98), Slightly Agree = (4.99 – 6.32), Agree = (6.33 – 7.65), Highly Agree = (7.66 – 9.00)

In general, all dimensions excluding "flexibility" scored 8.0000 for the $\tilde{x}$ scores. So far, the findings had hinted participants' positive acceptance towards the proposed model. These numbers implied that majority of the participants in the user experience testing activity have come to an agreement that LGC production model was general, flexible, complete, usable, and understandable. To strengthen the validity of the results, evaluation of LGC production model quality in a mode of hypothesis testing is explained in the next subsection.

5.2.3 Hypothesis Testing I

As previously stated, the five characteristics (generality, flexibility, completeness, usability, and understandability) represents the model in the terms of "Quality". Therefore, based on Norshuhada and Tenh (2014)'s method in measuring users perceived the proposed conceptual model as having quality; and consistent with the numerical scale previously described in Figure 5.3, the same measurement ($\tilde{x}$ = 6.33) was used as the primary indicator to determine whether LGC production model is significantly general, flexible, complete, usable, and understandable. Essentially, a score of 6.33 and above is the cutting point (hypothesized median) for statistical significance for each dimensions. In compliance to the positive interval value in Figure 5.3, decision to accept or to reject the null hypothesis (H_0) depends on the $\tilde{x}$

value. Particularly, this study rejects H_0 when $\tilde{x} \geq 6.33$.and fails to reject H_0 when $\tilde{x} < 6.33$. For generality dimension, the null hypothesis is as follows:

H_0: The proposed LGC production model is not significantly general.

One sample Wilcoxon signed rank non-parametric test was run and the results are displayed in Table 5.5.

Table 5.5 *One Sample Wilcoxon Signed Rank Analysis on Generality*

Attribute	Sig.	Decision
The median of Generality equals 6.33	.000*	Reject the null hypothesis.

*Asymptotic significance are displayed. The significance level is .05.

Here, the results discloses that the null hypothesis would not be accepted. This finding interprets that the proposed LGC production model is significantly general.

5.2.4 Hypothesis Testing II

For flexibility dimension, the null hypothesis is as follows:

H_0: The proposed LGC production model is not significantly flexible.

One sample Wilcoxon signed rank non-parametric test was run. The results depicted in Table 5.6 rejects the null hypothesis. This finding invokes that the proposed LGC production model is significantly flexible.

Table 5.6 *One Sample Wilcoxon Signed Rank Analysis on Flexibility*

Attribute	Sig.	Decision
The median of Flexibility equals 6.33	.000*	Reject the null hypothesis.

*Asymptotic significance are displayed. The significance level is .05.

5.2.5 Hypothesis Testing III

For completeness dimension, the null hypothesis is as follows:

H_0: The proposed LGC production model is not significantly complete.

The results of one sample Wilcoxon signed rank test is presented in Table 5.7 which discards the null hypothesis. This finding descibes that the proposed LGC production model is significantly complete.

Table 5.7 *One Sample Wilcoxon Signed Rank Analysis on Completeness*

Attribute	Sig.	Decision
The median of Completeness equals 6.33	.000*	Reject the null hypothesis.

*Asymptotic significance are displayed. The significance level is .05.

5.2.6 Hypothesis Testing IV

For usability dimension, the null hypothesis is as follows:

H_0: The proposed LGC production model is not significantly usable.

One sample Wilcoxon signed rank test was run. The results depicted in Table 5.8 rejects the null hypothesis. This finding invokes that the proposed LGC production model is significantly usable.

Table 5.8 *One Sample Wilcoxon Signed Rank Analysis on Usability*

Attribute	**Sig.**	**Decision**
The median of Usability equals 6.33	.000*	Reject the null hypothesis.

*Asymptotic significance are displayed. The significance level is .05.

5.2.7 Hypothesis Testing V

For understandability dimension, the null hypothesis the null hypothesis is as follows:

H_0: The proposed LGC production model is not significantly understandable.

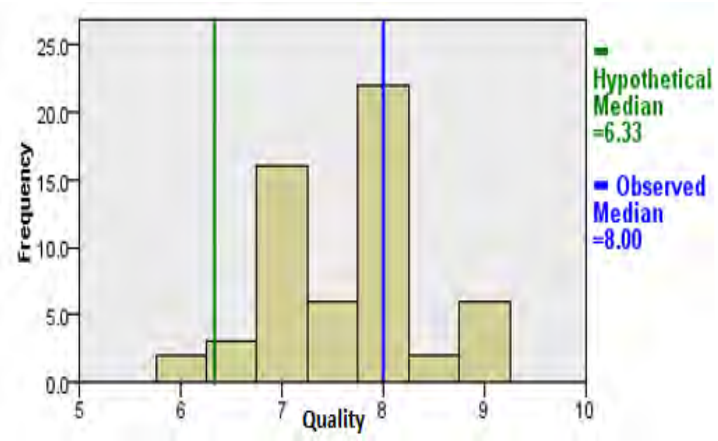
The results of one sample Wilcoxon signed rank test is in Table 5.9 indicates that the null hypothesis would not be accepted. This finding discloses that the proposed LGC production model is significantly understandable.

Table 5.9 *One Sample Wilcoxon Signed Rank Analysis on Understandability*

Attribute	**Sig.**	**Decision**
The median of Understandability equals 6.33	.000*	Reject the null hypothesis.

*Asymptotic significance are displayed. The significance level is .05.

Finally, one sample Wilcoxon signed rank non-parametric was run another round (including all 5 dimensions) to measure the overall quality of the proposed model. Results are displayed in Figure 5.5.



Total *N*	57
Test Statistics	1638.000
Standard Error	124.601
Standardized Test Statistics	6.561
Asymptotic significance	.000

Figure 5.5. Summary of One Sample Wilcoxon Signed Rank Analysis on Generality, Flexibility, Completeness, Usability, and Understandability collectively (Quality).

The results revealed that the Quality median ($\tilde{x}$ = 8.00) is different from the hypothesized median ($\tilde{x}$ = 6.33). Therefore, it is confirmed that users perceived the proposed LGC production model as having quality. This concludes that LGC production model has significantly served as guideline for learners to design and develop digital educational comics.

5.3 Assessment of LGC Products

Aligning with Objective 4 in this study, the LGC products developed during user experience testing activity, carried out in controlled environment were assessed. In

sum, there were 30 LGC product prototypes in a form of digital educational comics created by the participants.

5.3.1 Instructor Evaluation Results

All LGC products were firstly assessed by the class instructor by filling up the LGC product score instrument (refer to Appendix E). As previously mentioned, only the experimental group were provided with the proposed model in guiding them to design and develop the LGC. Hence, the goal this activity was to determine whether there were differences in LGC product assessment scores between the experimental group and the control group.

5.3.1.1 Analysis and Findings

The descriptive results of LGC product assessment score achieved by the participants in experimental group (LGC) and control group (non-LGC) are presented in Table 5.10 and Table 5.11.

Table 5.10 *Frequency Table of LGC Product Assessment Score.*

Group	LGC Product Score (0-100 marks)						Total
	70.0	75.0	80.0	85.0	90.0	95.0	
LGC	2	1	3	3	2	6	17
Non-LGC	11	1	1	0	0	0	13
Total	13	2	4	3	2	6	30

Table 5.11 *Descriptive Summary*

	Mean	Mean Std. Error	Median	Variance	Std. Deviation
LGC	85.882	2.1538	85.000	8.8803	78.860

Non-LGC	71.154	.8309	70.000	2.9957	8.974

Next, the total scores of all LGC products between the two groups were visually compared in Figure 5.6 and Figure 5.7. From the statistics, it was discovered that in the control group, majority of the LGC products scored 70 out of 100 and none scored more than 80. On the other hand, LGC of products in the experimental group (35.29%) received the uppermost score (95.0) by the instructor. The least score (70.0) was given to majority of the LGC products from the control group (84.62%) in contrast with the experimental group (11.76%).

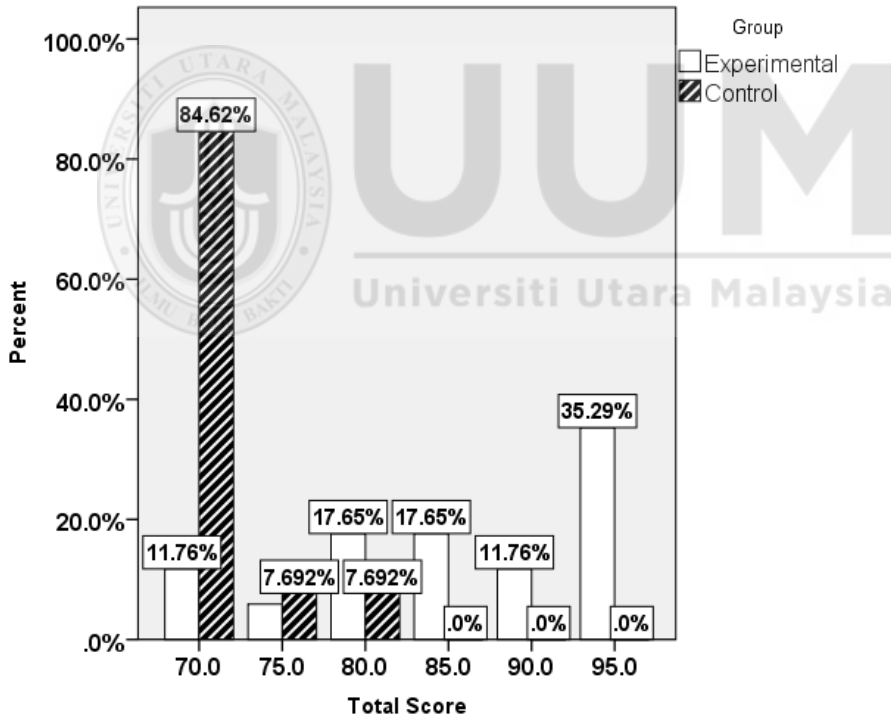


Figure 5.6. Histogram of LGC Product Assessment Score.

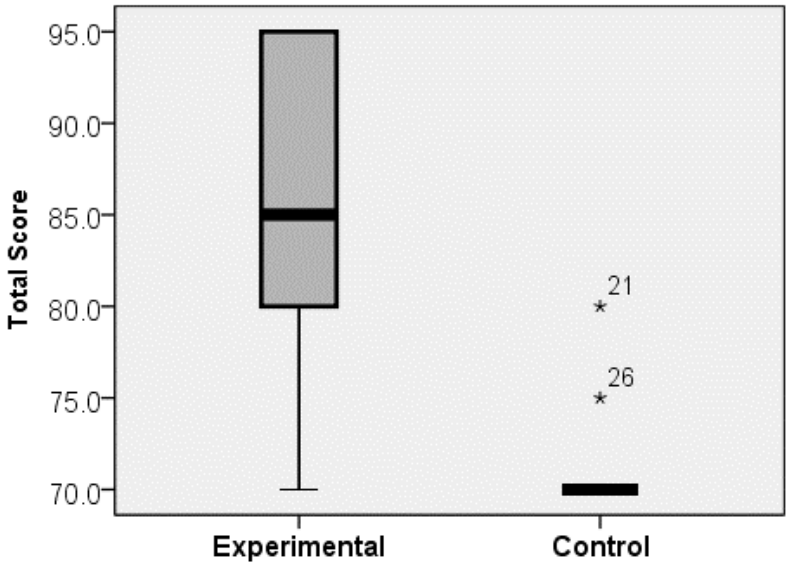


Figure 5.7. Boxplot of LGC Product Assessment Score.

These results straightforwardly demonstrated that, by using LGC production model as the guideline to develop digital educational comics, the participants in the experimental group were able to archive higher scores for their LGC product assessment.

The results represented that several aspects in the LGC from the experimental group were well incorporated compared to the LGC from the control group. This analysis indicated that the total assessment score of LGC products between the experimental group and control group were relatively different. Thus, a hypothesis test was performed in the next subsection to validate these findings.

5.3.1.2 Hypothesis Testing IV

Initially, a Shapiro-Wilk test was run to examine the distribution of both data sets (LGC group and non-LGC group). As shown in Table 5.12, the significance value results conveyed the assumption that the data was not normally distributed.

Table 5.12 *Test of Normality for LGC Assessment Score*

	W	df	Sig.
LGC Group (Experimental)	.871	17	.023
Non-LGC Group (Control)	.458	13	.000

Lilliefors Significance Correction

Since the assumption of normal data distribution was not met, non-parametric methods were employed in running this hypothesis. The aim of this test is to determine whether there was a significant difference of LGC product assessment scores between the experimental group (LGC) and the control group (non-LGC). The null hypothesis is as follows:

H_0: There is no significant difference in LGC product assessment scores between the experimental group and the control group.

Consequently, Table 5.13 shows the results from a Mann-Whitney non-parametric test.

Table 5.13 *Independent-Samples Mann-Whitney U Test on Scores*

Attribute	Sig.	Decision
The distribution of Scores is the same across categories of LGC and Non-LGC.	.000[1]	Reject the null hypothesis

Asymptotic significances are displayed. The significance level is .05.
[1]Exact significance is displayed for this test.

From the results (p = 0.000 < 0.05), it was decided that the null hypothesis was rejected. Therefore, it can be established that there is a significant difference in LGC product assessment scores between the experimental group and the control group.

5.3.2 Peer Review Results

The aim of this activity is to assess the learning and entertainment aspects of the LGC product. There were six LGC product samples assessed by twelve student respondents. The criteria of selection was samples with highest, medium, and lowest scores from both LGC (experimental) and non-LGC (control) groups previously filtered by the instructor as displayed in Figure 5.8. In this activity, the respondents reviewed the LGC products using the LGC product score instrument (see Appendix E) in a focus group environment.

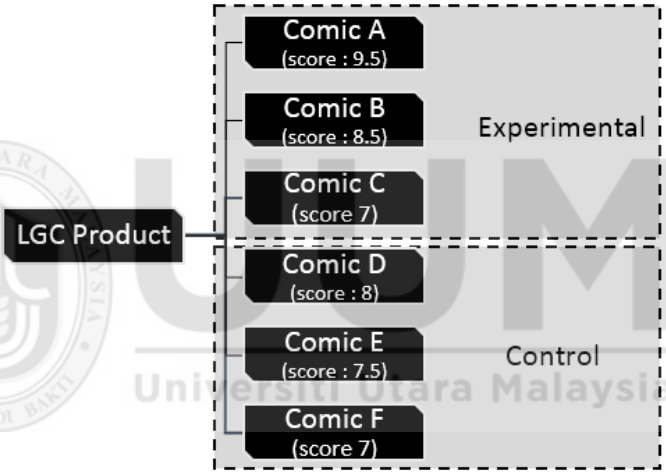


Figure 5.8. LGC Product Samples for Peer Review

5.3.2.1 Analysis and Findings

The total scores of LGC product assessment given by the respondents in the peer review session is presented Table 5.14 and Figure 5.9.

Table 5.14 *Frequency Table of LGC Product Peer Review Score.*

Respondents	Comic A	Comic B	Comic C	Comic D	Comic E	Comic F
1	88	88	87	87	86	76
2	92	78	65	66	61	57

3	93	90	88	88	82	77
4	78	77	65	66	57	54
5	100	97	95	100	95	92
6	94	85	82	82	72	40
7	82	74	70	73	70	69
8	94	93	88	92	87	81
9	84	82	79	80	78	76
10	77	69	64	67	63	61
11	85	83	81	82	79	78
12	94	90	81	89	71	68

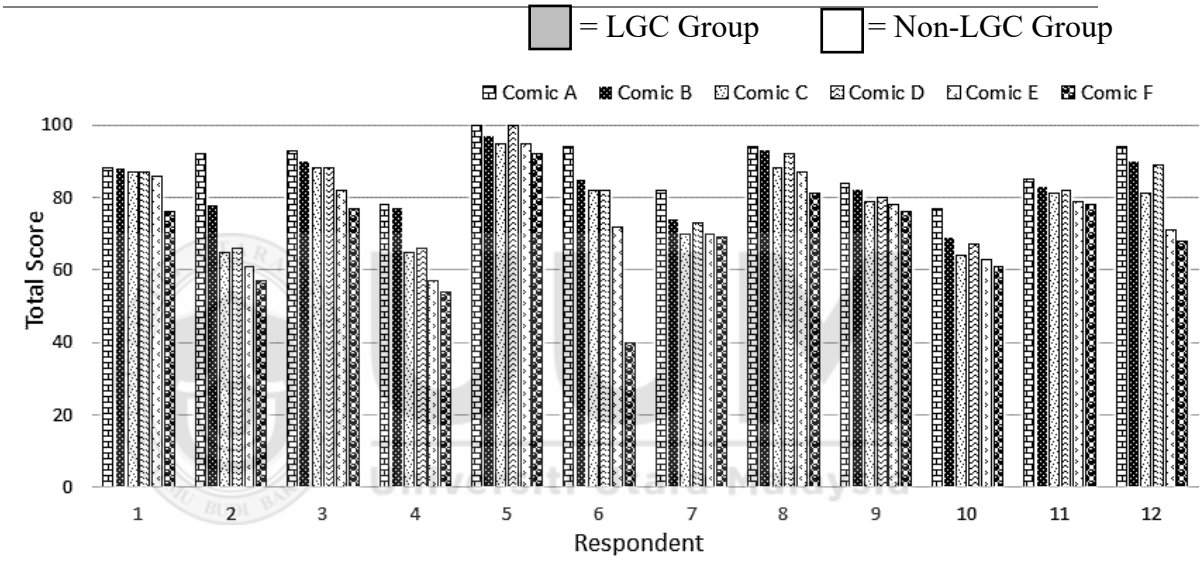


Figure 5.9. Bar Chart of LGC Product Peer Review Score.

Pulling the composite data, the descriptive results of LGC product peer review scores are shown in Table 5.15 and visualized in Figure 5.10. Findings reveal that the mean value for LGC product total score is higher (above 78 out of 100) for the experimental group compared to the control group.

Table 5.15 *Descriptive Summary of LGC Product Total Score*

Comic	Mean	Mean Std. Error	Std. Deviation	Variance
A	88.4167	2.08333	7.21688	52.083

B	83.8333	2.38948	8.27739	68.515
C	78.7500	3.01040	10.42833	108.750
D	88.4017	2.08333	7.21688	52.083
E	81.000	3.19090	11.05359	122.182
F	75.0833	3.31767	11.49275	132.083

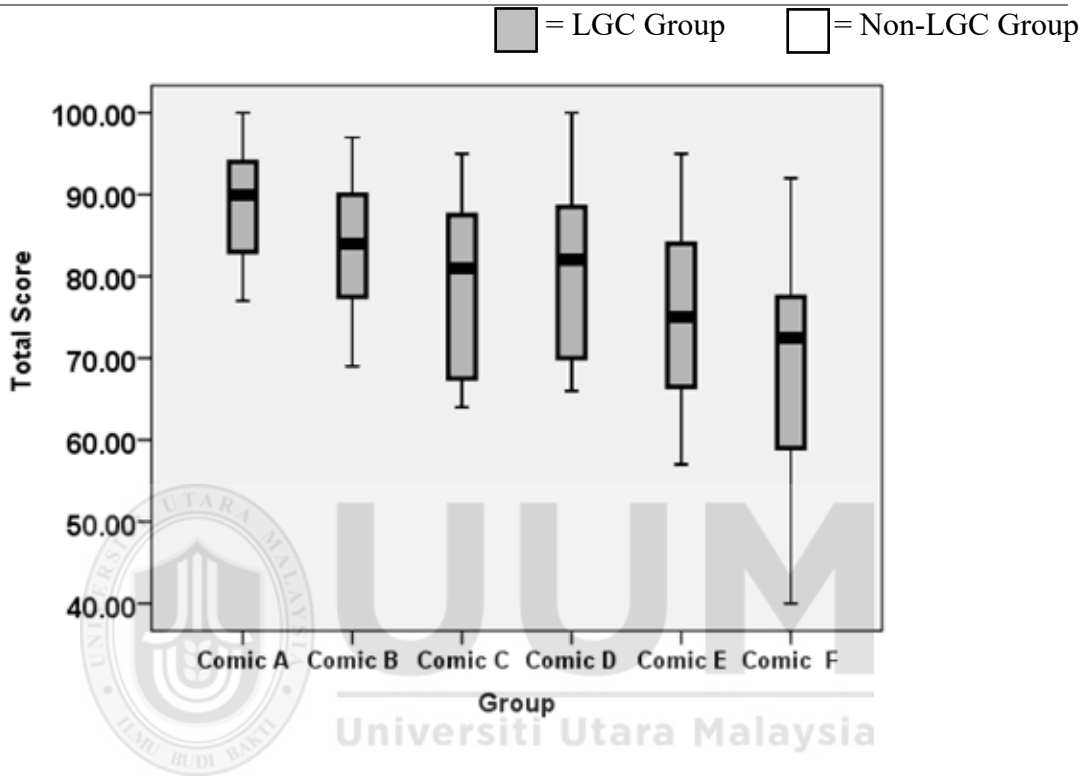


Figure 5.10. Box Plot of LGC Product Peer Review Score.

From the results, it was found that although Comic D (from control group) generally scored higher than Comic C (from the experimental group), majority of the respondents granted high scores to LGC products developed by the experimental group (Comic A and Comic B) compared to the control group.

Consequently, a more specific analysis was carried out to measure the score range of learning and entertainment aspects gained by the LGC product samples. Hence, data distribution of learning and entertainment aspect total score was firstly checked. The

significance value results using Shapiro-Wilk test ($p > .05$), implied the assumption that the data was normally distributed (see Table 5.16).

Table 5.16 *Test of Normality for Learning and Entertainment Aspects Total Score*

Total Score	**Learning**			**Entertainment**		
	W	df	Sig.	W	df	Sig.
Comic A	.962	12	.812	.937	12	.466
Comic B	.883	12	.096	.878	12	.084
Comic C	.985	12	.996	.961	12	.799
Comic D	.950	12	.643	.964	12	.839
Comic E	.963	12	.823	.940	12	.497
Comic F	.975	12	.955	.918	12	.273

Lilliefors Significance Correction

Since data normality was confirmed, parametric methods were employed in running analysis. Therefore, descriptive results of learning and entertainment aspect total score are displayed in Table 5.17.

Table 5.17 *Descriptive Summary of Learning and Entertainment Aspect Score*

Comic	**Mean**	**Mean Std. Error**	**Std. Deviation**	**Variance**
		Learning		
A	58.6667	1.11010	3.84550	14.788
B	56.4167	1.30534	4.52183	20.447
C	53.0833	1.64896	5.71216	32.629
D	53.8333	1.77454	6.14718	37.788
E	50.3333	2.05358	7.11379	50.606
E	48.1667	2.24227	7.76745	60.333
		Entertainment		
A	35.3333	.94815	3.28449	10.788

B	33.0000	1.23705	4.28528	18.364
C	31.6667	1.37804	4.77367	22.788
D	33.1667	1.36977	4.74501	22.515
E	31.0833	1.35657	4.69929	22.083
E	27.5000	1.79012	6.20117	38.455

= LGC Group = Non-LGC Group

The findings generally demonstrate that the mean values for LGC product score are high in learning (above 53 out of 60) and entertainment (above 31 out of 40) aspect for the experimental group. Furthermore, Figure 5.11 and Figure 5.12 illustrate the range of learning and entertainment aspects score range achieved by all LGC products.

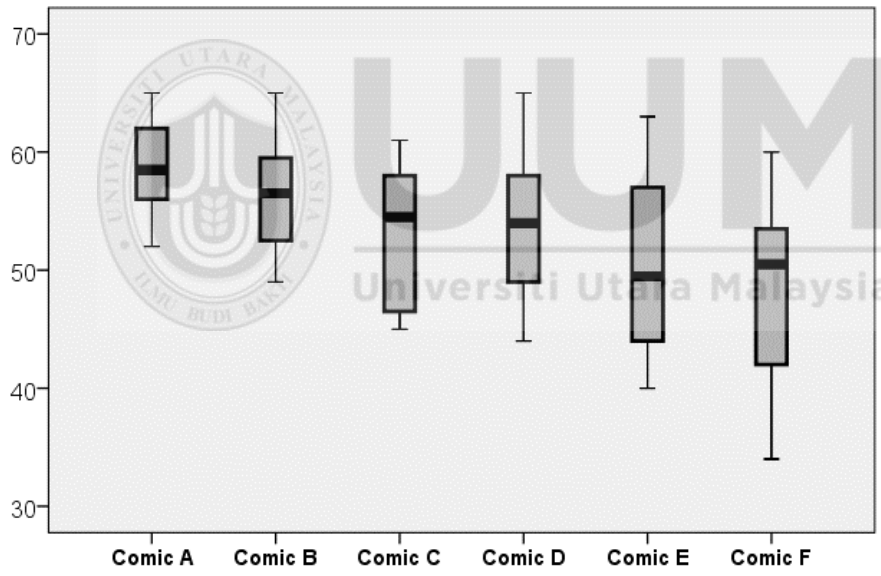


Figure 5.11. Boxplot of LGC Product's Learning Aspects Scores

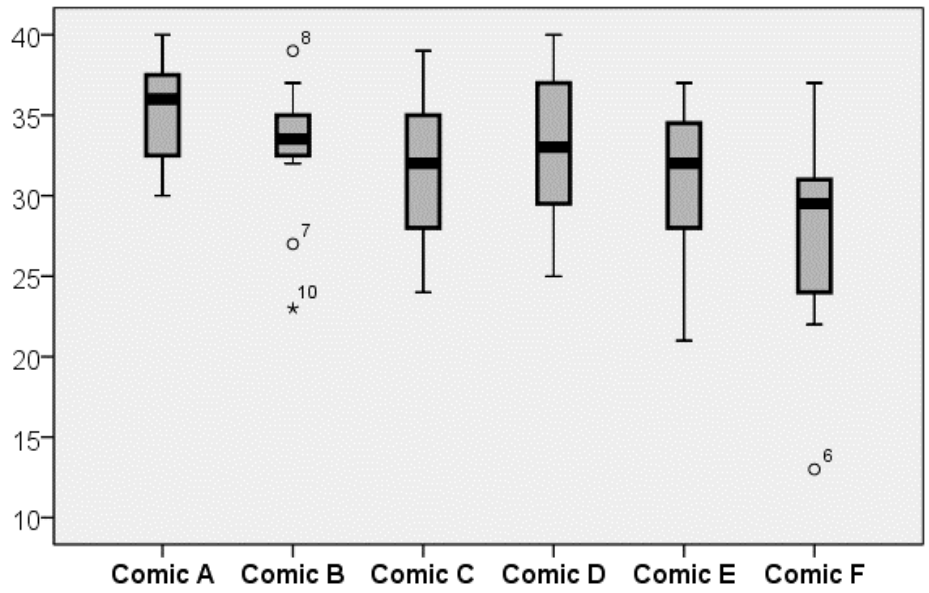


Figure 5.12. Boxplot of LGC Product's Entertainment Aspects Scores

It was apparent that Figure 5.11 has visually demonstrated that higher scores in learning aspect were achieved by Comic A and Comic B developed by the experimental group. Meanwhile, the lower range of entertainment aspect scores were given to LGC products in control group (see Figure 5.12).

Apart from that, verbal discussion with the respondents was simultaneously carried out to gather additional review towards the material. The respondents were asked to provide general comments on the LGC products based on learning and entertainment aspects.

For instance, in the aspect of learning, the information in LGC sample in experimental group is correct and presented in short, concise segments (see E in Figure 5.13); since the elucidation of content is carefully broken down into separate but continuous speech balloon. As depicted in Figure 5.12 (B), the characters

interaction with the educational content is meaningful as the dialog is aligned with the displayed information. Aside from that, the pictorials facilitate the reader's understanding towards the content (refer to D Figure 5.13); where in this scene, the props (correct and incorrect signs) provide comparison and highlight important facts to the reader.

In the aspect of entertainment, the characters' pose, gesture, expression, and position are reasonably placed (see A in Figure 5.13). As represented most panels in Figure 5.12, the speech balloons and captions placement in the LGC also ease the flow of the story and the pictorials complement with the plot. Finally, the LGC products also provide enough context and action to keep the reader moving through the story (refer to C in Figure 5.13); while this LGC casually embeds educational content, the fun and romantic story frame delivers intrigue to the respondents.

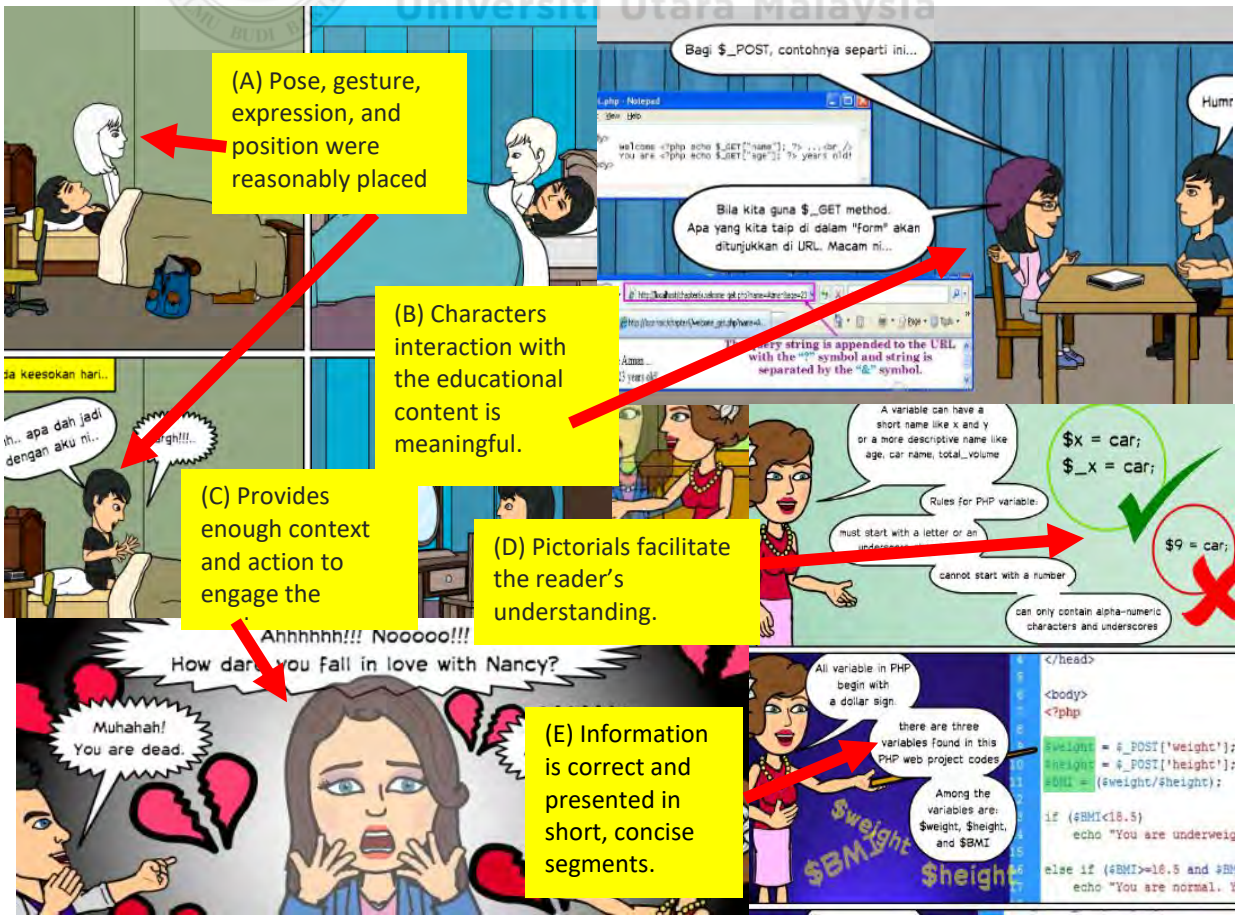


Figure 5.13. Several screenshots from LGC product examples in the experimental group.

On the other hand, LGC product examples in control group exposed that there is an unnecessary plot device that does not complement with the rest of the story. For example, although there is a concert scene in the beginning, it has absolutely no relation the following event (see A Figure 5.14). The flow is slightly disrupted because placement of speech balloons and captions are confusing (see B Figure 5.14). In this panel, the first balloon appears on the right instead on left side, resulting inexact spoken dialog succession. Plus, unlike the LGC products by the experimental group, there is a lack of other pictorials that would facilitate the reader in understanding the content in the LGC by the control group. As exposed in Figure 5.14, most presentation of educational content rely on speech balloon usage only instead of other visual cues. Overall, these drawbacks defect the learning aspect of the LGC.

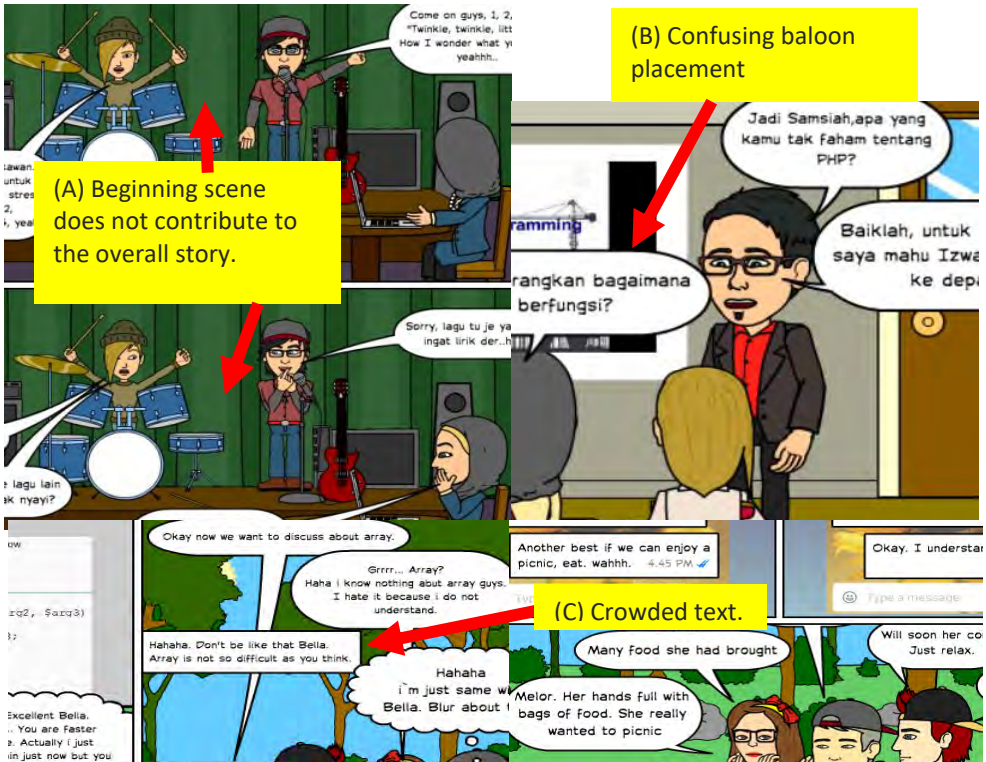


Figure 5.14. Several screenshots from LGC product examples in the control group.

Furthermore, many of the pages in LGC by the control group are too busy with text, distracting reader to emphasis on the key message (see C in Figure 5.14). As shown Figure 5.14 (D), some characters' expression and gesture were mismatched with their dialogue in certain panels. The male character is not speaking in contrast with his body language. Lastly, there is lack of continuity and imagination in the LGC (refer to E in Figure 5.14) from the control group. This is because it does not engage reader with creative setting or interesting character conflict, unlike the LGC from the experimental group. As a result, these inadequacies also affected the LGC's aspects of entertainment.

From peer review, the descriptive results and verbal discussions have approximately exhibited that there are differences of scores and feedback in the aspects of learning

and entertainment between LGC products in experimental and control group. Therefore, two final hypothesis tests were conducted to investigate whether these differences are strictly significant.

5.3.2.2 Hypothesis Testing V

The purpose of this hypothesis is to verify whether there were differences in learning aspect scores between all LGC products assessed in the peer review activity. The null hypothesis is as follows:

H_0: There is no significant difference in learning aspect scores between the LGC products by all groups.

As affirmed in the previous subsection, parametric hypothesis testing method was applied. Consequently, one way analysis of variance (ANOVA) was run. The results of this hypothesis testing are presented in Table 5.18.

Table 5.18 *Results of ANOVA Test on Learning Aspect Score*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	887.000	5	177.400	4.914	.001
Within Groups	2382.500	66	36.098		
Total	3269.500	71			

The results exhibit that there is a significant difference ($p = .001 < .05$) between all groups in aspect of learning with $F = 4.914$. Rejecting the null hypothesis, it can be said that there is a significant difference in learning aspect score between the LGC products assessed in the peer review session.

Next, in order to detect the differences among groups, a post hoc multiple comparison test using Tukey Least Significant Difference (LSD) was utilized. As shown in Table 5.19, this step was taken to determine whether a significant mean difference existed between each pair of groups.

Table 5.19 *Results of Tukey Least Significant Difference on Learning Aspect Score*

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Comic A	Comic B	2.25000	2.45284	.941
	Comic C	5.58333	2.45284	.218
	Comic D	4.83333	2.45284	.370
	Comic E	8.33333*	2.45284	.014
	Comic F	10.50000*	2.45284	.001
Comic B	Comic A	-2.25000	2.45284	.941
	Comic C	3.33333	2.45284	.751
	Comic D	2.58333	2.45284	.898
	Comic E	6.08333	2.45284	.145
	Comic F	8.25000*	2.45284	.016
Comic C	Comic A	-5.58333	2.45284	.218
	Comic B	-3.33333	2.45284	.751
	Comic D	-.75000	2.45284	1.000
	Comic E	2.75000	2.45284	.871
	Comic F	4.91667	2.45284	.351
Comic D	Comic A	-4.83333	2.45284	.370
	Comic B	-2.58333	2.45284	.898
	Comic C	.75000	2.45284	1.000
	Comic E	3.50000	2.45284	.711
	Comic F	5.66667	2.45284	.205
Comic E	Comic A	-8.33333*	2.45284	.014
	Comic B	-6.08333	2.45284	.145
	Comic C	-2.75000	2.45284	.871
	Comic D	-3.50000	2.45284	.711

	Comic F	2.16667	2.45284	.949
Comic F	Comic A	-10.50000*	2.45284	.001
	Comic B	-8.25000*	2.45284	.016
	Comic C	-4.91667	2.45284	.351
	Comic D	-5.66667	2.45284	.205
	Comic E	-2.16667	2.45284	.949

* The mean difference is at the 0.05 level. ($p < .05$)

The results of post hoc test revealed that there was a large mean difference value of Comic E and Comic F (from control group) towards Comic A and Comic B (from experimental group) which majorly contributed to ANOVA test results. However, despite being developed in the control group, the mean difference value of Comic D was low. This number indicated that the participants who developed Comic D were able to integrate learning aspects properly without referring to LGC production model. In parallel, discussion during the peer review exposed that Comic D has applied the analogy narrative which may add to the learning experience; resulting in higher learning aspect scores. Since analogy is also a listed activity (presentation) within LGC production model, the occurrence implied that elements suggested in proposed model are beneficial in boosting the LGC product's learning aspect. Henceforth, the next subsection conducts a hypothesis testing towards learning aspect scores.

5.3.2.3 Hypothesis Testing VI

This hypothesis was executed to authenticate whether there are differences in entertainment aspect scores between all LGC products assessed in the peer review activity. The null hypothesis is as follows:

H_0: There is no significant difference in entertainment aspect scores between the LGC products by all groups.

Accordingly, one way analysis of variance (ANOVA) was run. The results of this hypothesis testing are displayed in Table 5.20.

Table 5.20 *Results of ANOVA Test on Entertainment Aspect Score*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	415.958	5	83.192	3.698	.005
Within Groups	1484.917	66	22.499		
Total	1900.875	71			

The results showed that there were significant differences (p = .001 < .05) between all groups in aspect of learning with F = 3.698. Rejecting the null hypothesis, it can be defined that there were differences in entertainment aspect score between the LGC products assessed by the respondents. Subsequently, Table 5.20 depicts the results of Tukey Least Significant Difference (LSD) post hoc multiple comparison test.

Table 5.21 *Results of Tukey Least Significant Difference on Learning Aspect Score*

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Comic A	Comic B	2.33333	1.93644	.833
	Comic C	3.66667	1.93644	.415
	Comic D	2.16667	1.93644	.872
	Comic E	4.25000	1.93644	.254
	Comic F	7.83333*	1.93644	.002
Comic B	Comic A	-2.33333	1.93644	.833
	Comic C	1.33333	1.93644	.983
	Comic D	-.16667	1.93644	1.000
	Comic E	1.91667	1.93644	.920
	Comic F	5.50000	1.93644	.063
Comic C	Comic A	-3.66667	1.93644	.415

	Comic B	-1.33333	1.93644	.983
	Comic D	-1.50000	1.93644	.971
	Comic E	.58333	1.93644	1.000
	Comic F	4.16667	1.93644	.274
Comic D	Comic A	-2.16667	1.93644	.872
	Comic B	.16667	1.93644	1.000
	Comic C	1.50000	1.93644	.971
	Comic E	2.08333	1.93644	.889
	Comic F	5.66667	1.93644	.051
Comic E	Comic A	-4.25000	1.93644	.254
	Comic B	-1.91667	1.93644	.920
	Comic C	-.58333	1.93644	1.000
	Comic D	-2.08333	1.93644	.889
	Comic F	3.58333	1.93644	.441
Comic F	Comic A	-7.83333*	1.93644	.002
	Comic B	-5.50000	1.93644	.063
	Comic C	-4.16667	1.93644	.274
	Comic D	-5.66667	1.93644	.051
	Comic E	-3.58333	1.93644	.441

* The mean difference is at the 0.05 level. ($p < .05$)

The results of post hoc test revealed that there was an average mean difference value of Comic F (from control group) towards Comic A (from experimental group). Parallel discussion during the peer review revealed that story genre did not influence the respondents to enjoy the LGC. However, despite the low mean difference value in most groups, Comic A which successfully implemented the elements within LGC production model such as clear hook, conflict, and optimal dialogue suggested that; the proposed model would support effectual integration of learning aspect into LGC products. In addition, the findings also implied that when participants in the experimental group ignored the guides provided in the proposed model, their LGC product assessment scores would be affected. Overall, results from the instructor evaluation and peer review demonstrated that; by using LGC production model, participants were able to systematically design and develop digital educational comic with well-framed story, organized educational content, and effective comic visual storytelling techniques.

Next, expert review was conducted as the final process for evaluating LGC production model.

5.4 Expert Review of LGC Production Model

This section discusses the selection of experts, findings, and results obtained from the review.

5.4.1 Profile of Selected Experts

Eight experts were involved in this activity which comprised of six academicians and two practitioners. The numbers of experts were regarded adequate as stated in the conditions set by Nielsen (1989). Demographic information about the experts such as age, gender, position, and experience were collected to support the dependability of the selected experts in evaluating LGC production model. Table 5.22 presents the demographic profiles of the eight experts from different academic institutions including local and international.

Table 5.22 *Demographic Profile of Experts*

Expert	Gender	Age (Year)	Position	Academic Qualification	Affiliation	Experience (Year)
A	Male	55	Professor	PhD	Universiti Teknologi MARA	40
B	Male	44	Associate Professor	PhD	Ramapo College of New Jersey	24
C	Female	39	Associate Professor	PhD	University of North Florida	15
D	Male	46	Lecturer	PhD	Universiti Teknologi MARA	14

E	Female	42	Lecturer and Practitioner	PhD	Universiti Teknologi MARA and MOY Sdn Bhd	23
F	Female	33	Lecturer and Practitioner	Masters	Universiti Teknologi MARA and Gempakstarz	10
G	Male	37	Practitioner	-	Comicore Creative Solution	12
H	Male	35	Practitioner	-	ABS Holdings	6

In terms of educational background, one of them is a professor and two are associate professors. The remaining two are PhD holders and one possesses master degree. Besides that, some of them have more than 10 years' experience and holding key positions in their department.

It is important to emphasise that the criteria of selecting experts qualified for reviewing LGC production model was primarily based on their expertise in comics and digital media development. Particularly, Expert A is the first Malaysian scholar who obtained his PhD in Cartoon Studies from the University of Kent, Canterbury, UK in 1997. Besides sitting on the editorial board of the International Journal of Comic Art (IJOCA), he has written extensively on comic arts. His books include "The History of Malay Editorial Cartoons 1930s-1993", "Cartoons and Cartoonists in Malaysia", and "*Gila-Gila: Gaya dan Tema Kartun* (1978-2008)". As an advisor of The Association of Malaysian Comic Artists (PEKOMIK), Expert A has received the "Intellectual Cartoonist Figure Award" from PEKARTUN in 1999 and "Malaysian Cartoon Scholar Award" from the Prime Minister of Malaysia in 2012.

Expert B on the hand is considered as the pioneer and active researcher in LGC where he is the founder of the Comic Book Project since 2001 (Bitz, 2006). This non-profit workshop involved world-wide students producing LGC as a method of learning. It is a globally praised initiative and the results from the program showed significant gains the students' test scores (eg: Montgomery, Manuelito, Nass, Chock, and Buchwald (2012) and Bitz and Emejulu (2015)). Comparably, Expert C, who earns her Ph.D. in Curriculum and Instruction from Kent State University, has continuously focused her teaching practice on comic usage in the classroom. Her instructional books include "Teaching Graphic Novels", "Teaching Early Reader Comics and Graphic Novels", and "Teaching Content Area Graphic Novels".

Apart from that, Expert D is a PhD holder in animation who studied character design and production. Besides holding major position as academicians, both Expert E and Expert F are also cartoonists who published their works in recognized local comics (*Ujang* and *Gempak*). Meanwhile, as an active practitioner in local comic industry, Expert G has published several graphic novels under PTS publications and also a trainer in several comic production workshops. Finally, aside from working on Islamic online comics, Expert H has been conducting on-going LGC programs in Malaysian secondary schools. In summary, conforming to the experts' resourceful experience and capital knowledge in comics, their reviews were considered valuable and reliable for validating LGC production model.

5.4.2 Results of Expert Review

The gathered data were recorded in frequency and tabulated in Table 5.23 based on the questions asked in the instrument (Item (1) to (5)). In general, results from the analysis showed that the majority of the experts approved the most of the phases, tasks, and activities proposed in LGC production model. Majority of them also agreed that the proposed model is usable, has logical flow, and the terminology used is understandable.

Table 5.23 *Frequency Table of Responses from Expert Review*

(1) The following proposed components are relevant to represent the phases of digital educational comic development.

	Essential		Useful but not Essential		Not necessary	
	n	**%**	***n***	**%**	***n***	**%**
Context Setup	8	100	0	0	0	0
Narrative Brainstorming	8	100	0	0	0	0
Scriptwriting	5	62.5	3	37.5	0	0
Thumbnailing	6	75	2	25	0	0
Composing	8	100	0	0	0	0
Publishing	6	75	2	25	0	0
Assessment	7	87.5	1	12.5	0	0

	Essential		Useful but not Essential		Not necessary	
	n	**%**	***n***	**%**	***n***	**%**

(2) The following proposed tasks (and the activities within them) are relevant to represent all conceptual elements of digital educational comic development.

Purpose	8	100	0	0	0	0
Scope	7	100	1	0	0	0
Knowledge	7	87.5	1	12.5	0	0
Storyline	7	87.5	1	12.5	0	0

Characters	5	62.5	3	37.5	0	0
Basic	5	62.5	3	37.5	0	0
Comic	8	100	0	0	0	0
Layout	8	100	0	0	0	0
Text	8	100	0	0	0	0
Pictorial	6	75	2	25	0	0
Lettering	7	100	1	0	0	0
Modes	7	87.5	1	12.5	0	0
Medium	7	87.5	1	12.5	0	0
Learning	8	100	0	0	0	0
Entertainment	6	75	2	25	0	0

= Moderate Agreement.

	Yes		No	
(3) The connections and flows of all the components are logical.	7	87.5%	1	12.5%
(4) The production model is usable to the development of digital educational comic.	8	100%	0	0%
(5) The terminology used in the production model is understandable.	7	87.5%	1	12.5%

Legend – ***n*** = Frequency

The data is also plotted in the clustered column charts (see Figure 5.15 and Figure 5.16) which provide a straightforward way to illustrate the different frequency of responses.

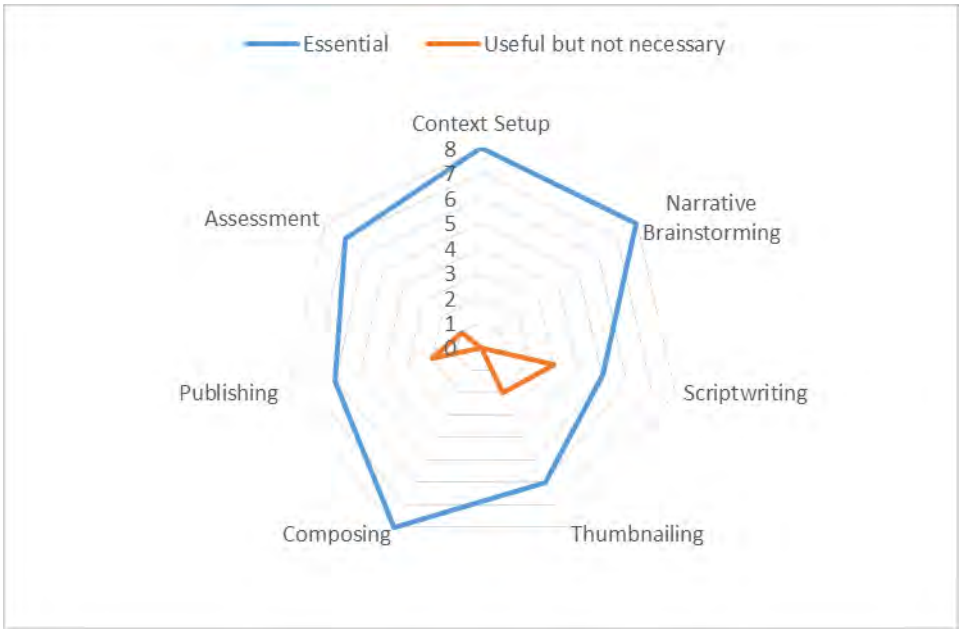


Figure 5.15. Frequency of the proposed phases' relevance in LGC production model.

In precise, the results exhibited that all experts had come into agreement that the Context Setup, Narrative Brainstorming, and Composing phases are essential to be included in the proposed model. On the other hand, two experts rated Thumbnailing and Publishing phases are useful but not essential. Next, only one out of eight experts stated that Assessment phase is useful but not essential. However, moderate agreement towards Scriptwriting phase was exhibited where five experts agreed that it is essential while three rated it as useful but not essential. These responses were reflected in additional comments by experts.

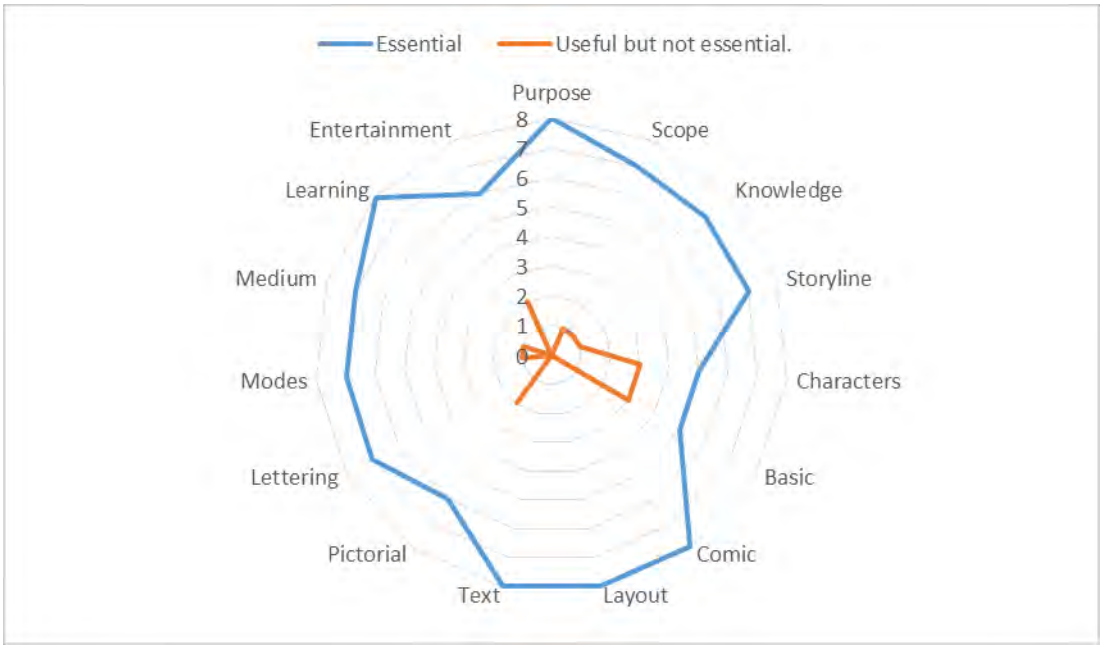


Figure 5.16. Frequency of the proposed tasks' relevance in LGC production model.

Overall, all experts agreed that Purpose, Comic, Layout, Text, and Learning tasks are essential to be incorporated in the proposed model. Meanwhile, seven out of eight experts rated Scope, Knowledge, Storyline, Lettering, Modes, and Medium as essential tasks in LGC production. Next, the Pictorial and Entertainment tasks were considered essential by six experts. However, three experts regarded Characters and Basic are useful but not essential LGC production tasks. Finally, one expert noted that the proposed model will have logical flow, usable and readable after the several aspects in the model are altered based on her recommendations.

To further contemplate the feedbacks given by the experts, all of the experts' written comments were also qualitatively analysed. These feedback and suggestions were grouped from the responses recorded in Item (6) to (12) (refer to Appendix D). In

conveying the clearer meaning, some of the comments were rephrased from the original versions as exhibited in Table 5.24).

Table 5.24 *Further Comments from the Experts*

Expert	Comments
A	(1) Target audience should be included in The Context Setup phase. For example, younger audience. (2) In Narrative Brainstorming phase (narrative type), may include daily scenes and symbols. (3) The description under Character activity may include the aspect of size and physical appearance. Dialogue must be appropriate for target readers. (4) The model is understandable, practical and flexible. (5) Overall, it is very important to identify the target reader, audience or user of the comic from the beginning of the process. This will determine the suitability of the following process.
B	(1) Context Setup phase is very important as it sets up the very purpose of the project. (2) You did a nice job in giving the scope of how students should pull together their ideas for the project. (3) You might add a discussion activity as part of Narrative Brainstorming or after it. It would be good for students to provide feedback for each other as they begin to plan and craft their comics. (4) Scriptwriting or Thumbnailing is certainly something to include, but given the time constraints of a typical classroom, perhaps it is something you would consider making optional. (5) Good job with giving a broad range of Composing phase options in this field. Perhaps consider providing ideas for outlets for publication/exhibition of the comics in Publishing phase. (6) I like how Assessment phase component is included so that there is a clear outcome to work toward. (7) Model description is very clear and understandable. (8) You have done an excellent job in the creation of this model. You have provided a very usable and effective model. I think it will be very useful and effective for educators. As you move forward, you may want to provide actual examples of these steps in action, perhaps through video. You might also consider providing an addendum to the model for classrooms that don't have immediate access to technology (that is, using hand-drawn comics). Overall, I think this is excellent work.
C	(1) How are you defining Basic phase? Basic of what? (2) Yes, the model will have logical flow, usable and readable once you fixed it. Refer to my notes.

	(3) How are Layout and Pictorial tasks different? Please specify. (4) Text and Lettering tasks seem to be overlapping too much. Are they more similar or different? (5) I can't wait to see how well this goes. Super fantastic project!
Expert	**Comments**
D	(1) Typography is essential because it defines the comic appeal. (2) Anthropomorphic should be added to assess character design. (3) Characters could be grouped under Storyline task. (4) Add narrative structure such as Gustar Freytag model in the description. (5) Overall, the model has listed all the necessary components for developing comic. However, it could also consider inserting these elements – content analysis, Freytag analysis, and anthropomorphism.
E	(1) Add symbol and semiotic elements into the model. (2) Character is considered an element in Storyline. (3) The model should be readable in monochrome. Therefore, consider eliminating colours for the phases' blocks. (4) Visually, the model does not require complex shape for each phases to avoid confusion. Stick to consistent shape for every proposed phase. (5) The model should be able to deliver message in a simpler way.
F	(1) The Context Setup is very essential for setting up the foundation for whole production. Narrative Brainstorming is important for group project. Scriptwriting is not essential because this usually can be included in thumbnail process. Thumbnailing is important because the Rough detail sketches fasten the next process. Composing is required for quality control can be made at this time before publish. Publishing save all the documentation and makes the final product run smoothly. (2) For comic publishing stage, I would add up special phase for digital development process especially for Androids and OS platform. Finishing up the comic is just a first part of the game, the other half is to make sure the comic run smoothly in variety platforms in every screen size of gadgets. Tasks for animated and Interactive comics should be considered by adding GIFs, or essential GUI (Graphic User interface) to be put for easy reading in the digital platform. Simple games can also be added to make the digital comics more interactive. (can easily be done in Flash or Construct). (3) The word 'Iconography' it is kind a bit off for visual metaphor representation in comic process. There is no definite term for this stage but I can only explain it to people as the 'exaggerated symbols' that defines movement and emotion in static world in comics. (4) I love the presentation of the chart flow of the production, but need

	more detail explanation based on different learning scopes. (5) The model it can be visually practical and understandable, the pipeline description in interactive infographics will be nice.

Expert	Comments
G	(1) I would not recommend Scriptwriting to be an essential phase because this phase process can be done when thumbnailing the comic. (2) Overall, the model is a decent guideline for effective comic production. But it is up to the comic artist to decide which his/her own preferable methods in developing comics.
H	(1) The model is adaptable for developing comic for different lesson/subjects. (2) The model could include examples from the proposed components. (3) The theme of comic should be clear. (4) Since the aim of educational comic is to motivate learning, help understanding content and encourage high level of thinking, this model is helpful for facilitating the process to achieve those aims through comic development.

Based on the comments, it can be concluded that; while majority of the experts approved the proposed phases and tasks, additional details could be included within the activities suggested in conceptual model. As pertaining to effective comic development, the experts pointed out their suggestions on the preparation, narrative, and visual elements of LGC production. Overlapping elements should also be amended. Plus, interestingly during the face to face meeting with two experts, they verbally remarked that, although 'storyboarding' and 'typography' terminologies were generally more common in digital media production, the use of 'thumbnailing' and 'lettering' terminologies in the proposed model should be maintained for its suitability in the comic area.

Subsequently, the justifications for the commentary are discussed in the next section. The comments from the review were coded and classified into flexibility, understandability, completeness, generality, and usability aspects.

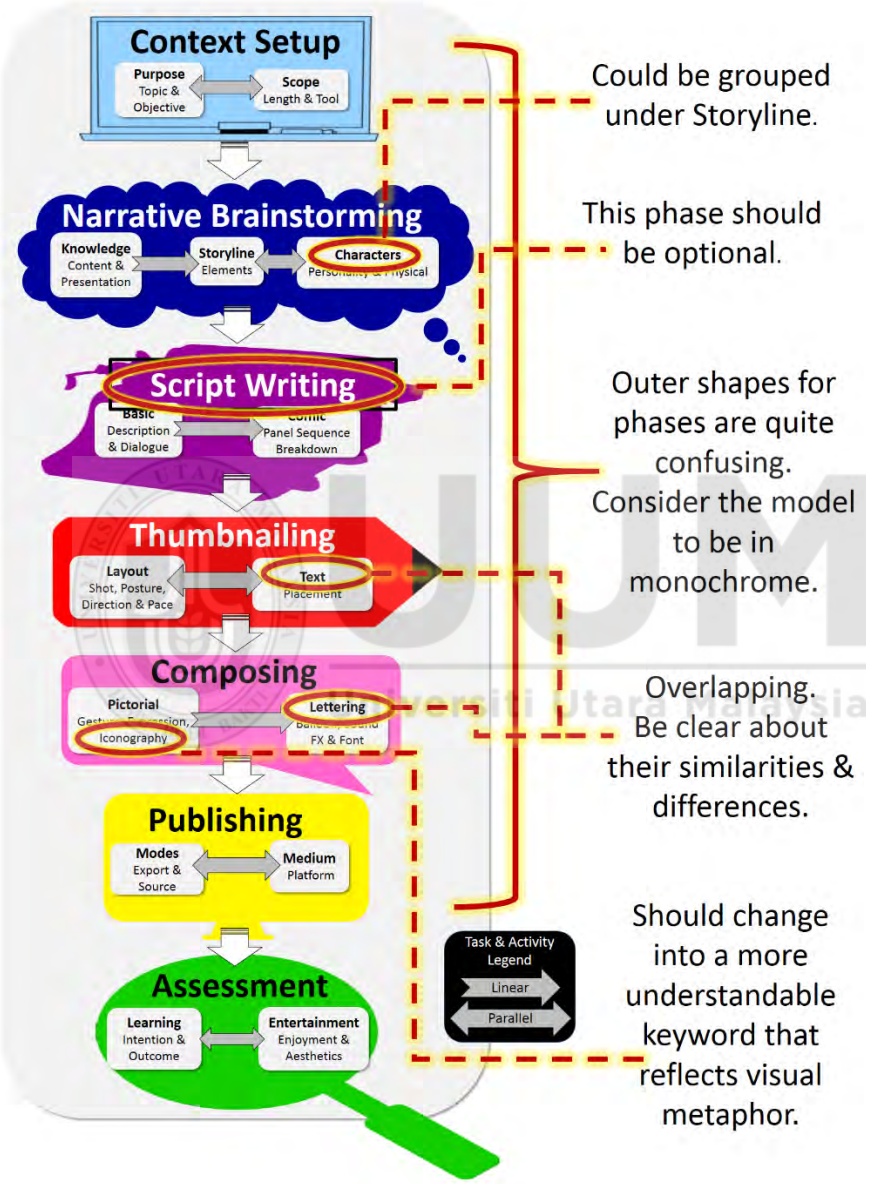


Figure 5.17. Several commentary towards LGC production model.

5.4.3 Justification on Experts' Comments

Given the mixed results towards certain phases and tasks depicted in Table 5.23, the feedback and suggestions from experts in Table 5.24 were analysed and considered in refining the proposed model.

The most apparent critique was towards the **flexibility** aspect on LGC production model. Primarily, three experts stated Scriptwriting phase as useful but not essential. Accordingly, since some practitioners directly draft their script into the sketch thumbnails, Expert F and Expert G recommended that Scriptwriting and Thumbnailing phases should be combined. In fact, Expect B prompted that these two phases should be optional due to constraints of a typical classroom. Moreover, Expert C argued that the Text task within Scriptwriting seems to be intersecting with Lettering. Hence, to tailor these issues, the Text task was replaced by Script task and merged under the Thumbnailing phase. These criticisms were decisively accepted by the researcher because it had been proven in the user experience testing stage where several participants concentrated straightforwardly on their thumbnails layout rather than the story script. In addition, the revised model also grouped Character as an activity within the Storyline task as recommended by Expert D and Expert E.

Secondly, the focus was on the **understandability** aspect of the proposed model. Answering Expert E's comments regarding the visual representation of LGC production model, readability of the diagram could be improved without confusing phase shapes. For example, during the user experience testing stage, participants could not figure out the typewriter shape for Scriptwriting phase and computer monitor for Publishing phase. Thus, this study visually revised the model by using

consistent rounded rectangle shape for each phases. However, Expert E's suggestion on modifying the diagram colours was omitted. This was because the colours matched with the phases' description referred during LGC production. Regarding Expert F's critique about "Iconography" keyword, after a discussion with Expert D and F, this was changed into "Visual Metaphor".

Next, the **completeness** aspects from the review were scrutinised. First, inclusion of content analysis, narrative models, and anthropomorphism was suggested by Expert D. As a response, the first two elements were embedded in Knowledge and Storyline tasks with the Narrative Brainstorming phase. Depending on the LGC's story, anthropomorphism would be an optional element under the Character task. Secondly, addition of symbol and semiotic were proposed by Expert E. These elements were considered inclusive in Pictorial and Text tasks within Composing phase. Thirdly, as addressed by Expert H, the theme element had already included in the Purpose task. Fourthly, Expert A highlighted the importance of target audience to be included in the model. This element is certainly associated with the Purpose task. When Topic and Objective are defined, target audience should also be relatively clarified by the learner. As a whole, most of the suggested elements by experts were included in the revised description section of LGC production model.

The next review focused on **generality** aspect. Concerning Expert C's argument on the difference between Layout and Pictorial tasks, the clarification were made in the model description. Despite their resemblance, Layout task concentrated on experimenting with the visuals before intensifying them during Pictorial task. Although Expert B evoked that discussion should be added into the model, Expert F

exclaimed that this embedded activity is more relevant to group projects within Narrative Brainstorming phase. In regards to Expert E's recommendation to add a specific process in assuring the comic run smoothly in variety platforms in every screen size of gadgets, this element had been included in Medium task within the Publishing phase. Thus, responding to the experts' recommendations, these suggested elements were included in the revised description section of LGC production model.

Finally, Expert B, Expert F, and Expert H emphasized on the **usability** aspect of the proposed model. For instance, Expert B suggested actual examples of LGC production process in action through video. Expert F on the other hand preferred an interactive infographic version of proposed model. Lastly, Expert H advocated to provide examples of the components proposed in LGC production model. These useful feedback were taken into major consideration in future study. This study undoubtedly acknowledged that a multimedia representation of the proposed model is an efficient factor in improving the quality of LGC production. In summary, the action taken towards the additional comments, critique, and suggestions by experts are depicted in Table 5.25.

Table 5.25 *Response towards Experts' Comments and Suggestions.*

Aspect	Experts' Comments	Action Taken
Flexibility	Scriptwriting phase is useful but not essential because this process can be carried out in thumbnail sketches. Plus, Text and Lettering tasks seem to be overlapping.	Scriptwriting phase was altered into Script task that replaced the Text task. This means the Dialogue, and Text Placement activity were merged within Thumbnailing phase. Description was also replaced as Caption activity.
	Character Task is considered as a Storyline element.	Character was grouped as an activity within Storyline task.
Understandability	Confusing phase shapes in the diagram.	Used consistent rounded rectangle shape for each phases.
	Model should be in monochrome.	Omitted because the colours are used to instantaneously refer the description of the model.
	"Iconography" is not suitable for visual metaphor representation in comic process.	The "Iconography" keyword was altered into "Visual Metaphor".
Completeness	Include the content analysis element.	This element was elaborated in Content activity description.
	Include narrative models.	This element was embedded as a narrative type example in Presentation activity description.
	Include anthropomorphism element.	This element was added as an example in Character activity description.
	Include symbol and semiotic elements.	These elements were considered inclusive in Visual Metaphor tasks.
	Add target audience element.	This element was considered inclusive in Purpose task.
	Include theme element.	This element was considered inclusive in Storyline task.
Generality	Include discussion activity.	This element was considered inclusive in Narrative Brainstorming phase.
	Add a specific process in making sure the comic run smoothly in variety platforms in every screen size of gadgets.	This activity was inclusive in Medium task.
	Specify the difference between Layout and Pictorial task.	The differences were clarified in aim of Thumbnailing and Compoing phase description.

Usability	Provide video or interactive infographic version of the model along with component examples.	These suggestions were very useful and taken into major consideration in future study.

5.4.4 Revised Production Model of LGC

Lastly, LGC production model had been revised and redesigned based on expert review as illustrated in Figure 5.18. The description was also amended and visibly highlighted in Table 5.26.

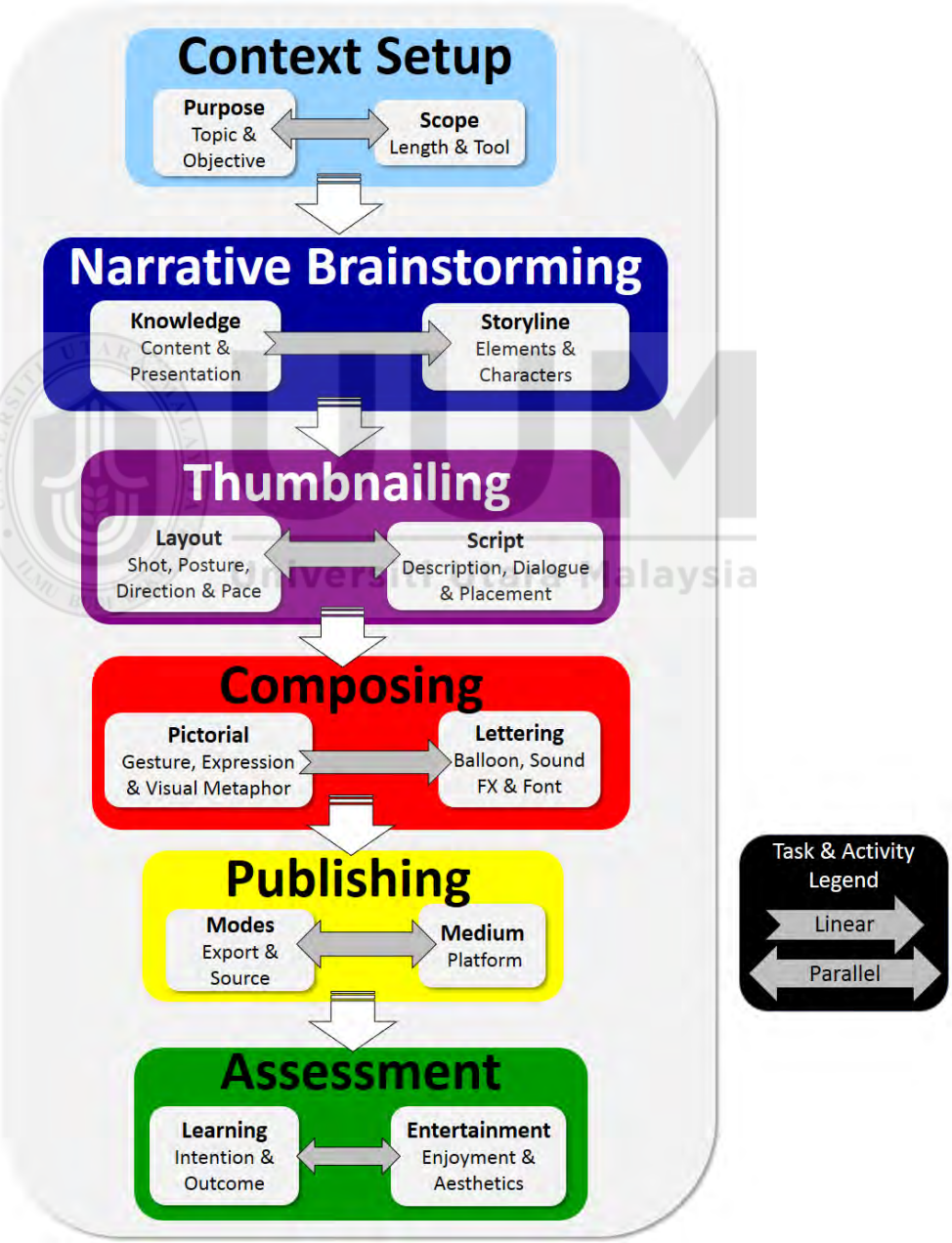


Figure 5.18. Revised LGC production model (Version 3)

Table 5.26 *Refined LGC Production Model Description*

Phase 1: CONTEXT SETUP		
To clarify the goal and requirements of the project or assignment.	**PURPOSE**	
	Topic • Identify the focused topic given by the instructor.	• Why do earthquakes happen? • Why food taste differently? • How to fractions work? • What is the difference between Client and Server Side Scripting?
	Objective • Decide how to answer the driving question in the comic.	• The comic will describe what causes earthquakes. • The comic will compare the difference between acid and alkaline food. • The comic will explain how to solve several fraction problems. • The comic will show the interaction between client and server.
	SCOPE	
	Length • Determine the length of comic to be developed.	• Comic Strip - *2-to 5 panels* • Loose/One Pager -*Single page* • Short comic /comic book - *Up to 30 pages* • Graphic Novel - *may reaches 600 pages.*
	Tool • Specify software, hardware, media or tools to be obtained/ purchased/ downloaded/ for the comic development.	• Mind mapping app • Scanner • Royalty-free images • Software, tutorial, etc
Phase 2: NARRATIVE BRAINSTORMING		
To concisely reflect, strategically structure the knowledge / educational content and frame the story.	**KNOWLEDGE**	
	Content • Gather, analyse, choose relevant and important factual and conceptual content to be included in the comic.	List/ sheet/ chart of information, details, key points, ideas, significant facts, definitions, concrete details, and quotes related to the topic.
	Presentation • Select a narrative type and plan on how to arrange, highlight, and present the knowledge/ educational content.	• Monologue • Agent / Persona • Scenario / Problem / Case • Metaphor / Analogy • Auto-Biography
	STORYLINE	
	Elements • Develop a conflict, theme or events that drive the plot until the final resolution.	• Hook, setting and point of view. • Unnecessary and repetitive scenes are removed.
	Characters • Design and specify characters'	Personality • Age, gender and profession

	personality and physical appearance that are stand out from each other.	• Hobby, interest, dreams and principles • Skills, advantages, fears and flaws • Backstory Physical • Proportion, facial feature, attire • Humanoid, anthropomorphic, creatures, objects.
To experimentally assemble the comic narrative by focusing on balance between pictorial and text, flow, focus, tone and continuity.		
	Pace • Estimate how many panels fit into single page and which dialogue or action occur in every panel. • Diversify the panel's size and shape to slow or speed up the pacing and set the tone.	• The largest panel in the page is utilized for significant knowledge or highly dramatic moment. • Unnecessary or distracting pictorial details are removed when highlighting factual or conceptual content
	Shot • Frame the action or dialogue with suitable visual point of view in every panel. • Interchange the angle in continuing panels. • There is a variation of shots in continuing panels that provide dynamic flow.	• Long shots- *establish a scene.* • Medium - *show action.* • Close-ups - *show reaction.*
	Posture • Position the characters, objects or props. • Give different visual prominence or depth for character, action or object that have significant role in the panel.	• Walking • Standing • Sitting • Jumping
	Direction • Arrange the characters to face or move to a logical direction in continuing panels. • The continuing panel complies with 180 degree rule.	• The characters' location and orientation in different panels are consistent.

	Dialogue • Write the speech and thoughts of every character including the narrator.	• The dialogue is optimally used to present factual and conceptual content, develop character personality, convey setting or forward the story. • All text are condensed carefully without altering the message.
	Caption • Insert description minimally to complement dialogue.	• Location & time • Internal Monologue • Editorial
	Placement • Place text that lead the audience's eyes smoothly across the page. • Refrain the text from blocking major pictorial elements.	• The dialogue is positioned close the speaker. • There is a clear path through multiple dialogue text. • The dialogue is divided into several balloons to display pieces of information.
To produce the comic by controlling and enhancing the mood, clarity and intensity of the pictorials and text.		
	Gesture • Communicate particular message with appropriate character gesture.	The characters interact logically with appropriate gesture.
	Expression • Display characters' emotion.	The characters' expression illustrates the story mood and character's attitude.
	Visual Metaphor • Symbolize an action or emotion using analogy or pictograms.	• Motion Lines • Impact Starts • Fight cloud • Star/Heart Eyes • Sweat drop • Bulb • Devil horns • Dashes
	Balloon • Point the balloon tail correctly to the speaker. • Demonstrate dialogue purpose with corresponding balloon shapes.	• Speech • Thought • Whisper • Shout / Scream • Linked • Overlapping
	Sound FX • Convey mood with sound effects.	• *boom* • *wham* • *blam* • *slam* • *grab* • *snatch* • *jab*
	Font • Capture character's tone, object and scenery's sound with apposite font type.	• Bold, distinctive shape, size or colour of text for emphasis. • A readable jaggy font for spooky dialogue. • A typewriter-like font for a robotic voice.
Phase 5: PUBLISHING		
To compile and	**MODES**	

finalize the comic.	**Export** • Convert Single or multiple page comic files into standard readable format.	• jpg • zip • png • cbr • gif • pdf
	Source • Keep the native files for reuse or modifications.	• psd • ai • Bistrips
	MEDIUM	
	Platform • Assign either the comic is accessible in desktop or mobile	• Windows, Android, IOS • Website, Online Portal, Social Media
To review the quality of the comic.		
	Intention • Define if comic has met its educational goal and requirement.	The comic meets its educational goal and requirement as initiated by the instructor.
	Outcome • Indicate if the comic has provided accurate & useful knowledge.	The knowledge, factual and conceptual content in the comic are accurate & useful.
	Enjoyment • Review if the narrative is been fun and interesting.	The story and characters emotively capture interest.
	Aesthetics • Perceive if the comic is visually pleasing to read.	The comic's visuals are well-presented and adequate to read.

5.5 Summary

This study evaluated the proposed model in terms of quality. The individual dimension results conveyed that generality, flexibility, completeness, usability, and understandability of LGC production model evaluation scored high overall median and mean. Hypotheses testing was also conducted and the results demystified that the quality of the LGC production model is significant. This implied that the proposed model was significant in serving as a guideline for learners to design and develop digital educational comics. Furthermore, assessment scores were different between LGC products developed by the experimental group and control group. Supplementary hypothesis testing results revealed that there were differences in

learning and entertainment aspect scores between the LGC products assessed in the peer review session. Furthermore, this chapter has also reported that the majority of the respondents in the expert review activity approved the most of the phases, tasks, and activities proposed in LGC production model. The experts also approved the connections and flows of all of the components. In addition, the further comments and suggestions from the experts were analysed and classified into flexibility, understandability, completeness, generality, and usability aspects. Finally, the components and description in LGC production model were revised based on the quantitative and qualitative data from expert review. Limitations of the results and findings obtained in the evaluation stage are thoroughly discussed in Chapter 6.

CHAPTER SIX
CONCLUSION

This chapter provides important aspects that can be derived from the study of learner-generated comic (LGC) production model. It highlights the answer of research questions and discussion of findings. This chapter also provides summaries of research limitations and contributions. This chapter then ends with a discussion of future research and conclusions of the study.

6.1 Answers of Research Questions

This study aims to develop a production model of LGC which functions as a systematic guideline that includes the fundamental components for learners to develop digital educational comics. Accordingly, this study was conducted based on four research questions:

a) What are the core components of LGC production model?

b) How to construct a systematic LGC production model based on the identified components?

c) How to evaluate the quality of the proposed LGC production model?

d) How to assess the learning and entertainment aspects of the LGC products?

The answers for these questions are provided in the subsequent sections.

A) Research Question 1:
What are the core components of LGC production model?

Components of LGC production model comprise (i) Context Setup, (ii) Narrative Brainstorming, (iii) Thumbnailing, (iv) Composing, (v) Publishing, and (vi) Assessment. These components are classified as phase and supported by task and activity subcomponents. The components are presented in detail in Table 6.1.

Table 6.1 *List of LGC Production Model Components.*

Phase	Task	Activity
Context Setup	Purpose	Topic
		Objective
	Scope	Length
		Tool
Narrative Brainstorming	Knowledge	Content
		Presentation
	Storyline	Elements
		Characters
Thumbnailing	Layout	Pace
		Shot
		Posture
		Direction
	Script	Dialogue
		Caption
		Placement
Composing	Pictorial	Gesture
		Expression
		Visual Metaphor
	Lettering	Balloon
		Sound FX
		Font
Publishing	Modes	Export
		Source
	Medium	Platform
Assessment	Learning	Intention
		Outcome
	Entertainment	Enjoyment
		Aesthetics

These components were determined based on activities described in Chapter 4.

B) Research Question 2:
How to construct a systematic LGC production model based on the identified components?

As a conceptual process model, this study formulated that LGC production model consists of components classified into phases, tasks, flow, and activities. Phases are distinct general stages of the model that can be performed in order, while tasks can be described as constituent parts of the model that contribute to each phase. On the other hand, flow in the model define the way and manner of progress from one phases, tasks, or activity to another. In addition, activities in the model refers to specific steps or processes that are recommended to be conducted during LGC production.

The phase components were identified through a comparative study of LGC classroom strategies. The general steps or process in LGC practices were initially grouped under generic production stage; either pre-production, production or post-production. Then, the LGC development steps with commonalities were categorized into distinct phases. Next, the task components were acquired by extracting comic, story, and learning elements through comparative study of DST models and frameworks as well as comparative analysis of professionals' creative process. Subsequently, the activity components were attained through expert consultation with comic practitioners and literature review. Finally, the flow of LGC production was determined through user participation.

C) Research Question 3:
How to evaluate the quality of the proposed LGC production model?

The study seeks to provide a unified DST method for LGC production. Accordingly, LGC production model has been evaluated through user experience testing and expert review. These two evaluation stages ensure that the implementation of production model of LGC represents a systematic approach of producing LGC.

To measure if LGC production model is significant in assisting learners to develop educational comics, participants from user experience testing activity has rated their experience of using the proposed model in terms of quality. It is categorized into five dimensions, namely generality, flexibility, completeness, usability, and understandability. Initially, all dimensions scored a high overall median score. Then, a one sample Wilcoxon signed rank non-parametric test was run (including all 5 dimensions) where the results showed significant values. Consequently, the null hypothesis was rejected which concluded that the LGC production model is significant in terms of quality. This finding was further supported through the LGC product assessment scores between experimental group and control group; which were significantly different.

The expert review process was conducted as a conformity assessment of LGC production model quality. Principally, results from the expert review described that the majority of the experts approved the most of the phases, tasks, flow, and activities proposed in LGC production model. Subsequently, critiques and

suggestions from the experts in the aspect of flexibility, understandability, completeness, generality, and usability were analysed. Complying with the quantitative and qualitative evaluation by experts, as well as user experience testing results, all revisions finally made the definitive version of the LGC production model (refer to Figure 5.18).

C) Research Question 4:
How to assess the learning and entertainment aspects of the LGC products?

In this study, an evaluation instrument was designed to assess the LGC products developed by users of the proposed model. The LGC product assessment scores are measured based on two primary aspects; namely learning and entertainment. This is because an assessable educational comic should be measured based on what level it is able to educate and entertain its reader. Consequently, the scores of LGC products submitted in the user experience testing were provided by the instructor and further assessed and discussed in a peer review activity.

In the aspect of learning, the LGC product is assessed by determining whether the knowledge or ideas in LGC are relevant, accurate, thorough, and reliable. The presentation of educational content should be readable, balanced, consistent, and concise. Moreover, it is recommended that the LGC product has positive consciousness, and is reusable and extendable. In the aspect of entertainment, the LGC product is assessed by measuring at what level the LGC emotively attract the audience's interest through its illustrative appeal and assemble of comic's visual storytelling elements. Additionally, enjoyable and well-developed storyline and characters also contribute to the entertainment aspect of LGC.

Essentially, feedback and results from both instructor evaluation and peer review activities have demonstrated that there was a significant difference of assessment scores between LGC products in experimental group and control group. This finding generally interpreted that LGC products developed by the proposed model users invoked more learning and entertainment aspects than LGC products by non-users Therefore, it is indicated that by using the proposed LGC production model, learners were comparatively able to design and develop better digital educational comic.

6.2 Objective of the Study – Revisited

The main aim of this study is to propose a LGC production model. At the end of this study, the primary aim has been achieved through completion of four supporting objectives: (1) to determine the core components for LGC production model, (2) to construct a systematic LGC production model based on the identified components, (3) to evaluate the quality of the proposed LGC production model, and (4) to assess the learning and entertainment aspects of the LGC products developed through applying the proposed model.

The first objective was achieved through the identification of the LGC production model components from content analysis, comparative studies, and expert consultation. The second objective was accomplished with incorporation of the identified components into the proposed model and through user participation. Next, the third objective was realised through user experience testing and expert review. Both evaluation methods produced significant and positive results. Lastly, the fourth objective was attained through LGC product performance score assessment carried

out in user experience testing. Overall, evaluation results concluded that LGC production model was not only significant in terms of quality, it also assisted users in constructing well-developed LGC products.

6.3 Limitations and Recommendations for Future Works

This study outlines two areas of limitation which are (i) the production model of LGC and (ii) the LGC product prototypes. The following subsection address each of the limitation in details.

6.3.1 LGC Production Model

To construct LGC production model, a number of LGC classroom strategies, DST models and frameworks were analysed in extracting their common components. Nevertheless, the studies used for comparative analysis are less exhaustive since the selection represents the design methods and models for the past 10 years (i.e. 2004-2014). Definitely, consideration of more recent studies of LGC classroom strategies and DST models might produce different conceptual production model.

Secondly, only two industry experts committed to participate in the initial design and development of LGC production model. Although the model components and their respective examples were acquired successfully, input from the experts was limited to a certain degree as they focused more on visual storytelling techniques with comics. Thus, consultation with instructional designers would have generated a broad range of elements for LGC in the perspective of learning and education.

Perhaps, with a focus group study involving a group of both industry experts and academicians, might substantially lead to diversified components of LGC.

The third limitation is about the participant selection for the user experience testing. For the purpose of homogeneousness, convenience sampling was adopted. Hence, the conclusions of LGC production model quality may not be generalizable to a broader cross-section of the population because this study was restricted to a particular group of learners, which were Malaysian undergraduate students. Consequently, replication studies of measuring the quality of LGC production model is encouraged as part of the adoption effort so as to add to the body of knowledge. Plus, the demographic background of participants did not consider their past experience in reading or producing comics and LGC. This indicates that; in what way existing and previous experience in LGC influence users' perception and attitude towards LGC production model should be examined in extended research.

Fourth, although this study was able to fabricate an adaptive assessment method for LGC products, the user experience testing did not determine which specific components in LGC production model contribute to the scores of LGC products. Due to restricted contact hour, the LGC production was based on a total of 2-hour explanation and discussion session in assumption that the participants can produce LGC product within 2 weeks interval. This study did not have the capacity to observe the participants' precise steps and proficiency of using LGC production model during the stated time frame. Thus, it is put forward that upcoming research should channel the user to itemize the process or components that assist them to produce educational and entertaining digital educational comic.

6.3.2 LGC Product Prototypes

Findings from instructor evaluation has established that there is a significant difference in LGC product assessment scores between the experimental group and the control group. Besides that, peer review activity results have revealed that there is a significant difference in learning and entertainment aspect scores between the LGC product samples in experimental and control group. These outcome denote that; by using LGC production model as the guideline to develop digital educational comics, the participants in the experimental group were able to archive higher range of scores for their LGC product assessment. Nonetheless, it was also discovered that even though several participants in control group did not formally refer to LGC production model, their LGC products were able to score sufficiently in learning and entertainment aspects. It was found that several elements suggested in the proposed model were indirectly applied into the LGC product in the control group; thus impacted their scores. This implication suggested that the LGC production model would still be representative in assisting learners to design and develop digital educational comics that are capable to educate and entertain.

Therefore, although it is possible to draw general conclusions about the validity and practicality of LGC production model, further investigation is crucial to examine the exact elements within the proposed model that contribute to the learning and entertainment aspects of LGC product. Discussion during the peer review activity however has emphasized on the advantages of the LGC product samples by the experimental group compared to the control group.

Primarily, LGC products developed by the proposed model users are more readable, well organized, and potentially extendable. The concepts and factual information within the comic narrative are concise, relevant, thorough, balanced, and consistent compared to the LGC by non-model users. Plus, in the LGC products by users of the proposed model, comic visual storytelling elements are well utilized with more interesting story and characters. These evidences suggested that by referring to LGC production model; learners have the advantage to clearly and strategically reflect, structure, and present knowledge, ideas, and narrative, and applied effective comic visual storytelling techniques resulting a comparatively more educational and entertaining digital educational comic. Hence, as previously illuminated, extended research should strictly investigate which precise elements within the proposed model enhance the LCG product's learning and entertainment aspects.

Finally, the LGC products developed by participants were digitally constructed using BitStrips comic authoring tool. Future research evokes using photo-based comic authoring tool such as Comic Life for assessing LGC production model adaptability. Besides that, the LGC products in this study are only limited to web programming topics. This calls for more case studies of LGC production model implementation encompassing diverse subjects and educational content. The anticipated goal is to investigate the effects of LGC production model towards the LGC product quality with different topics and digital tools.

6.4 Conclusion

This research has proposed and produced a LGC production model that has been constructed through extensive literature review, expert guidance, user participation, and analysis of theories, elements, technological, and systematic approaches of LGC and DST; through the layered components of comic, story, and learning. The underlying premise of this study is; a systematic production model based on storytelling and learning elements combined with an understanding of digital comic development processes, can contribute to the planning, implementation, and evaluation of educational DST session. Essentially, the model demystifies many aspects that should be taken into account to develop good LGC products.

Although considerable future works remain, this thesis has demonstrated that LGC production model is significant as a guideline for learners to design and develop well-produced digital educational comics. From the findings obtained in this study, there were indications that open up new means for educators to adopt LGC development process into their project-based classroom practice. In conclusion, it is hoped that this study will not only demonstrate the potential and impact of LGC production in technology-enhanced student-centred learning, but also provide a capstone on LGC research in field of comic and multimedia studies.

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APPENDIX A

Soal Selidik Rekabentuk Komik Pendidikan Berdasarkan Pandangan Pelajar

Assalamualaikum dan salam sejahtera,

Tahniah! Saudara/saudari telah dipilih untuk menjawab soalan-soalan di dalam soal selidik ini. Borang soal selidik ini diedar untuk mengumpul dan menganalisis pendapat responden terhadap projek komik pendidikan digital yang akan dibangunkan. Segala kerjasama dan masa yang telah diluangkan di dahului dengan ucapan ribuan terima kasih.

BAHAGIAN I : Latar Belakang Asas

Penuhkan maklumat di bawah ini dengan mengisi atau menulis (X) pada ruang jawapan yang disediakan.

1. Umur : _____ 2. Jantina (L/P) : _____

3. Bangsa :

☐ Melayu ☐ Cina ☐ India ☐ Lain-lain (Nyatakan: _____)

BAHAGIAN II : Tahap Kekerapan Membaca Komik

Nyatakan jawapan anda dengan menulis (X) pada ruang jawapan berdasarkan skala yang diberikan.

No.	Setiap minggu, berapa kerapkah anda membaca media berikut?	1 hingga 7 hari seminggu	Jarang sekali@ Tidak pernah
1.	Komik bercetak (Contoh: *Majalah komik Gempak, Apo?, Komik-M, novel grafik Doraemon, Naruto, Batman dll*)		
2.	Komik di media sosial (Contoh: *Komik MfrStudio, Sarkasm dll*)		
3.	Komik di aplikasi mobil (Contoh: *Comixology, Webtoon dll*)		

BAHAGIAN II : Tujuan Membaca Komik

Nyatakan jawapan anda dengan menulis (X) pada ruang jawapan berdasarkan skala yang diberikan.

No.	Tujuan VS Skala	Amat bersetuju	Setuju	Sederhana setuju	Tidak setuju	Amat tidak setuju
1.	Membaca komik dapat mengurangkan rasa stress dengan rutin harian.					
2.	Membaca komik memang menyeronokkan.					
3.	Sifat komik yang tidak padat dengan teks					

	serta mesejnya mudah disampaikan melalui bingkai lukisan berturutan menyebabkan saya gemar membaca komik berbanding novel, buku umum dll.					
4.	Mesej yang disampaikan melalui komik yang saya baca mampu menjana minda dan kemahiran berfikir saya.					
5.	Membaca komik memberi ilham kepada saya untuk menghasilkan karya sendiri seperti cerpen, novel, skrip teater dll.					

BAHAGIAN III : Komik Pendidikan

Nyatakan jawapan anda dengan menulis (X) pada ruang jawapan berdasarkan skala yang diberikan.

No.	Item VS Skala	Ya	Tidak
1.	Saya pernah membaca komik pendidikan. (Contoh: *Ana Muslim, Pasukan X-Venture dll)*		
2.	Kandungan komik pendidikan yang menepati silibus pembelajaran di Malaysia masih kurang di pasaran.		

No.	Item VS Skala	Amat bersetuju	Setuju	Sederhana setuju	Tidak setuju	Amat tidak setuju
1.	Komik pendidikan mampu mengajar nilai murni dan fahaman agama yang baik.					
2.	Komik pendidikan mampu membantu saya mengingati dan menghafal fakta dengan lebih berkesan.					
3.	Komik pendidikan mampu membantu saya memahami konsep teknikal yang rumit.					

BAHAGIAN V : Mengarang Komik Pendidikan

Nyatakan jawapan anda dengan menulis (X) pada ruang jawapan berdasarkan skala yang diberikan.

No.	Item VS Skala	Amat bersetuju	Setuju	Sederhana setuju	Tidak setuju	Amat tidak setuju
1.	Saya berminat untuk menghasilkan komik pendidikan yang dapat membantu saya meningkatkan pemahaman dan daya ingatan dalam pembelajaran.					
2.	Dengan mengarang komik pendidikan, saya boleh memasukkan elemen cerita mengikut citarasa saya sendiri.					
3.	Komik pendidikan yang saya hasilkan mestilah mengandungi fakta akademik yang					

	lebih banyak berbanding cerita.					
4.	Kandungan komik pendidikan yang saya hasilkan mestilah seimbang dari segi fakta akademik dan jalan cerita.					
5.	Komik yang saya hasilkan mestilah memaparkan identiti dan imej Malaysia.					
6.	Saya berharap komik pendidikan yang saya hasilkan mampu menjadi rujukan ilmiah rakan lain.					

No.	**Item VS Skala**	**Amat bersetuju**	**Setuju**	**Sederhana setuju**	**Tidak setuju**	**Amat tidak setuju**
1.	Kekangan utama untuk saya menghasilkan komik pendidikan ialah keupayaan terhad melukis.					
2.	Kekangan utama untuk saya menghasilkan komik pendidikan ialah keupayaan terhad mengarang cerita dan watak.					
3.	Kekangan utama untuk saya menghasilkan komik pendidikan ialah keupayaan terhad menyampaikan kandungan ilmiah.					
4.	Kekangan utama untuk saya menghasilkan komik pendidikan ialah pengetahuan terhad elemen asas komik.					
5.	Kekangan utama untuk saya menghasilkan komik pendidikan ialah kemahiran terhad menyampaikan cerita yang berkesan dengan Bahasa Inggeris.					

Cadangan/Komen lain (Sekiranya ada)

Terima kasih kerana sudi meluangkan masa untuk berkongsikan pendapat anda.

APPENDIX B

Expert Review of Instrument for Learner-Generated Comics (LGC) Production Model & Prototype Evaluation

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Introduction and Background

Thank you for your interest to review the proposed instrument. My PhD research proposes the **Learner-Generated Comics (LGC) Production Model** which aims to provide a systematic method for learners to develop digital educational comics. One part of this research is to construct an instrument in a form of **questionnaire** to evaluate the proposed model.

The target respondents of the final validated questionnaire will be undergraduate students. Thus, the purpose of this questionnaire is to **measure respondents' perception** towards the proposed model. In other words, the items asked in the questionnaire seek to identify the **significance** of the proposed model in **serving as a guideline** that enables the students to **develop digital educational comics**. The second instrument is used to assess the **digital educational comic prototypes.**

Instruction

Through this review, I sincerely require your expertise to assess the **content validity** of the questionnaire. Based on your knowledge, expertise, skills, and experiences in **digital educational media** design and development, it would be greatly appreciated if you could review the **validity** of the **items** in the given questionnaire.

You will only need to tick (✓) in [**Rate the RELEVANCE of the item**] and fill in the [**Remarks**] sections of the evaluation form. Please indicate whether the items and keywords meet the appropriate standards of media production, accurately reflect the criteria category, and capture the entire scope of learner-generated comic production domain, and other required details or suggestions.

Consent

The information supplied will be treated as confidential and will be used for research purposes which may be reported anonymously in academic publications.

Queries or Concerns

Please feel free to contact me by email in regards to any queries. Thank you for your time and assistance.

(1) <u>Borang Soal Selidik untuk mengukur persepsi pelajar terhadap LGC</u>
<u>Questionaire for Measuring Students' Perception towards LGC</u>

Berdasarkan pengalaman anda menggunakan LGC untuk pembangunan komik digital pendidikan, sila nyatakan skala anda untuk setiap item berikut.
Instruction
*Based on your experience of using **LGC** for digital educational comic development, please rate the appropriate scale for each item.*

	Criteria	Strongly Disagree ⟷ Strongly Agree		
1	**Fungsi Umum / *Generality***	**1** ⟷ **9**	**Rate the RELEVANCE of the item**	**Remarks**
a.	LGC membolehkan saya meringkaskan apa yang telah belajar belajar dalam bentuk komik digital pendidikan. *LGC enables me to summarize what I had learnt in the form of digital educational comic.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b.	LGC membolehkan saya mengulas dengan lebih lanjut serta mengatur pengetahuan saya bentuk komik digital pendidikan. *LGC enables me to elaborate and organise my knowledge the form of digital educational comic.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya mengaitkan apa yang dipelajari saya dengan teori / idea / maklumat / pengetahuan penting. *During the digital educational comic development, LGC enables me to relate my learning towards essential theories/ ideas/ information/ knowledge.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d.	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya menggunakan pengetahuan saya dalam permasalahan yang dibincangkan dalam kelas saya. *During the digital educational comic development, LGC enables me to apply knowledge to the discussed problem.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	

e.	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya menggunakan pengetahuan saya kepada situasi / permasalahan yang lain. *During the digital educational comic development, LGC enables me to apply knowledge to other situations/ problems.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
f.	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya untuk merujuk pengetahuan lama saya dan mengaitkannya kepada apa yang baru saya belajar. *During the digital educational comic development, LGC enables me to reflect previous knowledge and connect it to new knowledge.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
2	**Fleksibiliti / *Flexibility***			
a.	LGC adalah fleksibel dalam pembangunan komik digital pendidikan walaupun dengan perancangan yang minimum. *LGC is flexible for digital educational comic development with minimal planning.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b.	Menggunakan LGC adalah bersesuaian dengan cara bekerja yang saya suka. *Using LGC fits well with the way I like to work.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c.	LGC membolehkan saya untuk membangunkan komik digital pendidikan mengikut citarasa saya sendiri. *LGC enables me to develop digital educational comic according to my own taste and preferences*.		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d.	Saya tiada masalah dalam membuat perubahan terhadap keperluan dan spesifikasi komik digital pendidikan berdasarkan LGC. *Changing requirements in LGC over time is possible.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
e.	LGC mudah disesuaikan kepada kepada perubahan. *LGC is adaptive and responsive to changes.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
f.	Saya tiada masalah apabila proses pembangunan komik digital pendidikan saya tidak selari dengan aktiviti dan fasa yang		Essential ☐	

	dinyatakan dalam LGC. *Deviating from the established activities and phases in LGC is possible.*		Useful but not essential ☐ Not necessary ☐	
g.	LGC adalah toleran kepada kesilapan kecil dan sebarang perubahan. *LGC is tolerant of minor errors and alterations.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
3	**Kesempurnaan / *Completeness***			
a.	Semua konsep dan komponen yang dalam LGC adalah sangat diperlukan untuk pembangunan komik digital pendidikan yang berkesan. *All the concepts and components included in LGC are strictly necessary for effective digital educational comic development.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b.	Semua komponen dalam LGC adalah releven dalam mewakili proses pembangunan komik digital pendidikan. *All the components in LGC are relevant for the representation of the digital educational comic development process.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c.	LGC memberi gambaran lengkap terhadap proses pembangunan komik digital pendidikan. *LGC gives a complete representation of the digital educational comic development process.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d.	LGC membolehkan saya untuk melaksanakan aktiviti dalam pembangunan digital komik pendidikan dengan lebih teliti. *LGC enables me to accomplish tasks in digital educational comic development more thoroughly.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
e.	LGC membolehkan saya untuk menilai kesesuaian dan tahap kesempurnaan komik digital pendidikan yang saya bangunkan. *LGC allows me to intelligently judge the relevance and completeness of my digital educational comic.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
4	**Kebolehgunaan / *Usability***			
a.	Menggunakan LGC akan menghasilkan komik digital pendidikan, sepertimana yang ditetapkan.		Essential ☐ Useful but not essential ☐	

	Using LGC produces the digital educational comic, for which it is intended for.		Not necessary ☐	
b.	LGC berkesan dalam memberikan maklumat yang saya perlukan untuk pembangunan komik digital pendidikan. *LGC is effective in providing information I need on digital educational comic development.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c.	Menggunakan LGC akan meningkatkan kualiti komik digital pendidikan saya. *Using LGC enhances the quality of my digital educational comic.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d.	LGC menyediakan ruang komunikasi dan kerjasama berkesan antara ahli kumpulan dengan menetapkan tugasan mengikut keperluan secara berterusan. *LGC provides communication and collaboration between group members to continuously assign tasks according requirements.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
e.	Menggunakan LGC akan meningkatkan prestasi dan produktiviti saya. *Using LGC increases my performance and productivity.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
f.	LGC mempunyai lebih kebaikan berbanding keburukan. *The advantages of using LGC outweigh the disadvantages.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
g.	Dalam menjelaskan proses pembangunan komik digital pendidikan, LGC adalah sumber berguna berbanding penerangan dalam bentuk teks sahaja. *LGC would be an improvement to a textual description of the digital educational comic development process.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
5	**Kebolehfahaman / *Understandability***			
a.	Mempelajari LGC adalah mudah bagi saya. *Learning LGC is easy for me.*		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b.	LGC adalah jelas dan mudah difahami.		Essential ☐	

	LGC is clear and understandable.		Useful but not essential Not necessary			
c.	Menggunakan LGC tidak memerlukan daya mental yang tinggi. *Using LGC does not require a lot of mental effort.*		Essential Useful but not essential Not necessary			
d.	Secara keseluruhannya, panduan dalam LGC boleh dilaksanakan. *LGC as a whole is workable.*		Essential Useful but not essential Not necessary			
e.	*Fasa-fasa dan aktiviti LGC mudah diikuti.* *The phases and activities in LGC are easily followed.*		Essential Useful but not essential Not necessary			
f	Mematuhi fasa dan aktiviti dalam LGC adalah mudah. *Complying to the phases and activities in LGC is easy.*		Essential Useful but not essential Not necessary			
g.	LGC tidak rumit untuk digunakan. *LGC is not cumbersome to use.*		Essential Useful but not essential Not necessary			

(2) EDUCATIONAL COMIC ASSESSMENT CRITERIA

INSTRUCTION: Thank you for participating in this study. Please carefully observe the materials different educational comic prototypes). Then, based on the attached assessment criteria, circle the number that fits your best response towards the comics.

Aspects		**Description**	**Rank** 1 ⟷ 5 **Poor** **Excellent**	Rate the RELEVANCE of the item	Remarks
(1) Learning					
		Intention			
a	Learning Goal Alignment	• *Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini selari dan releven dengan topik?* At what level the comic's ideas/questions/facts/pieces of information are relevant to the topic?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b	Agility	• *Sejauh manakah elemen teks dalam komik ini dipersembahkan dengan ringkas dan padat?* To what degree the text element in the comic is presented in short, concise segments?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c	Typography	• *Sejauh manakah bentuk, warna dan saiz font melancar dan merancakkan pembacaan?* To what extent the font shapes, colours and size facilitate and stimulate reading?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d	Consistency	• *Sejauh manakah elemen visual dalam komik ini konsisten dalam membantu proses pembelajaran?* To what degree the comic make use of certain pictorial consistency which adds significantly to the learning process?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
e	Recipient	• *Sejauh manakah komik ini memupuk nilai dan persepsi positif terhadap topik?* To what degree does the comic promote a positive attitude toward the topic? To what degree does the comic respect the reader by presenting positive race/gender/ethical, and/or cultural values?		Essential ☐ Useful but not essential ☐ Not necessary ☐	

		To what extent do the comic's readability and interest level developmentally appropriate for universal audience?			
f	Reusability	• *Pada tahap manakah fail komik dapat digunakan di ruang digital atau konteks berlainan?* To what degree do the digital comic's native files work efficiently for different users in different digital environments and in different educational contexts over time? At what level the native file self-contained, modular, traceable, modifiable, usable, standardized and properly grained, generic, and platform independent?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
		Outcome			
a	Accuracy	• *Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini tepat & bebas daripada kesilapan?* At what level the ideas/questions/facts/pieces of information in the comic is accurate, free of errors, and fact-checked?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
b	Reliability/ References	• *Pada tahap manakah kandungan dalam komik dinyatakan sumbernya?* At what level the quoted materials are visibly cited?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
c	Argumentation/ Constructive Activity	• *Sejauh manakah komik ini menjana idea / soalan / fakta / maklumat tambahan mengenai topik ini?* At what level the ideas/questions/facts in the story are sufficient in number and scope to support the targeted educational outcomes? To what extent do the comic generates ideas/questions/facts/pieces of information about the topic?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
d	Thoroughness	• *Pada tahap manakah interaksi watak komik dengan kandungan pembelajaran bermakna dan meningkatkan pemahaman anda terhadap konsep / topik?* At what level the characters/personas interaction with the educational content are meaningful and permit the reader to have a much greater understanding of the concept/topic?		Essential ☐ Useful but not essential ☐ Not necessary ☐	
e	Emphasis of Key Concepts	• *Adakah kandungan komik ini jelas, seimbang, boleh dibezakan yang benar atau rekaan? Pada tahap manakah konsep atau maklumat penting dalam topik tersebut diberi penekanan?* To what extent the comic's pictorials facilitate the reader's		Essential ☐ Useful but not essential ☐ Not necessary ☐	

		involvement in, understanding of, and use/transfer of its educational content? At what level the ideas/questions/facts/pieces of information in the comic are easily balanced, distinguished or discernable from fiction or fantasy?			
f	Prospective	• *Pada tahap manakah cerita komik tersebut boleh dikembangkan atau disambung? Adakah ia mencetuskan persoalan lanjut berkaitan topik?* To what degree the story potentially open for sequel or continuation? To what extent the comic ending trigger further questions related to the educational topic?			
Entertainment					
		Aesthetics			
a	Visual Appeal	• *Pada tahap manakah ilustrasi / gambar / grafik komik ini kelihatan menarik dan membentuk nada serta mood cerita?* At what level the comic's illustrations/photos/graphics are appealing? To what degree the colour palette (e.g., pastels, primary colours, sepia tones) aid the reader in understanding the tone and mood of the story? To what extent the comic contain a vivid and interesting writing style that actively involves the reader?			
b	Layout	• *Sejauh manakah visual dan teks dalam komik ini saling melengkapi Antara satu sama lain? Pada tahap manakah unsur kontras dan efek khas membantu anda fokus pada aspek tertentu?* To what extent do the pictorials and words complement one another? At what level the contrast and effects are used effectively to aid focus?			
c	Clear Instructions	• *Sejauh manakah teknik-teknik perspektif diaplikasikan dengan baik dalam komik ini? Pada tahap manakah watakwatak dipamerkan secara munasabah?* To what extent the story pace, shot, direction natural & make sense to the reader? To what degree the characters position are reasonably placed?			

d	Navigation	• *Pada tahap manakah susunan panel komik, dialog dan kapsyen memudahkan aliran cerita? Adakah elemen visual tidak terlalu padat hingga mampu menganggu pembacaan?* To what degree the comic panels, speech balloons and captions placement ease and flow of the story? At what level the white space between the text, frames, and illustrations help readers move through the comic, or are the pages too busy?			
			Enjoyment		
a	Organization	• *Pada tahap manakah komik tersebut mempunyai yang latar, permulaan, pertengahan dan penutup cerita yang jelas?* To what degree does the comic have a beginning, middle, and end? To what degree does the comic have a well-described setting?			
b	Plot	• *Sejauh manakah plot berkembang dengan baik, kreatif, dan berkesinambungan? Adakah resolusi kepada konflik cerita tersebut membuahkan penamat yang memuaskan?* To what extent the plot exhibit good development, imagination, and continuity? To what extent does the resolution bring the conflict to a satisfying end?			
c	Characters	• *Sejauh manakah watak dalm komik menarik dan berkembang dengan baik? Adakah bahasa tubuh dan ekspresi watak itu sesuai dengan situasi dalam cerita yang disampaikan?* To what extent the characters are believable and well developed? To what degree the characters' pose, gesture & expression make sense in the story?			
d	Feedback	• *Pada tahap manakah plot dan aksi dalam komik mendorong anda meneruskan pembacaan komik ini?* At what level the comic provide enough context and action to keep the reader moving through the story? At what level the plot necessarily gives user adequate direction and information for progressing to?			

APPENDIX C

EDUCATIONAL COMIC PROJECT

Consent Form for Student Participation

Before agreeing to participate in this research, we strongly encourage you to read the following explanation of this project. This study has been approved and funded by the Malaysian Ministry of Education.

- I understand that my participation will be treated confidentially and all information will be stored anonymously and securely. All data will be kept in a secure location and only those directly involved with the research will have access to them.
- I understand that all information appearing in the final report will be anonymous. My name and any other identifying details will never be revealed in any publication of the results of this project. All information provided will only be reported as group data with no identifying information.
- I understand that I am free to ask any questions at any time. I am free to discuss any questions or comments I would like to make with the instructor.
- I have read and understood the above, and agree to take part in this project.

Metrics No.	Signature

Date: _____

Perception towards Learner-Generated Comics (LGC) Production Model

SECTION A

Introduction and Background

Thank you for participating in this study. The purpose of this survey is to help us identify what is your perception towards the **Learner-Generated Comics (LGC)** Production Model. Generally, **LGC** functions as a **systematic guideline** for students to synte develop **digital educational comics**.

Consent

The information supplied will be treated as confidential and will be used for research purposes which may be reported anonymously in academic publications.

Queries or Concerns

Please ask the lecturer in regards to any queries **during** the data collection.

Procedures and Use

1) Please observe several **digital educational comics** provided by the lecturer.

2) Pay attention at how the digital comics visually present **educational content** and **story**.

3) Now observe **LGC** production model provided by the lecturer.

4) Pay attention at how the **steps, tasks** and **activities** in **LGC** present the **process of digital educational comic development.**

5) Based on your observations, would the guideline in **LGC** is able to help you to systematically design and develop **digital educational comics** of your own? If you are provided with all the tools and software, to what extent **LGC** is **clear** and **useful** to be applied in **developing digital educational comics**? What is your perception towards LGC in terms of **generality, flexibility, completeness, usability**, and **understandability**? Please rate your answers in **Section B**.

SECTION B

	Age :
	Gender : M/ F
	Race:
	Course:

ARAHAN: **Bulatkan nombor** yang paling sesuai dengan jawapan pilihan anda bagi setiap pernyataan di bawah. Jika soalan tersebut mengelirukan atau sukar difahami, nyatakan maklumbalas anda di ruang **Remarks**.

INSTRUCTION: **Circle the number** that fits your response best for each statement. If the question is confusing or difficult to understand, leave your feedback in the **Remarks** column.

Sangat TIDAK Setuju *Strongly Disagree* — **Sangat Setuju** *Strongly Agree*

	Criteria									
1	**Fungsi Umum / *Generality***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
a.	LGC membolehkan saya merumuskan apa yang telah saya belajar dalam bentuk komik digital pendidikan. *LGC enables me to summarize what I had learnt in the form of digital educational comic.*	1	2	3	4	5	6	7	8	9
b.	LGC membolehkan saya mengulas dengan lebih lanjut serta mengatur pengetahuan saya dalam bentuk komik digital pendidikan. *LGC enables me to elaborate and organise my knowledge the form of digital educational comic.*	1	2	3	4	5	6	7	8	9
c	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya mengaitkan apa yang dipelajari saya dengan teori / idea / maklumat / pengetahuan penting. *During the digital educational comic development, LGC enables me to relate my learning towards essential theories/ ideas/ information/ knowledge.*	1	2	3	4	5	6	7	8	9
d.	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya mengaplikasikan pengetahuan saya kepada situasi / scenario / konteks yang lain. *During the digital educational comic development, LGC enables me to apply knowledge to other situation/ scenario / contex.*	1	2	3	4	5	6	7	8	9
e.	Semasa pembangunan komik digital pendidikan, LGC membolehkan saya untuk merujuk pengetahuan sedia ada saya dan mengaitkannya kepada apa yang baru saya belajar. *During the digital educational comic development, LGC*	1	2	3	4	5	6	7	8	9

	enables me to reflect prior knowledge and connect it to new knowledge.									
2	**Fleksibiliti / *Flexibility***									
a.	Menggunakan LGC adalah bersesuaian dengan cara bekerja yang saya suka. *Using LGC fits well with the way I like to work.*	1	2	3	4	5	6	7	8	9
b.	LGC membolehkan saya untuk membangunkan komik digital pendidikan mengikut citarasa saya sendiri. *LGC enables me to develop digital educational comic according to my own taste and preferences*.	1	2	3	4	5	6	7	8	9
c.	Saya mempunyai pilihan untuk mengikut atau tidak mengikuti fasa dan aktiviti yang dicadangkan dalam LGC. *I have the options to follow or deviate from the phases and activities suggested in LGC.*	1	2	3	4	5	6	7	8	9
d.	LGC membolehkan saya mengubahsuai proses dan aktiviti tertentu ketika pembangunan komik digital pendidikan. *LGC enables me to make alterations towards certain phases and activities in digital educational comic development process.*	1	2	3	4	5	6	7	8	9
3	**Kesempurnaan / *Completeness***									
a.	Semua konsep dan komponen yang dalam LGC adalah sangat diperlukan untuk pembangunan komik digital pendidikan. *All the concepts and components included in LGC are strictly necessary for digital educational comic development.*	1	2	3	4	5	6	7	8	9
b.	Semua komponen dalam LGC adalah releven dalam mewakili proses pembangunan komik digital pendidikan. *All the components in LGC are relevant for the representation of the digital educational comic development process.*	1	2	3	4	5	6	7	8	9
c.	LGC memberi gambaran lengkap terhadap proses pembangunan komik digital pendidikan. *LGC gives a complete representation of the digital educational comic development process.*	1	2	3	4	5	6	7	8	9
d.	LGC membolehkan saya untuk melaksanakan aktiviti dalam pembangunan digital komik pendidikan dengan lebih mendalam. *LGC enables me to accomplish tasks in digital educational comic development more thoroughly.*	1	2	3	4	5	6	7	8	9
e.	LGC membolehkan saya untuk menyemak kesesuaian dan tahap kesempurnaan komik digital pendidikan yang saya bangunkan. *LGC allows me to intelligently check the relevance and completeness of my digital educational comic.*	1	2	3	4	5	6	7	8	9
4	**Kebolehgunaan / *Usability***									
a.	Menggunakan LGC akan menghasilkan komik digital pendidikan, sepertimana yang ditetapkan. *Using LGC produces the digital educational comic, for*	1	2	3	4	5	6	7	8	9

	which it is intended for.									
b.	LGC adalah berguna dalam memberikan maklumat yang saya perlukan untuk pembangunan komik digital pendidikan. *LGC is useful in providing information I need on digital educational comic development.*	1	2	3	4	5	6	7	8	9
c.	Menggunakan LGC akan meningkatkan kualiti komik digital pendidikan saya. *Using LGC enhances the quality of my digital educational comic.*	1	2	3	4	5	6	7	8	9
d.	LGC adalah penambahbaikan kepada penerangan dalam bentuk teks sahaja dari segi proses pembangunan komik digital pendidikan. *LGC would be an improvement to a textual description of the digital educational comic development process.*	1	2	3	4	5	6	7	8	9
5	**Kebolehfahaman / *Understandability***									
a.	LGC adalah jelas dan mudah difahami. *LGC is clear and understandable.*	1	2	3	4	5	6	7	8	9
b.	Memahami LGC tidak memerlukan lebih daya mental. *Understanding LGC does not require a lot of mental effort.*	1	2	3	4	5	6	7	8	9
c.	Secara keseluruhannya, panduan dalam LGC boleh dilaksanakan. *LGC as a whole is workable.*	1	2	3	4	5	6	7	8	9
d.	*Fasa dan aktiviti dalam LGC boleh diikuti.* *The phases and activities in LGC can be followed.*	1	2	3	4	5	6	7	8	9

APPENDIX D

EXPERT REVIEW FORM

LEARNER-GENERATED COMIC (LGC): A PRODUCTION MODEL

I am Farah Nadia Azman and I'm currently pursuing PhD study in Multimedia at Universiti Utara Malaysia (UUM) Malaysia. I am delighted to inform you that you have been exclusively selected to participate in this research.

My PhD research proposes the **Learner-Generated Comic (LGC)** Production Model. The conceptual model aims to provide a systematic method for learners to develop digital educational comics. The target users of the proposed model will be **undergraduate students** who will create comic narrative as strategy to support their STEM (science, technology, engineering and mathematics) **content literacy**. This project-based learning activity however does not involve illustrating comics. Instead, **LGC** focuses on **storytelling** with the **utilization of comic authoring software** such as BitStrips, ComicLife, Pixton and more.

Hence, to evaluate the proposed **LGC** production model, you are invited to review the proposed model according the criteria as listed in the review form. Your review is important to determine the model's impact in **serving as a guideline for learners** to develop digital educational comics.

Therefore, based on your knowledge, expertise, skills, and experiences in **comic production**, it would be greatly appreciated if you could complete this evaluation form. The information supplied will be healed as confidential and will be used for research purposes which may be reported anonymously in academic publications.

Please feel free to contact me by email (**farah@utem.edu.my**) in regards to any queries or my supervisors (**shuhada@uum.edu.my**) and (**syamsulbahrin@uum.edu.my**).

INSTRUCTIONS

Please read on and go through the figure and description of **LGC Production Model** (Appendix A) carefully. Once this is done, with the expertise you possess, please provide feedback for all questions by filling in the provided spaces. Then, please save this document and email it to **farah@utem.edu.my.**

Alternatively, you may also print out this document, write down your feedback and scribble the model figure. Then, kindly scan and email the scanned files to **farah@utem.edu.my.**

Thank you for your time and assistance.

Expert Information	**Age :**
	Years of Experience:

Items to Review

Based on the proposed production model (as depicted in Appendix A), please tick (✓) your choice.

1.	**Are the following proposed components relevant to represent the phases of digital educational comic development?**	**Essential**	**Useful but not Essential**	**Not necessary**
	Context Setup			
	Narrative Brainstorming			
	Script Writing			
	Thumbnailing			
	Composing			
	Publishing			
	Assessment			

2.	**Are the following proposed tasks (and the activities within them) relevant to represent all conceptual elements of digital educational comic development?**	**Essential**	**Useful but not Essential**	**Not necessary**
	Purpose			
	Scope			
	Knowledge			
	Storyline			
	Characters			
	Basic			
	Comic			
	Layout			
	Text			
	Pictorial			
	Lettering			
	Modes			
	Medium			
	Learning			
	Entertainment			

3. The connections and flows of all the components are logical. **Yes** ☐ **No** ☐

4. The production model is usable to the development of digital educational comic. Yes ☐ No ☐

5. Overall, the production model is readable. Yes ☐ No ☐

6. Would you add any phases, tasks or activities? If so please explain what and why.

7. Would you remove any phases, tasks or activities? If so please explain what and why.

8. Would you refine/update the phases, tasks or activities? If so please explain what and why.

9. Would you suggest any updates or improvement related to the model description? If so please explain what and why.

10. Could the model be made more understandable? How?

11. Could the model be made more practical and flexible? How?

12. Could the model be made more useful? How?

13. Please write your further comments below.

APPENDIX E

EDUCATIONAL COMIC ASSESSMENT CRITERIA

ARAHAN: Terima kasih atas kerjasama anda dalam projek ini. Dengan teliti, analisa bahan **(komik pendidikan berlainan)** yang diedarkan oleh pensyarah. Kemudian berdasarkan kriteria yang dilampirkan, **bulatkan nombor yang sesuai** bagi menilai komik-komik tersebut. Untuk sebarang kemusykilan, sila bertanya terus kepada penyelidik.

INSTRUCTION: *Thank you for participating in this study. Please carefully observe the materials* ***(different educational comics****) distributed by the lecturer. Then, based on the attached assessment criteria,* ***circle the number*** *that fits your best response towards the comics. For any inquiries, please ask the researcher for immediate assistance.*

	Age :
	Gender : **Male** **Female**
	Race: **Malay** **Chinese** **Indian** **Others**

Criteria		**Description**
Learning		
a	RELEVEN Learning Goal Alignment	• Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini selari dan releven dengan topik? *At what level the comic's ideas/questions/facts/pieces of information are relevant to the topic?*
b	RINGKAS Agility	• Sejauh manakah elemen teks dalam komik in dipersembahkan dengan ringkas dan padat? *To what degree the text element in the comic is presented in short, concise segments?*
c	TIPOGRAFI Typography	• Sejauh manakah bentuk, warna dan saiz font melancar dan merancakkan pembacaan? *To what extent the font shapes, colours and size facilitate and stimulate reading?*
d	KONSISTEN Consistency	• Sejauh manakah elemen visual dalam komik ini konsisten dalam membantu proses pembelajaran? *To what degree the comic make use of certain pictorial consistency which adds significantly to the learning process?*
e	PERSEPSI POSITIF Recipient	• Sejauh manakah komik ini memupuk nilai dan persepsi positif terhadap topik? *To what degree does the comic promote a positive attitude toward the topic?*
f	KITAR SEMULA Reusability	• Pada tahap manakah fail komik dapat digunakan di ruang digital atau konteks berlainan? *To what degree do the comic's native / digital / source files are file self-contained, modular, traceable, modifiable, usable, standardized and properly grained, generic, and platform independent?*
g	TEPAT Accuracy	• Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini tepat & bebas daripada kesilapan? *At what level the ideas/questions/facts/pieces of information in the comic is accurate & free of errors?*
h	KEBOLEHPERCAYAAN Reliability	• Pada tahap manakah kandungan dalam komik dinyatakan sumbernya? *At what level the quoted materials are visibly cited?*
i	NILAI TAMBAH Argumentation	• Sejauh manakah komik ini menjana idea / soalan / fakta / maklumat tambahan mengenai topik ini?

		To what extent do the comic generates ideas/questions/facts/pieces of information about the topic?
j	TELITI Thoroughness	• Pada tahap manakah interaksi watak komik dengan kandungan pembelajaran bermakna dan meningkatkan pemahaman anda terhadap konsep / topik? *At what level the characters/personas interaction with the educational content are meaningful and permit the reader to have a much greater understanding of the concept/topic?*
k	PENEKANAN TERHADAP KONSEP PENTING Emphasis of Key Concepts	• Adakah kandungan komik ini jelas, seimbang, boleh dibezakan yang benar atau rekaan? Pada tahap manakah konsep atau maklumat penting dalam topik tersebut diberi penekanan? *Do the contents in the comic are easily balanced, distinguished or discernable from fiction or fantasy? At what level the comic emphasis on key concepts?*
l	KESINAMBUNGAN Prospective	• Pada tahap manakah cerita komik tersebut boleh dikembangkan atau disambung? Adakah ia mencetuskan persoalan lanjut berkaitan topik? *To what degree the story potentially open for sequel or continuation? Does it trigger further questions related to the educational topic?*
Entertainment		
a	TARIKAN VISUAL Visual Appeal	• Pada tahap manakah ilustrasi / gambar / grafik komik ini kelihatan menarik dan membentuk nada serta mood cerita? *At what level the comic's illustrations/photos/graphics are appealing and aid the reader in understanding the tone and mood of the story?*
b	SUSUN ATUR Layout	• Sejauh manakah visual dan teks dalam komik ini saling melengkapi Antara satu sama lain? Pada tahap manakah unsur kontras dan efek khas membantu anda fokus pada aspek tertentu? *To what extent do the pictorials and words complement one another? At what level the contrast and effects are used effectively to aid focus?*
c	ARAHAN Clear Instructions	• Sejauh manakah teknik-teknik perspektif diaplikasikan dengan baik dalam komik ini? Pada tahap manakah watakwatak dipamerkan secara munasabah *To what extent the story pace, shot, direction natural & make sense to the reader? Do the characters position are reasonably placed?*
d	NAVIGASI Navigation	• Pada tahap manakah susunan panel komik, dialog dan kapsyen memudahkan aliran cerita? Adakah elemen visual tidak terlalu padat hingga mampu menganggu pembacaan? *To what degree the comic panels, speech balloons and captions placement ease and flow of the story? Are the white space between the text, frames, and illustrations help readers move through the comic, or are the pages too busy?*
e	ORGANISASI Organization	• Pada tahap manakah komik tersebut mempunyai yang latar, permulaan, pertengahan dan penutup cerita yang jelas? *To what degree does the comic have a well-described setting with a clear beginning, middle, and end?*
f	JALAN CERITA Plot	• Sejauh manakah plot berkembang dengan baik, kreatif, dan berkesinambungan? Adakah resolusi kepada konflik cerita tersebut membuahkan penamat yang memuaskan? *To what extent the plot exhibit good development, imagination, and continuity? Does the resolution bring the conflict to a satisfying end?*
g	WATAK Characters	• Sejauh manakah watak dalm komik menarik dan berkembang dengan baik? Adakah bahasa tubuh dan ekspresi watak itu sesuai dengan situasi dalam cerita yang disampaikan *To what extent the characters are believable and well developed? Do the characters' pose, gesture & expression make sense in the story?*
h	MAKLUMBALAS Feedback	• Pada tahap manakah plot dan aksi dalam komik mendorong anda meneruskan pembacaan komik ini? *At what level the plot and action necessarily gives user adequate direction and information for progressing to?*

	Kriteria
1	Releven
2	Ringkas
3	Tepat
4	Mencukupi
5	Nilai Tambah
6	Konsisten
7	Teliti
8	Penekanan Konsep
9	Typography
10	Persepsi Positif
11	Lestari
12	Kesinambungan
13	Organisasi
14	Arahan
15	Susun Atur
16	Navigasi
17	Jalan Cerita
18	Watak
19	Tarikan Visual
20	Maklumbalas

COMIC A						
1		1	2	3	4	5
2		1	2	3	4	5
3		1	2	3	4	5
4		1	2	3	4	5
5		1	2	3	4	5
6		1	2	3	4	5
7		1	2	3	4	5
8		1	2	3	4	5
9		1	2	3	4	5
10		1	2	3	4	5
11		1	2	3	4	5
12		1	2	3	4	5
13		1	2	3	4	5
14		1	2	3	4	5
15		1	2	3	4	5
16		1	2	3	4	5
17		1	2	3	4	5
18		1	2	3	4	5
19		1	2	3	4	5
20		1	2	3	4	5
	Total					
	100					

COMIC B						
1		1	2	3	4	5
2		1	2	3	4	5
3		1	2	3	4	5
4		1	2	3	4	5
5		1	2	3	4	5
6		1	2	3	4	5
7		1	2	3	4	5
8		1	2	3	4	5
9		1	2	3	4	5
10		1	2	3	4	5
11		1	2	3	4	5
12		1	2	3	4	5
13		1	2	3	4	5
14		1	2	3	4	5
15		1	2	3	4	5
16		1	2	3	4	5
17		1	2	3	4	5
18		1	2	3	4	5
19		1	2	3	4	5
20		1	2	3	4	5
	Total					
	100					

COMIC C						
1		1	2	3	4	5
2		1	2	3	4	5
3		1	2	3	4	5
4		1	2	3	4	5
5		1	2	3	4	5
6		1	2	3	4	5
7		1	2	3	4	5
8		1	2	3	4	5
9		1	2	3	4	5
10		1	2	3	4	5
11		1	2	3	4	5
12		1	2	3	4	5
13		1	2	3	4	5
14		1	2	3	4	5
15		1	2	3	4	5
16		1	2	3	4	5
17		1	2	3	4	5
18		1	2	3	4	5
19		1	2	3	4	5
20		1	2	3	4	5
	Total					
	100					

APPENDIX F

DIGITAL EDUCATIONAL COMIC PROJECT

SUBJECT	WWW PROGRAMMING
OBJECTIVE	REFLECTING UNDERSTANDING ON PHP & SERVER SIDE SCRIPTING THROUGH DIGITAL EDUCATIONAL COMIC STORYTELLING

Introduction

In this project, each group of students (maximum of **3 members** per group) are required to develop a **digital educational comic** based on the requirements below:

PART 1: TOPIC & STORY BRAINSTRORMING

Create a digital educational comic that presents your understanding on **PHP & Server Side Scripting** topic. In the comic, show a story on how PHP works and other interesting or important aspects related to Server Side Scripting with PHP.

Based on what you have learned so far in official lecture and lab sessions, you may refer additional books and online resources to help you reflect and organise your overall idea about PHP & Server Side Scripting.

PART 2: DIGITAL COMIC DEVELOPMENT

Topic: Server Side Scripting with PHP- How it works?
Number of comic pages: **Min: 8 pages | Max: 25 pages**
Main Software: **Bitstrips Authoring Tool** (use the same previous group account)
Supplementary Software: **Adobe Photoshop** (for photo editing etc), **MS Paint** (for screen capture), **Microsoft Word** (for script writing & mind mapping) & etc.

PART 3: SUBMISSION

Download all of your completed comic pages (.png) you created from Bitstrips and send the files to **UUM portal**. You must also **print out** the entire comic and hand them in to the instructor.

PART 3: ASSESSMENT

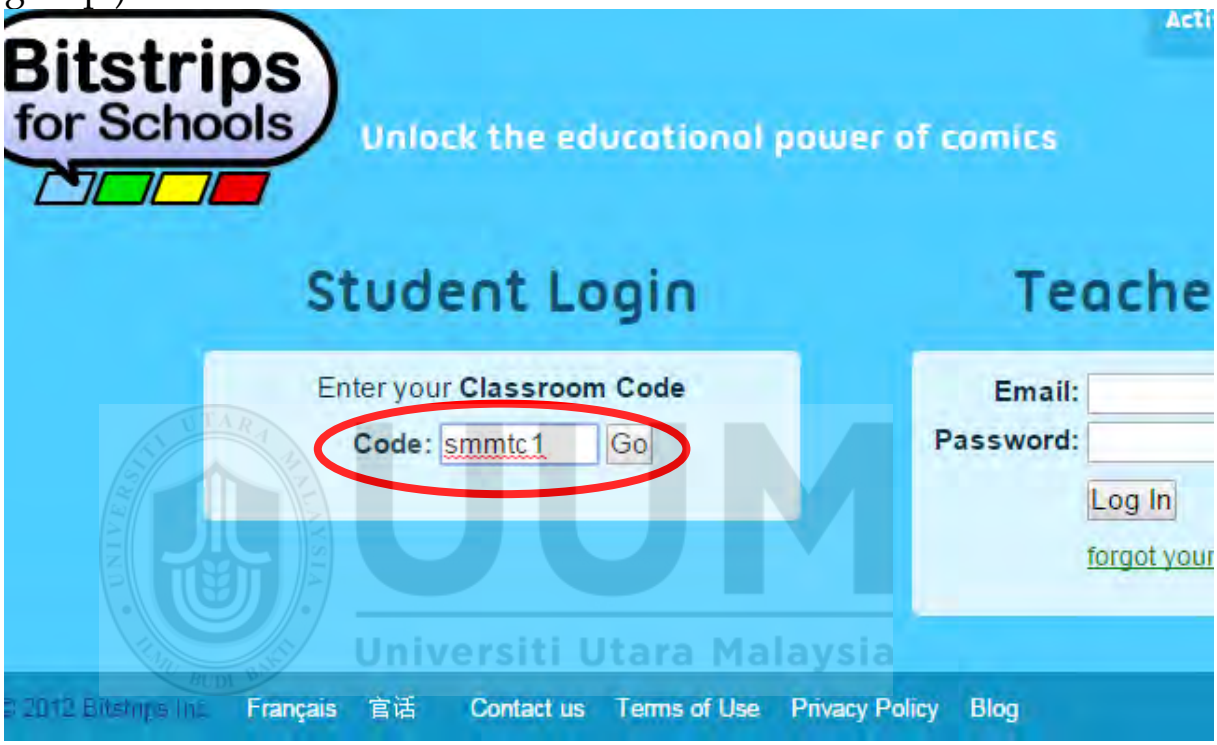
Criteria		Description	Score
Learning		*1 Poor* ⟷ *5 Excellent*	
a	RELEVEN Learning Goal Alignment	• Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini selari dan releven dengan topik? *At what level the comic's ideas/questions/facts/pieces of information are relevant to the topic?*	
b	RINGKAS Agility	• Sejauh manakah elemen teks dalam komik in dipersembahkan dengan ringkas dan padat? *To what degree the text element in the comic is presented in short, concise segments?*	
c	TIPOGRAFI Typography	• Sejauh manakah bentuk, warna dan saiz font melancar dan merancakkan pembacaan? *To what extent the font shapes, colours and size facilitate and stimulate reading?*	
d	KONSISTEN Consistency	• Sejauh manakah elemen visual dalam komik ini konsisten dalam membantu proses pembelajaran? *To what degree the comic make use of certain pictorial consistency which adds significantly to the learning process?*	
e	PERSEPSI POSITIF Recipient	• Sejauh manakah komik ini memupuk nilai dan persepsi positif terhadap topik? *To what degree does the comic promote a positive attitude toward the topic?*	
f	KITAR SEMULA Reusability	• Pada tahap manakah fail komik dapat digunakan di ruang digital atau konteks berlainan? *To what degree do the comic's native / digital / source files are file self-contained, modular, traceable, modifiable, usable, standardized and properly grained, generic, and platform independent?*	
g	TEPAT Accuracy	• Sejauh manakah idea/soalan/fakta/maklumat dalam komik ini tepat & bebas daripada kesilapan? *At what level the ideas/questions/facts/pieces of information in the comic is accurate & free of errors?*	
h	KEBOLEHPERCAYAAN Reliability	• Pada tahap manakah kandungan dalam komik dinyatakan sumbernya? *At what level the quoted materials are visibly cited?*	
i	NILAI TAMBAH Argumentation	• Sejauh manakah komik ini menjana idea / soalan / fakta / maklumat tambahan mengenai topik ini? *To what extent do the comic generates ideas/questions/facts/pieces of information about the topic?*	
j	TELITI Thoroughness	• Pada tahap manakah interaksi watak komik dengan kandungan pembelajaran bermakna dan meningkatkan pemahaman anda terhadap konsep / topik? *At what level the characters/personas interaction with the educational content are meaningful and permit the reader to have a much greater understanding of the concept/topic?*	
k	PENEKANAN TERHADAP KONSEP PENTING	• Adakah kandungan komik ini jelas, seimbang, boleh dibezakan yang benar atau rekaan? Pada tahap manakah konsep atau maklumat penting dalam topik tersebut diberi penekanan? *Do the contents in the comic are easily balanced, distinguished or*	

	Emphasis of Key Concepts	*discernable from fiction or fantasy? At what level the comic emphasis on key concepts?*	
l	KESINAMBUNGAN Prospective	• Pada tahap manakah cerita komik tersebut boleh dikembangkan atau disambung? Adakah ia mencetuskan persoalan lanjut berkaitan topik? *To what degree the story potentially open for sequel or continuation? Does it trigger further questions related to the educational topic?*	
Entertainment			
a	TARIKAN VISUAL Visual Appeal	• Pada tahap manakah ilustrasi / gambar / grafik komik ini kelihatan menarik dan membentuk nada serta mood cerita? *At what level the comic's illustrations/photos/graphics are appealing and aid the reader in understanding the tone and mood of the story?*	
b	SUSUN ATUR Layout	• Sejauh manakah visual dan teks dalam komik ini saling melengkapi Antara satu sama lain? Pada tahap manakah unsur kontras dan efek khas membantu anda fokus pada aspek tertentu? *To what extent do the pictorials and words complement one another? At what level the contrast and effects are used effectively to aid focus?*	
c	ARAHAN Clear Instructions	• Sejauh manakah teknik-teknik perspektif diaplikasikan dengan baik dalam komik ini? Pada tahap manakah watakwatak dipamerkan secara munasabah *To what extent the story pace, shot, direction natural & make sense to the reader? Do the characters position are reasonably placed?*	
d	NAVIGASI Navigation	• Pada tahap manakah susunan panel komik, dialog dan kapsyen memudahkan aliran cerita? Adakah elemen visual tidak terlalu padat hingga mampu menganggu pembacaan? *To what degree the comic panels, speech balloons and captions placement ease and flow of the story? Are the white space between the text, frames, and illustrations help readers move through the comic, or are the pages too busy?*	
e	ORGANISASI Organization	• Pada tahap manakah komik tersebut mempunyai yang latar, permulaan, pertengahan dan penutup cerita yang jelas? *To what degree does the comic have a well-described setting with a clear beginning, middle, and end?*	
f	JALAN CERITA Plot	• Sejauh manakah plot berkembang dengan baik, kreatif, dan berkesinambungan? Adakah resolusi kepada konflik cerita tersebut membuahkan penamat yang memuaskan? *To what extent the plot exhibit good development, imagination, and continuity? Does the resolution bring the conflict to a satisfying end?*	
g	WATAK Characters	• Sejauh manakah watak dalm komik menarik dan berkembang dengan baik? Adakah bahasa tubuh dan ekspresi watak itu sesuai dengan situasi dalam cerita yang disampaikan *To what extent the characters are believable and well developed? Do the characters' pose, gesture & expression make sense in the story?*	
h	MAKLUMBALAS Feedback	• Pada tahap manakah plot dan aksi dalam komik mendorong anda meneruskan pembacaan komik ini? *At what level the plot and action necessarily gives user adequate direction and information for progressing to?*	

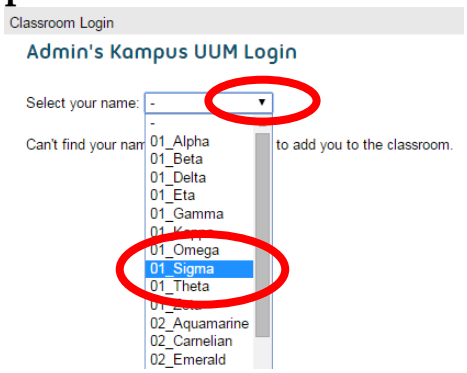
BITSTRIPS STUDENT GUIDE

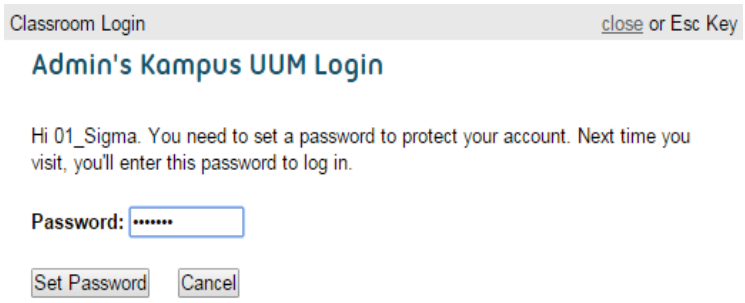
HOW TO LOGIN

1) Open your web browser & go to bitstripsforschools.com/login. Enter '**smmtc1**' or '**smmtc2**' or '**smmtc3**' (depends on your class group)and click the **Go** button.



2) Select your **username** given by your lecturer & setup your own **password**.



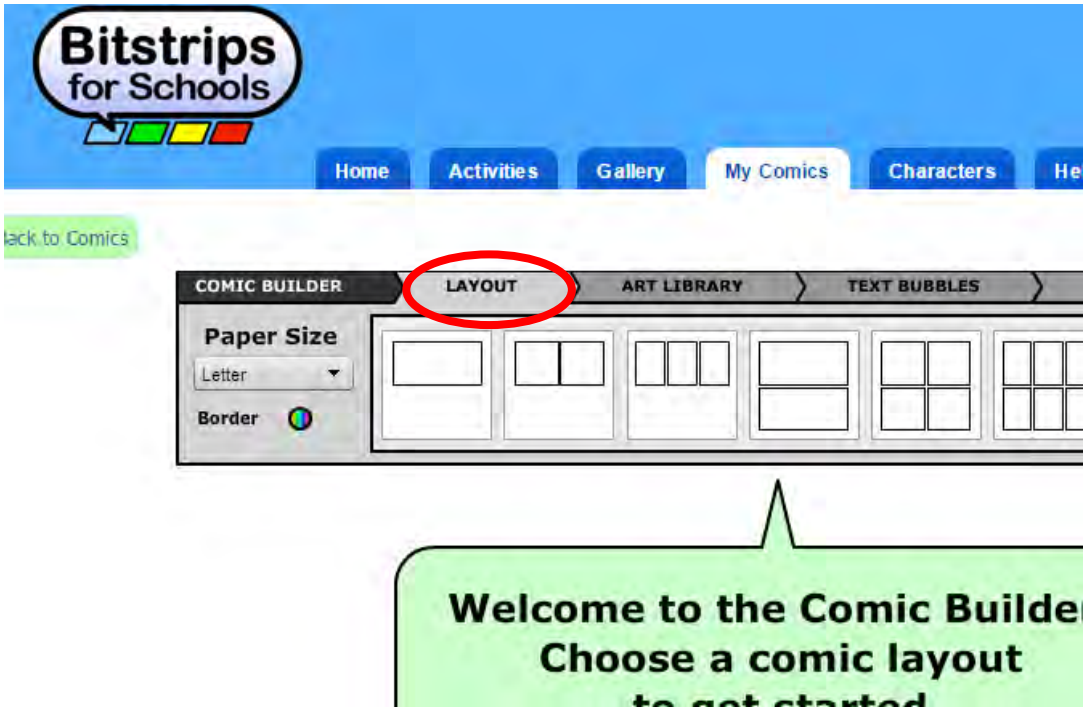


3) The next time you login to your account, again enter the same class code & use the login details you specified.

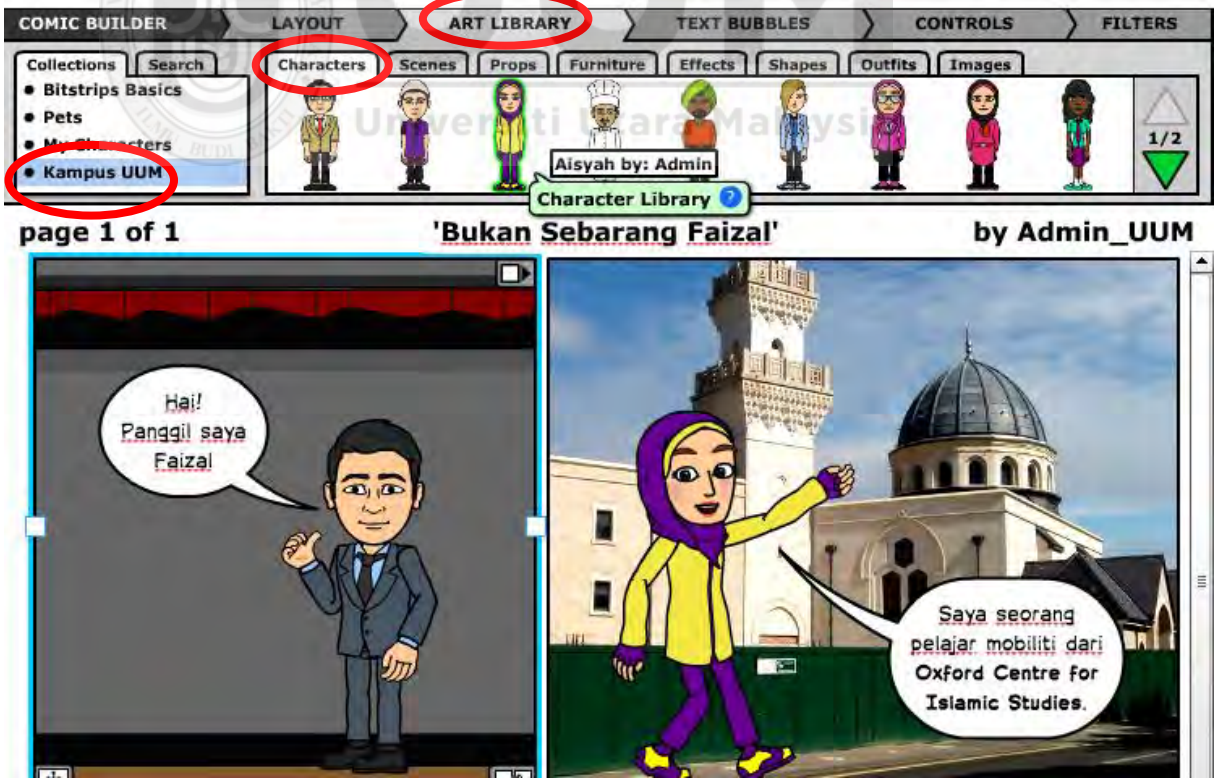
HOW TO CREATE COMICS

1) From the main dashboard, click '**My Comics**' tab.

2) Choose any page layout and start creating your comic by dragging & manipulating characters, speech balloons & so on.



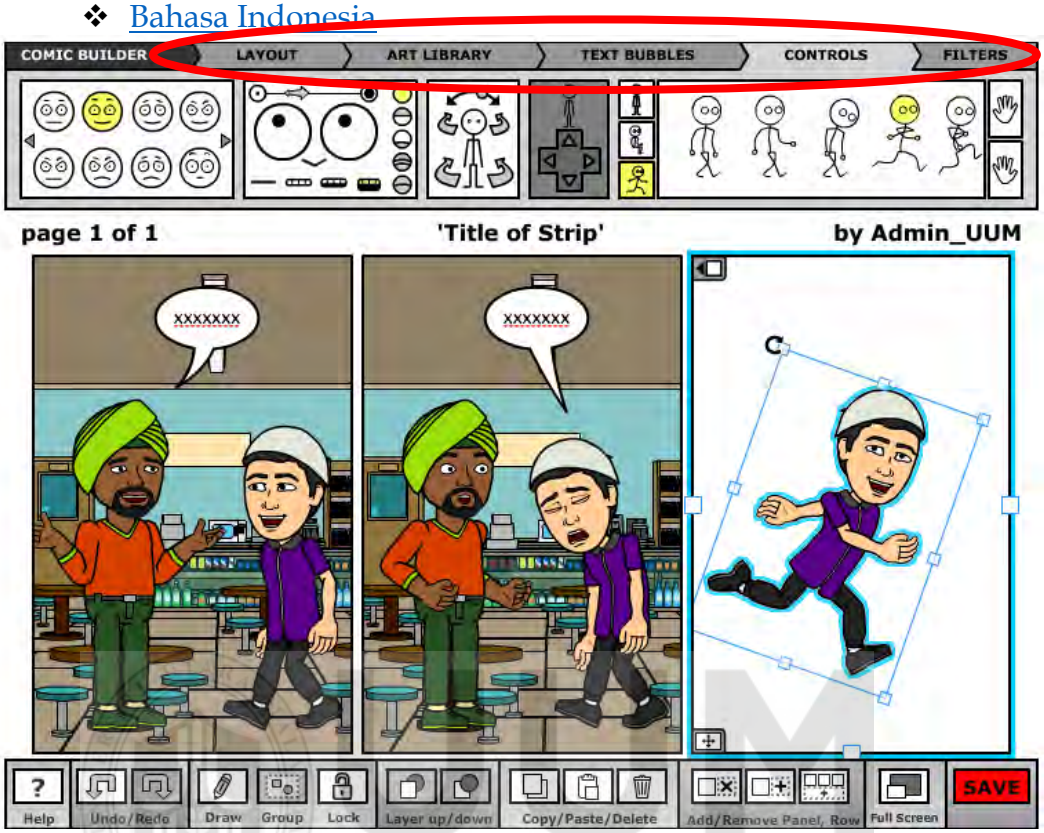
3) Here are plenty of characters, backgrounds & props you can insert into your comic.



3) Explore the top tabs to control the many functions of Bitstrips authoring tool. Here are several **video tutorials** on how to create digital comics with

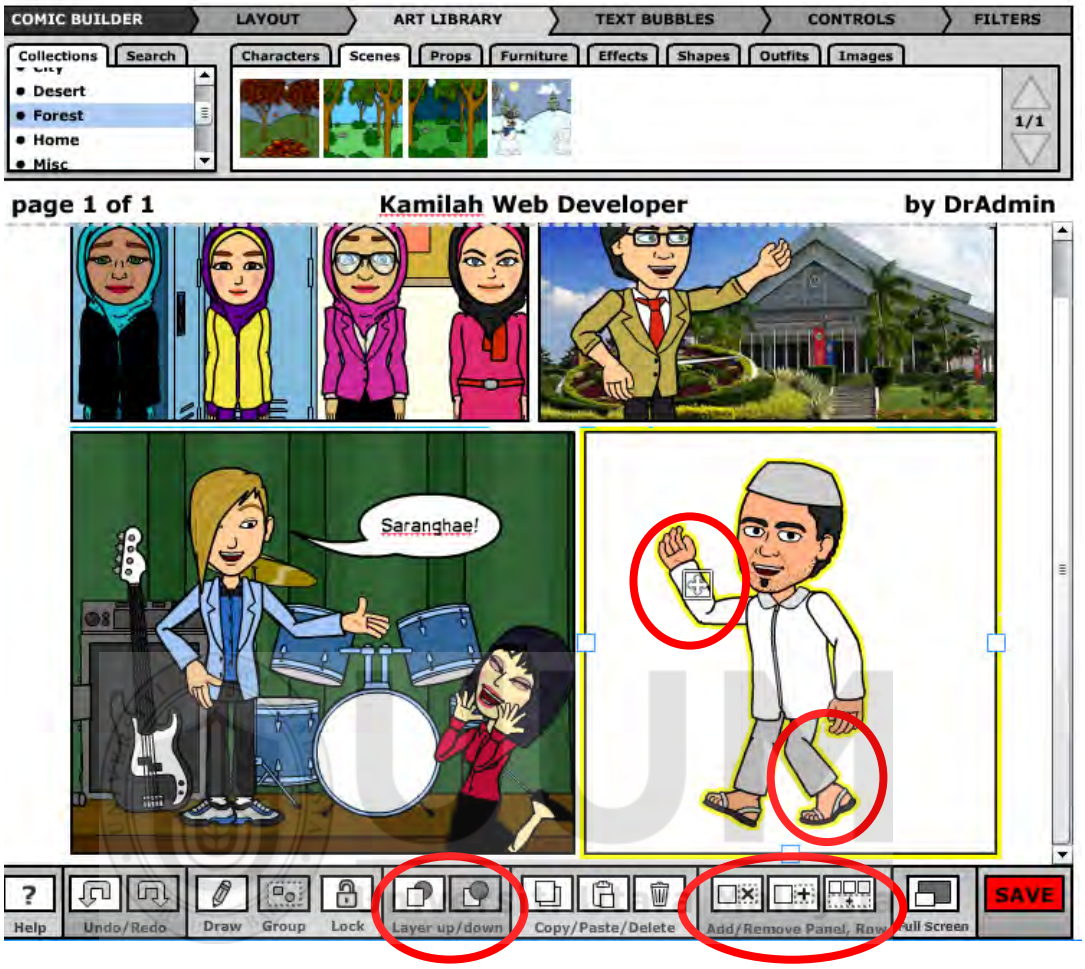
Bitstrips:

- English
- Bahasa Indonesia



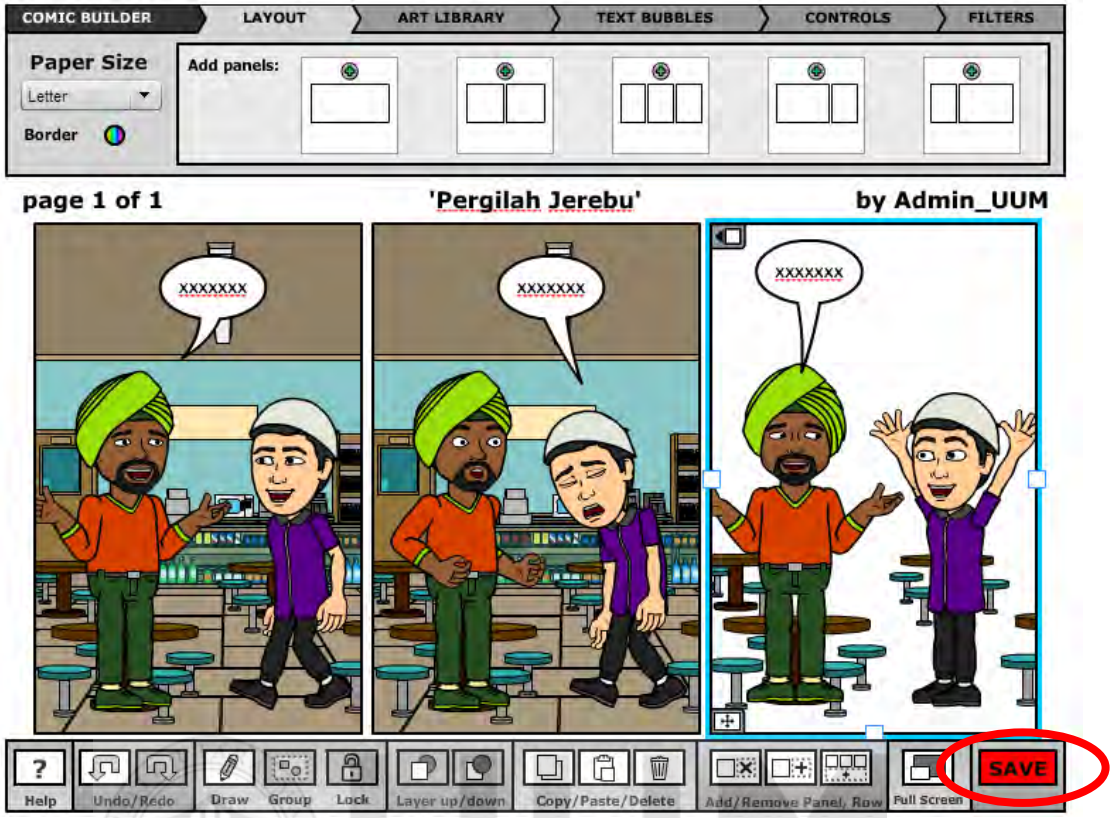
4) You can also import your own **photos** and **external images** from **Art Library>Images** tab.

5) Double click the character to control the **pose** precisely. Explore the bottom buttons to control layered items, add comic panels and more.

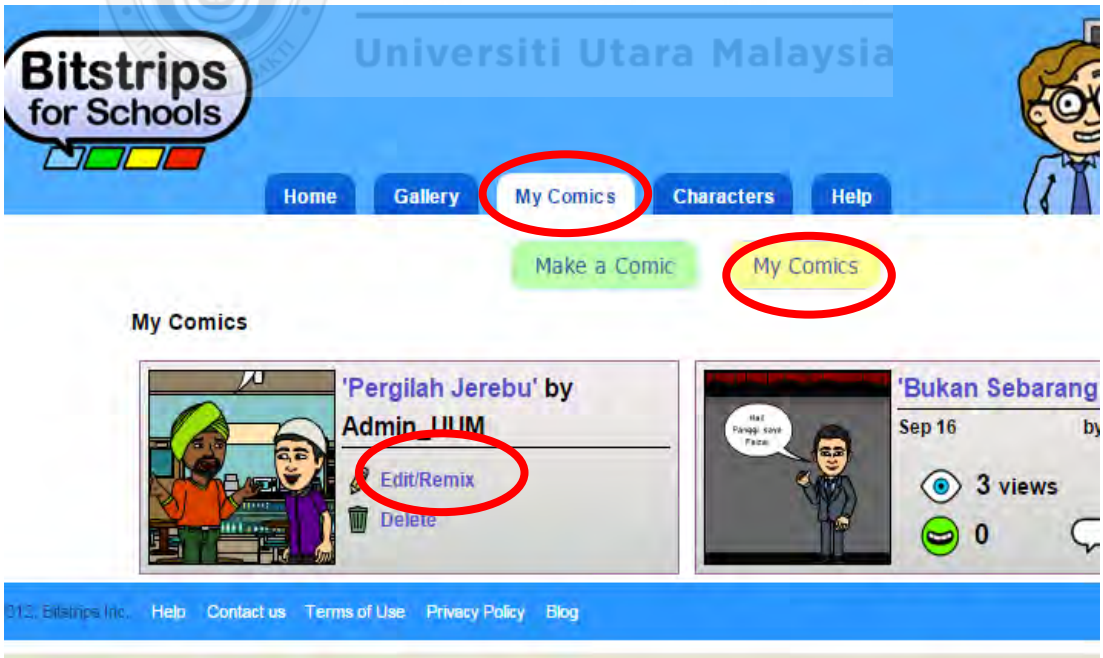


HOW TO SAVE YOUR COMICS

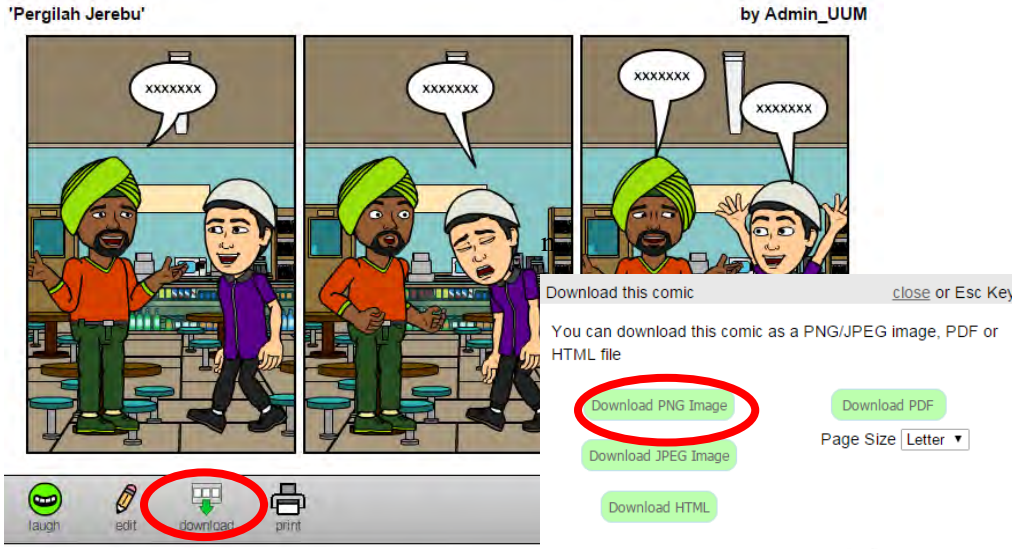
1) Remember to **always SAVE** your uncompleted work by clicking the SAVE button.



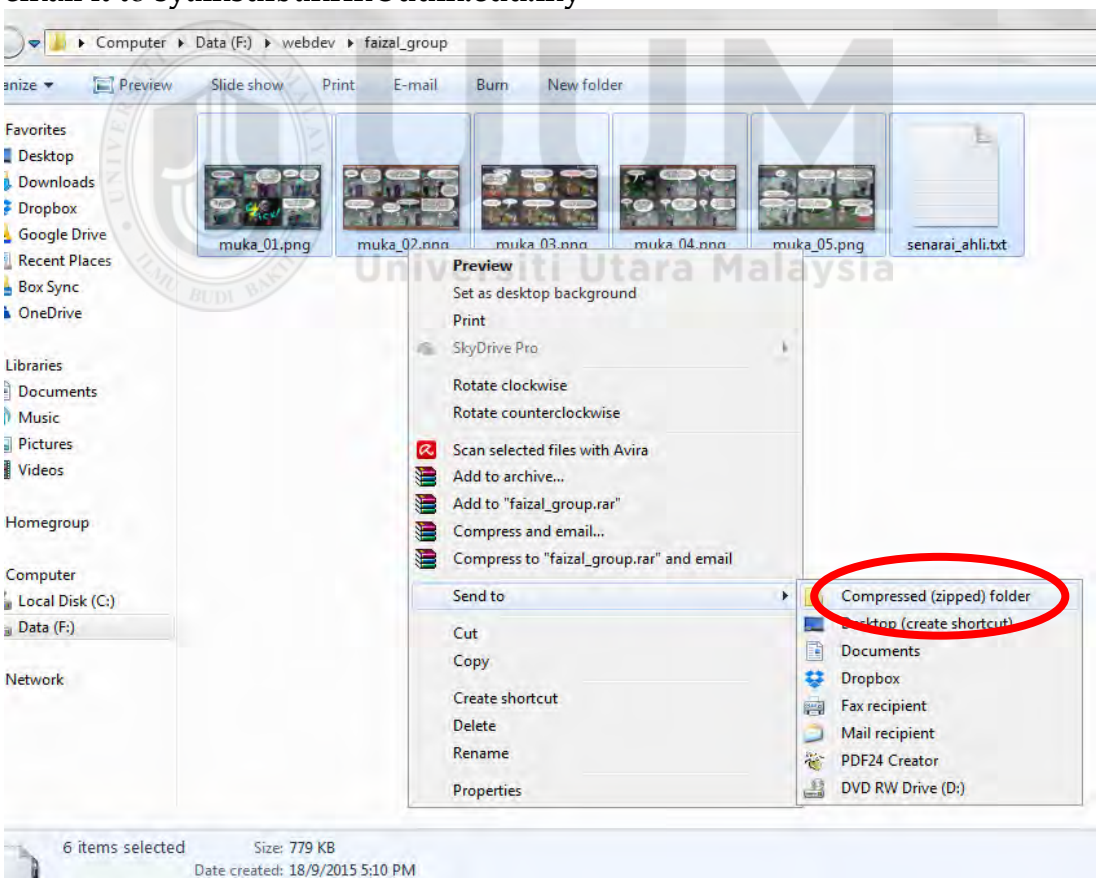
2) To locate all your comic pages (in-progress or completed works), click 'My Comic' tab.



3) You can export your comic into **png files** by clicking the 'download' icon.



4) Finally, archive all your **png.** files containing all finished comic pages and email it to **syamsulbahrin@uum.edu.my**



APPENDIX G

REFLECTION ON DIGITAL EDUCATIONAL COMIC PRODUCTION

Consent Form for Student Participation

Before agreeing to participate in this research, we strongly encourage you to read the following explanation of this project. This study has been approved and funded by the Malaysian Ministry of Education.

- I understand that my participation will be treated confidentially and all information will be stored anonymously and securely. All data will be kept in a secure location and only those directly involved with the research will have access to them.
- I understand that all information appearing in the final report will be anonymous. My name and any other identifying details will never be revealed in any publication of the results of this project. All information provided will only be reported as group data with no identifying information.
- I understand that I am free to ask any questions at any time. I am free to discuss any questions or comments I would like to make with the instructor.
- I have read and understood the above, and agree to take part in this project.

	Metrics No.	**Signature**
Student 1		
Student 2		
Student 3		

Date: _____

GIVE YOURSELF A THUMBS UP!

Congratulations on your accomplishment in educational comic development project!

What do you think of the end product [digital educational comic] you developed? List down what parts of it that you particularly like/don't like. Explain why.

What elements would you have added or changed to make the end product better? List them down and explain why.

YOU ARE THE EXPERT!

What process did you go through to produce the end product [digital educational comic]?

List down about 4 to 7 steps/phases of how you developed your end product.

List down about 1 to 3 sub phases from every steps you listed above.

What was the purpose/goal of those sub phases? What output did you produce from each of these sub phases?

Did you encountered problems during these sub phases? If yes, how did you solve them? If

no, explain why.

In what ways would you do this comic project differently? List down what new phase/task would you add to improve your educational comic development process.

Explain why these newly added phase/task would improve your next educational comic development process.

WELL DONE. NOW ITS' TIME TO TAKE ACTION. GOOD LUCK!