

APPLYING INTERPRETIVE HERMENEUTIC APPROACH TO INTERRELATE THE GAME ENVIRONMENT AND LEARNER'S INTERACTION

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ABSTRACT

In 21st century, one of the prominent learning tool in the education industry is highlighted as Educational games (EG). There are many ways in which the literature describes its importance in the current generation. In addition, the learning environment, the rules embedded in the game, the theoretical aspects on which the game is built, and the learners/subject-matter experts; all play a crucial role in EG. Hence, this requires a projecting need of understanding the relationships that allows an enhancement in the learning objectives for learners while interacting through the game environment. Although, relationships are vaguely dispersed in literature; understanding the need to interrelate other concepts of game environment with learner's expectations, and how the elements of game environment interact throughout the play is essential. Therefore, this article highlights the proposed multi-domain framework for game developers to effectively map the game elements while extracting implicit vaguely supported relationships based on game environment domain and learner's concepts through a systematic literature review. Consequently, this article explains on twelve (12) implicit relationships in perspective of game environment domain and learners. They are validated through qualitative interviews with eight (8) game-based learning experts. Subsequently, the results are interpreted in relevancy with all domains of proposed framework by applying interpretive hermeneutic approach, and using NViVO software to obtain the themes, sub-themes, and coding strategy was adopted to code the expert's response with each relationship and its elements. The findings conclude twelve (12) explicit relationships between game environment domain and the learner's relationships; for game developers to guide them through the development phase of EG.

Keywords: *Game Environment, Learners, Multi-Domain Framework, Hermeneutic, Interpretivism Paradigm, Coding Technique*

1. INTRODUCTION

Currently, the recognition of potential benefits in educational gaming has boosted not only within the research community, but in game industry, subject-matter (teacher), learners, learning theorist, and game-based learning experts. Educational games (EG) or game-based learning (GBL) is defined as an act of appropriate scenario recreation, game mechanics, and problem-oriented learning processes to ensure that learning objectives embedded in the game are accomplished [1]. As game literacy emerge consistently, technology development such as internet and web-based applications have accelerated alongside, hence, GBL has become a significant focus of attention in the field of education [2-4]. Besides, EG is a form of medium where specific contents and skills in a friendly environment can allow learners to freely

play, probe, make mistakes, and gain knowledge [5, 6].

GBL is grown around the game environment. Game-based learning environment (GBLE) is defined as a design in which learning process occurs by controlling the interactions between learners, such as collaboration, competition and learning by teaching, hence, it leads to an interaction among learners and game itself [7]. Likewise, learning environments are a powerful force in technology-enhanced learning as the idea is to drag the learning content out of textbooks and place it in the virtual reality for learners to access from home or through the EG [8]. Takaoka proposed a framework that can create an interaction for every player and helps to control the learning environment and introduced principles of GBLE [7]. To ensure learners attract towards the striking graphics of an environment, it is essential for

graphic design to perform multiple tasks for learners to explore and indulge through the scenario.

It is clear that learners prefer realistic scenarios, where they are provided with a good set of rules and regulations to follow, objectives to be achieved of a subject that is embedded and a strong learning theories base to ensure their learning ability is productive. Thus, GBL researchers should understand the depth of the structures of underlying experience that can contribute to the learning flow, hence, build a game environment through a process of modelling, which depends on multiple criteria such as how one element can relate to another element or types of domains which are embedded in EG.

There are relationships that exist amongst the learners who play the EG and the environment of EG; and they are vaguely dispersed in the literature. The relationships are crucial when the game developers initiate the development of EG, they need to ensure all related concepts and techniques such as collaboration between elements and domains is effectively pre-model. Hence, there is a need to provide an explicit idea which is based on EG domains and their relative components; which can be modelled in a way which can provide a promising approach towards delivering an effective EG environment and an experiential outcome for learners.

2. LITERATURE REVIEW

Game environment defined as a part of the game that allows the learners to discover new rules and ideas rather than memorizing. This can be done by exploring, experiencing and experimenting to provide intrinsic reward [9]. Designing and developing a learning environment evolves many other components to provide the desired requirements. Gros has proposed a method that needs four types of actions to create an effective environment: (1) *Experimentation*, the establishment of learning objectives and the activities/tasks to be carried out, (2) *Reflection*, the comparison of results obtained from groups, (3) *Activity*, particularly designed for the games which may involve other educational materials to be used as reference such as books, or the internet etc., (4) *Discussion*, relying on the reflection on the actual process of learning, gaining knowledge, and the joint discussion related to the proposed activities [2].

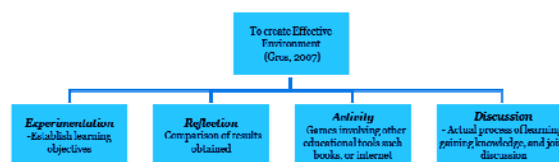


Figure 1: Elements to create effective environment

To provide a learning environment that can cover all the aspects to achieve an effective EG is a challenging task for game developers as there exists a variety of learning environments. Collaborative environment which allows learners to encounter and solve the challenges in an emotive environment which means, while they solve the challenges, they also engage themselves through feelings such as enthusiasm, competition, aggressiveness, and curiosity [10, 11]. Literature also emphasize on instructional environment where a game shall include skills, knowledge and values for the learners to gain experience of a different kind of profession as they solve challenges through the EG [12].

Multi-User Virtual Environment (MUVE) are the combination of guidance and instructional theory to improve learning through game [13]. Nelson elaborated that guidance is accommodating tacit, reflective, and collaborative factors, while relating student self-efficacy to improve the learning outcomes of students. VISOLE (Virtual interactive student-oriented learning environment) has three identified principles, namely, realistic game, motivational elements, and compatibility to prove positive perception and encroachment in subject-specific [14].

An environment which is friendly indicates that it combines content and skills to provide a better interactivity in games [8]. Other learning environments includes: (1) Authentic environments where the game reflects the real world by presenting a complex task in scenarios [15], (2) Multimedia learning environment which combines gesture, sound, fun, fantasy, and multi-tasking interface for learners [16, 17], (3) Immersive environment that allows connection between game components as a whole and links the player along [18], (4) Simulated and interactive learning environment as a fundamental part of knowledge and intellectual expansion but it can also be a distraction to some learners [19]. The game components that can collaborate with learning environment are presented in the proposed framework (Figure. 1). Social capital is a game component which is highly related to learning

environments. It combines collaboration, teamwork, competition among players, and it allows players to choose their avatars according to their desires while connecting their emotions with the avatar to complete the objective or task given, hence, share their understanding on the learning outcome achieved [10].

Game environment has the ability to involve every other component and combine them to provide an ambiance that will give the learner a motivation to continue with task to achieve goals. For example, if the environment is instructional, it will be able to provide learner with instructions to complete complex level or be productive to follow instructions throughout the game level. There are various numbers of domains and elements/components that needs to be planned. When EG is in development process, there is a need of game designers, developers, educators, subject-matter, game-based learning experts and learning theorist to combine their perspectives towards achieving a goal effectively. The game developers need to plan on how they can extract a model of EG. To proceed to development of EG based on the conceptualized model is a very crucial task for game developers. Table 1 describes the components under game environment.

Table 1: Game Environment Components and their Description

Component	Description
Authentic Environment	Game environment reflecting the real world with complex tasks.
Friendly	A friendly environment can combine content and skills to use all four factors of game.
Genre modelling environment	Genre of a game and how it is modeled with other domains is very important in collaboration with environment. Genre helps to evolve the concepts, contents and objectives expected to be achieved.
Simulated/ interactive learning environment	These can be distraction or a fundamental part of knowledge and intellectual expansion.
Gamification elements	Achieved by player when a goal is completed. This also helps to assess the assessment, knowledge skills or the ability at each point in the game.
Problem solving. Gaming experience. Game levels.	A game environment allowing players to engage in problem solving challenges and experience a realistic in-game experience. Once a problem is solved, the players move to the next game level.
Gender/race	Gender differentiation should be

inclusive contents and plots	designed in the game to keep track of the actors/character in the game. The story/subject/topic of the game embedded in the game for the learner/player to understand at the completion of the activity.
Instructional environment	A game shall include skills, knowledge and values for learner to gain experience of a different profession perform and solve problems.
Usability factor	Speediness and easiness of use.
Multimedia learning environment (gesture, sound, fun, fantasy, multi-task interface)	The graphic design of the educational game is a factor of attracting the players to indulge in the game. Players/students' prefer exploratory task where the information is in multiple form. Multimedia learning environment must be highly considered
Immersive environment	The components connect and combine as a whole to maintain a link between the player and the game.
Game design	It is based on the way in which the design elements are implemented inside the game to provide an interactive and amusing way of learning [20].
Complex scenario	A game environment exhibiting complex real world scenario to provide a realistic interface for learner's to engage them.
Collaborative environment	Playing game is referred to as solving challenges in an emotive and collaborative environment. Collaborative environment is the environment that must be blended into the game in order to ensure the player's communication and interaction to solve problems or challenges effectively.
Educational system design	Interactive is one of the fun elements of the game to keep the interaction between the player and the game.
Social capital environment	An environment with supporting learning and shared understanding. This involves players, characters, collaboration among them, and the combination of them working together.
Game types	Such as action-based, complex, interactive events, non-interactive events, effective and motivating instructional.

The value of subject-matter/learners is stressed in many literatures when the development of game is concerned. They are described in many different

contexts of the educational games. Some literature makes subject-matter as the course/syllabus being used in the content of game, whereas, some use the term as learner or educator or teacher. Table 2 describes the elements.

Table 2: Subject-Matter Components and their Description

Component	Description
Skill	The level of player's skill and applying them in an activity of a game.
Assessment	It is in a form of puzzle or quest, to test the skills and knowledge gained.
Learning outcome	The objective set by the game itself to achieve at the end of a topic or a module of the game.
Moral building	The values or the outcome that the learners learn throughout the game.
Learning performance and competition practice	Pathway students take to learn a set of knowledge i.e., the order in which they develop their skills.
Syllabus	The course content in the educational game plot.
Knowledge	This contains both the pre-knowledge and post knowledge of the learner before and after playing game.
Attention, observation, complex thinking	These belong to the values and types of thinking the learner goes through while being in the educational game.
Learner's skill level	The ability to solve and handle challenge to balance them easily.
Assessment technology	Learner's performance can be assessed through assessments to find their abilities or knowledge they have gained.

3. MULTI-DOMAIN FRAMEWORK AND IMPLICIT RELATIONSHIPS

The authors have proposed a Multi-domain framework for modeling the educational games effectively (Figure 2). The framework has been proposed which states the 95 relationships based on the 4 domains and their occurrence in literature

[21]. Therefore, this article briefly explains about the multi-domain framework. It was designed and developed as a result from systematic literature review (SLR) based on 15 existing frameworks and models (Table 3). The frameworks and models were reviewed based on four (4) major division. Multi-domain framework has four major domains: (1) Game play (GP), (2) Game environment (GE), (3) Subject-matter (SM), and (4) Learning Theories (LT). The proposed multi-domain framework has 153 game components defined under each domain according to the definition of the domain as shown in Figure 2.

Table 3 shows fifteen (15) frameworks and models reviewed under five (5) different concepts, namely, developing game design[8, 22, 23], well-designed game[24], effective video game [25], learning theories [26] and key elements of game [20]. Out of 27 elements altogether, there were two (2) frameworks which covered nine (9) elements: Serious-game design model [27] and Garris Game-based learning model [28]. Only educational game design model has 11 elements and conceptual model for 3D multi-agent technology has 12 elements. Osman and Bakar design model [29] has 13 elements out of 27. Fourteen (14) elements were found in two (2) frameworks, namely, learner-centered learning [30] and framework of flow in computer-mediated environment [31, 32].

DGBL model for history educational game design [33] managed to have fifteen (15) elements covering the framework. Four-dimensional framework [34, 35] covers sixteen (16) elements in the framework. There are two (2) frameworks covering seventeen (17) elements out of 27 elements, namely, the Staaldunin and Freitas framework [36] and six-steps model to design serious games [37]. The most surprising aspect to notice is that there are four (4) frameworks covering twenty-three (23) elements, i.e., game object model 2 [10], experiential gaming model [38], FIDGE model [39], and "I" model[40].

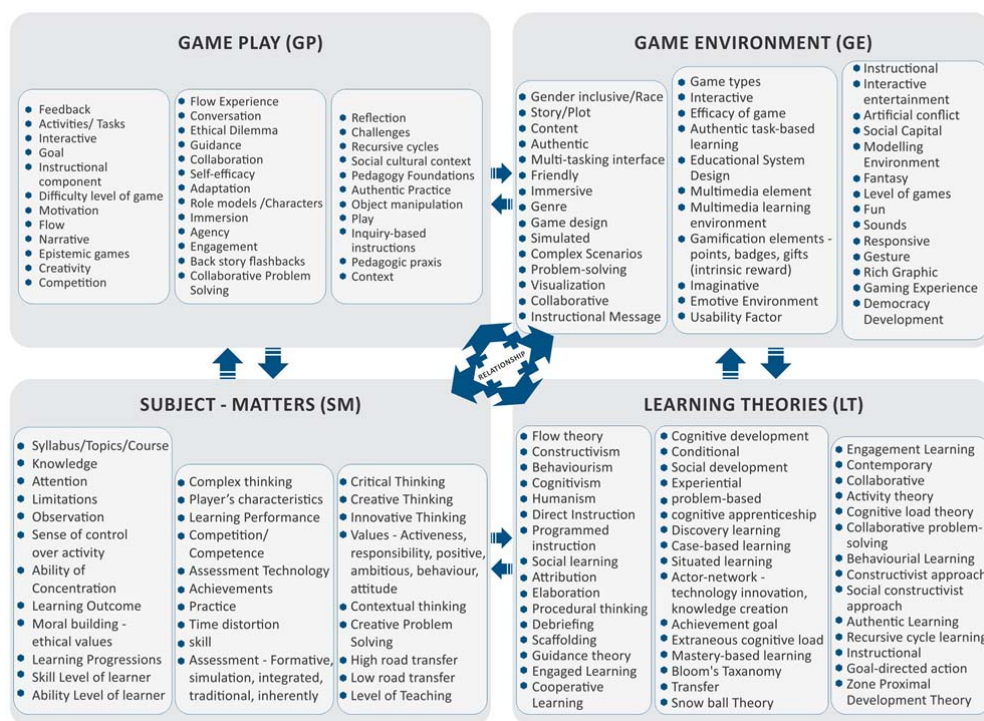


Figure 2: The Multi-Domain Framework for Modelling Educational Games

Table 3. Summary Matrix of 15 Frameworks and models on game design elements and development

#		Developing Game Design		Well-designed Game				Effective Video Game		Learning Theories		Key Elements of Game					
	Elements <																

To conclude from above visualization, the maximum number of elements of design, theoretical aspects, environmental aspects, subject-matter concepts and effective game design elements were twenty-three (23) out of twenty-seven (27). The elements that are mostly not considered in developing or designing models and frameworks are cost-effective, evaluation of games, gamification, adaptive challenges and control. Another observation from the Table 3 is that most frameworks do not consider the major learning theories mentioned. This aspect needs to be improved as there is a great need of providing a strong base of an EG.

With reference to the proposed multi domain framework, this article discusses implicit relationships which are vaguely supported by literature and they are not explicitly mentioned. Therefore, the selected twelve (12) relationships are mapped upon the game environment domain which are then validated by GBLE. The Table 4 shows the twelve (12) implicit relationship statements with highlighted (bold) game components from framework.

Table 4: The implicit relationships which are vaguely supported

#	Implicit Relationships	Ref
1	Educational game should adapt player's learning process to enhance learning experience .	McClarty et al., 2012
2	Students prefer rich graphics, multi-tasking interface and competing environment to improve self-determination .	Amory, 2007
3	Learning environment is more productive if it is multi-user .	Hirumi & Stapleton, 2009
4	Learners prefer rich graphics, animated designs, and interfaces showing multi-type of information.	McClarty et al., 2012
5	Rich graphic can also be a distraction to learners to rather focus on.	Kristian Kiili, 2005
6	Games and stories are not the same. Games provide interaction and stories provide narrative context of games.	McClarty et al., 2012
7	The relationship between reader/story is different to that between player/game .	Amory, 2007
8	Well-designed games are able to expose learners with complex tasks and professional diagnostic feedback to provide narrative content efficiently.	Kristian Kiili, 2005
9	Complex games are able to	Amory,

	provide new strategies for learners to solve ethical dilemma .	2007
10	Digital games are able to teach the 'future' skills for future jobs such as collaboration, problem-solving, and communication .	Hirumi & Stapleton, 2009
11	A learning environment should be discovery of new rules and ideas , not memorizing .	Kristian Kiili, 2005
12	Well-designed games are able to provide a diagnostic feedback and integrated learning experience in the actions that the learners take.	Amory, 2007

4. RESEARCH METHODOLOGY

4.1 The Research Design

Initially, a multi-domain framework was proposed as a result of systematic literature review (SLR)[41]. Systematic literature review (SLR) is the method used in reviewing the literature and selecting the most pertinent literature with the objective of proposing a new framework for educational game design. There are five (5) steps proposed by [42], which assisted the authors to do a broad search of the literature performed through internet resources such as Google Scholar, IEEE Xplore, ACM Digital Library and Springer Link using keywords such as 'educational games', 'framework', 'design framework', 'game design', and 'developing models'. The literatures collected from the broad search were narrowed further to literatures that discussed about elements/components of EG necessary through the development process. Further literature search is conducted for the authors to have better understanding of the elements.

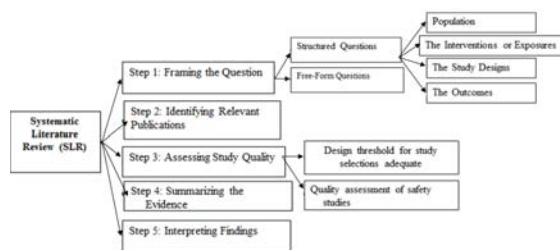


Figure 3: Five steps adopted to conduct SLR

4.1.1 Samples and instrument of the study

The multi-domain framework is composed of four major domains: (1) Game play (GP), (2) Game environment (GE), (3) Subject-matter (SM), and (4) Learning Theories (LT). Each domain is composed of game components categorized according to the

domain's definition. The extraction of relationships was more puzzling as they are not explicitly mentioned in literature. The authors used the NVIVO software to code the literatures that contain the educational games elements and domains. In other words, the elements in the domains were the main coding synonyms. Using the coding technique, sentences containing the elements were highlighted. These sentences were extracted and further analyzed to discern the sentences which were then known as the implicit relationships between elements.

To validate the implicit relationships and the framework ability to map out those relationships, the authors selected eight (8) game-based learning experts (GBLe) for the qualitative interviews to understand their experience over this research field. GBLe experts interviewed include lecturer, senior lecturer, associate professor and post-doctoral researchers in the field. Table 5 provides information of the experts, however, due to confidentiality reasons; their initials were changed accordingly.

Table 5. Details of GBLe interviewed

No	Initials of Expert	Gender	Institute	Position	Work Experience
1	Expert_1	F	Universiti Kebangsaan Malaysia(UKM)	Professor in Science Education	14
2	Expert_2	F	Universiti Sains Malaysia (USM)	Associate Professor in eLearning, instruction technology, and higher education	20
3	Expert_3	M	Universiti Pendidikan Sultan Idris (UPSI)	Professor in Game-based learning	7
4	Expert_4	M	Institute of Teacher Education	Senior Lecturer in Instructional Technology	8
5	Expert_5	M	Universiti Sains Malaysia (USM)	Professor in Multimedia design, ICT in Education	33
6	Expert_6	M	Universiti Sains Malaysia (USM)	Lecturer in IT & 3D animation, design computer games	13
7	Expert_7	F	Universiti Pendidikan Sultan Idris (UPSI)	Post Doctoral in Multimedia Education	5
8	Expert_8	F	Universiti Pendidikan Sultan Idris (UPSI)	Lecturer in Educational games	3

4.2 Data Collection

There were 96 responses collected by each experts for validating twelve (12) relationships. The data collected was then transcribed and coded into NVIVO software to understand the emergence of new "nodes" in each relationship. Each domain of framework is the major theme. This paper discusses game environment as a major theme and

its relationships as sub-themes. Each relationship has its components and those components are the existing "nodes" (highlighted as bold) in Table 4.

The results and discussions of each relationship is presented by applying interpretive hermeneutic approach of qualitative study to understand in-depth of how each relationship of game play domain can relate to other domains of educational games. Interpretive hermeneutic method is associated to interpretivism philosophical perspective of qualitative study, which allows understanding of in-depth experience of experts in this research area study [43-51]. Interpretivism is described as the belief in multiple observations of reality, subjective and socially constructed through language, consciousness and shared meaning [52-54].

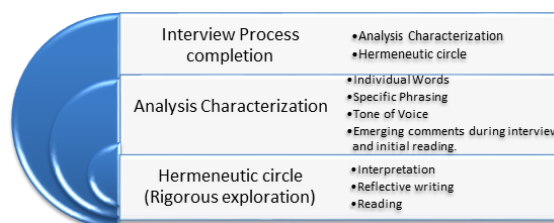


Figure 4: Show the Interview Process Interrelated in Hermeneutic Method

The goal is to conduct and develop an understanding of social life and discover how people (experts) construct the meaning in natural setting to accomplish what people perceive it to be [55, 56]. In addition, hermeneutics is mainly described as putting the "parts" of the "whole" research together which are described by different experts in the field of research area [46, 51, 57-69].

To ensure that the selected relationships are crucial and they need to be explicitly mentioned. To support the interpretations, the same analyzed data is preserving both hermeneutic and statistically to first analyze it qualitatively and then, it is displayed quantitatively within one single research process [70-73]. In other words, the authors have to transform the analyzed data (the qualitative interviews into themes, nodes and emerging nodes); into categories or codes or synonyms to represent quantitative data [74]. Thus, the authors have categorized each relationship into five (5) types of responses by the experts, namely: (1) Strongly Agree, (2) Agree, (3) Neutral (agreed but with some additional comments), (4) Disagree, and (5) Strongly Disagree. Lastly, there are 12 explicit relationships that shall be considered by game developers in developing process of EG when they

consider game environment domain with learner's concept.

4.3 Data Preparation and Software for Data Analysis

With respect to hermeneutic method implementation, the data was prepared by transcribing the interviews recorded using a digital recorder, in detail dialog and dictated by hermeneutic circle, which characterizes the process of analysis. The researcher then typed and input the transcripts into qualitative analytical software known as QSR NVIVO. This software assists in organizing raw data (interviews, observations, pictures, recordings, and field notes) and links them with memos and "data bites" where researchers might make codes and analytical notes, and then edit and report ideas as the research study progresses [75-77]. In addition, QSR NVIVO software enables the researcher to link, search, and sort the data, and reports it according to the hermeneutic method. Figure. 5, show the transcription screen with major themes and their sub-themes.

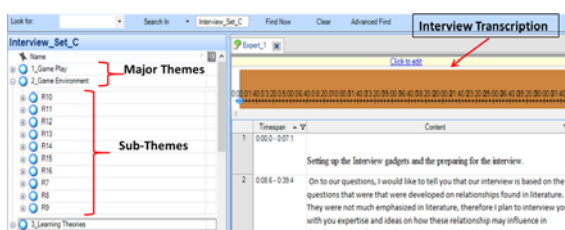


Figure 5: Transcription of experts interviews (on the right) with major themes and their sub-themes (on the left)

Although, this software has facilitated the management of data, the intellectual processes of hermeneutic circle, namely, interpretation, reflective writing, and reading were completed solely by the researcher. It is also capable of creating emerging nodes and coding them with the transcript text individually (idiographic level analysis) and across multiple expert views (nomothetic analysis, see Figure 5. Coding is the process of organizing the raw materials (interviews transcripts) into chunks or segments of text before bringing meaning to information [55, 78]. There were four (4) major themes (dimensions of proposed Multi-domain framework) and minor themes (12 relationships) that were sorted and coded throughout the analysis. Hence, open coding is adopted to accommodate idiographic level and nomothetic level analysis.

Open coding begins by identifying and labelling manuscripts for concepts and categories. The concept is 'words stand for ideas', which resulted from the interpretation. It is the basic unit of theory development and sometimes referred to as codes [79, 80]. Each sub-theme has pre-defined nodes, while they were coded with new emerging "nodes" that were highlighted by experts individually. As hermeneutic circle was adopted, identifying and considering the features of words, sentences, and paragraphs from the transcription was coded thoroughly. As the number of interview transcripts increased, the merging nodes for each sub-theme was observed. The concepts were compared thoroughly by each expert's experience and opinion to understand further clarification on the relationships. This iterative process provides new interrelationship among the sub-themes and their nodes that are coded. This reflects the Reflective Writing in hermeneutic circle.

Another article by Harris stated that the hermeneutic circle is "the pattern that develops in the dialogue between us and our world: we can understand the whole of something only in terms of its parts and the parts only through their relationship to the whole" [69]. A change of understanding in one pole, the whole or parts, triggers a change in understanding at the other pole, forcing us into an interpretive (hermeneutic) loop (Figure. 6)

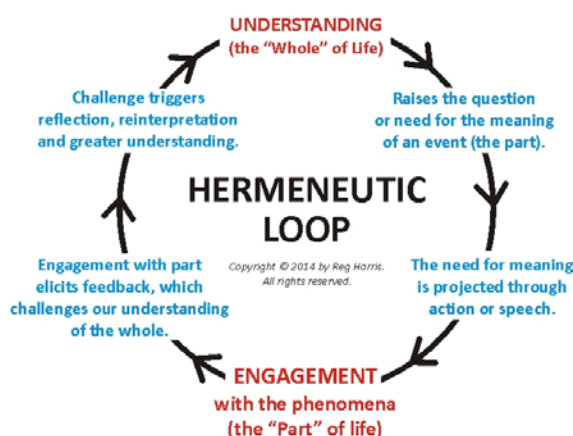


Figure 6: Hermeneutic Loop or circle (Harris, 2014)

Data analysis is often performed by applying the hermeneutic cycle that constitutes of reading, reflective writing and interpretation in a rigorous fashion [65]. This process can be demonstrated as in the given Figure 7. Although the principle hermeneutic circle is known for its infinite process of interpretation, however, it may end in practice when there is a sensible meaning, a coherent

understanding, free of inner contradictions has been reached [81].

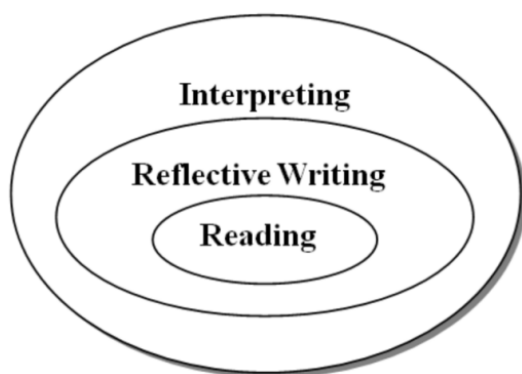


Figure 7: Hermeneutic cycle adopted [68]

Once the idiographic level analysis is completed (individual level analysis) the themes and nodes emerge clearly (Figure 8). The ideal situation is to analyse an interview immediately subsequent to its completion and prior to conducting the next interview, in case there are insights to be gained that would help improve the next interview. This also reflects the hermeneutic circle as each individual expert's experience is coded into the nodes and interpreted.

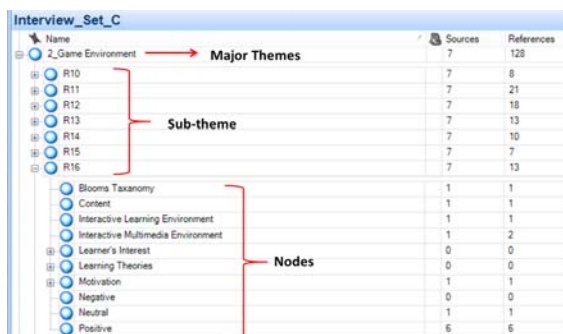


Figure 8: Idiographic level analysis of Set C overview

To identify and interpret the major themes, sub-themes and nodes, this research presents nomothetic (across individual) analysis (Figure 9). It is an extension of idiographic level which captures the range of individual perspective and their experience towards the relationship of the phenomena (GBL). The output of idiographic level provided the emerging nodes. The emerging nodes are expressed by GBLe and this also identifies which relationship has nodes coded by multiple GBLe. Hence, it covers the goal of hermeneutic circle and validates the proposed multi-dimension framework with respect to 12 relationships.

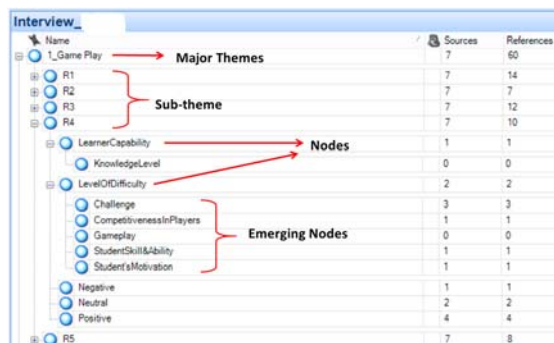


Figure 9: Nomothetic level analysis of Set C overview

In addition, the QSR NVIVO software is developed by Qualitative Solutions & Research International (QSR) is used at constant manner to confirm the descriptive and coding of sub-theme, hence, it consequently assists in interpretive hermeneutic approach of this study. NVIVO software is also used to performs word frequency analysis, word cloud, and text analysis and provide modelling technique of four (4) major themes and their sub-themes to map emerging nodes.

To summarize this section, it describes in detail on how the research design was adopted to achieve the quality output and how it incorporates with the research design of this study. It also provides details on how data was extracted, sampling types that were used in verifying the interview questions (pilot study). Consequently, the results of pilot study finalized the interview questions to conduct the data collection with GBLe. Following that, the data analysis was carried out using QSR NVIVO software. The data analysis is done using two levels of analysis (idiographic and nomothetic). Finally, they were further interpreted by the researcher's experiences. This allowed the researcher to achieve the goal of hermeneutic circle, hence, provide new emerging nodes in the proposed fore-structure of the research.

4.4 Reliability and Trustworthiness of Research Methodology

Hermeneutic phenomenology is appropriate to this research as it has pedagogic significance that is enlisted in four rigor criteria for this type of research [82]. Considering hermeneutic phenomenology as a pedagogic practice of textuality where doing research is to be involved in the considering of the texts that explicate the life world stories of the research participants, van Manen enlists orientation, strength, richness and depth as the major quality concerns.

According to him, orientation is the involvement of the researcher in the world of the research participants and their stories. Strength refers to the convincing capacity of the text to represent the core intention of the understanding of the inherent meanings as expressed by the research participants through their stories. Richness is intended to serve the aesthetic quality of the text that narrates the meanings as perceived by the participants. Depth is the ability of the research text to penetrate down and express the best of the intentions of the participants. Likewise, Langdridge proposes for analytical rigor persuasive account, and participant feedback as the major components that determine the quality of a hermeneutic phenomenological research [83].

Analytical rigor refers to the attitude displayed by the researcher to pay attention to every case that either confirms or disconfirms the theme. No taken for granted attitude is permitted during the hermeneutic analysis. Persuasive account refers to the quality of convincing the reader and its appeal to think about the personal experience for the reader on the light of what he/she has read. Participant feedback is another quality trail that a hermeneutic phenomenological research has to pass before reaching to its audience since it helps to best represent what is intended by the participants.

To formulate all these quality claims what is most important with hermeneutic phenomenological research is to pay attention to the rhetoric. Rhetoric refers to the writing or reporting style of the research work. According to Firestone, rhetoric is the art of speaking and writing effectively[84]. It refers generally to how language is employed. Since hermeneutic phenomenology aims at explicating the core essences as experienced by the participants, the everyday language cannot do justice to express what is intended by the participants. That is why hermeneutic phenomenology demands for a typical rhetoric that best elicit the true intention of the research participants.

Ethical issues are equally important in hermeneutic phenomenology like any other research paradigms. As a qualitative research paradigm, some ethical issues must be observed and practiced while doing this kind of research. Along with the ethical standards for qualitative research proposed by Creswell who mentions assigning aliases to the participants to protect their privacy, clarifying the purpose and procedure of the research beforehand, obtaining informed consent and not disclosing the identities of participants and

places a number of other ethical practices are to be applied that include the strict adherence to the ethics or care, confidentiality and other issues as required like that of sharing the research findings with the participants[43].

The reliability and validity for a hermeneutic phenomenological research, the multiple stages of interpretation that allow patterns to emerge, the discussion of how interpretations arise from the data, and the interpretive process itself are seen as critical [85]. When conducting phenomenological or hermeneutic phenomenological studies, researchers need to ensure the credibility of the study. Issues of rigor in interpretive inquiry are confusing to discuss, at times, as there is not an agreed upon language used to describe it or one universal set of criteria used to assess its presence. The rigid concepts presented above may be utilized by researchers in hermeneutic phenomenology which are more clearly articulating the quality of the study. Hence, it ensures its credibility.

5. INTERPRETIVE RESULTS AND DISCUSSION

As stated above, there were 96 responses collected from eight (8) GBLe for 12 implicit relationships of game environment domain. This section will provide interpretations of each relationship statement with respect to understanding the interpretive paradigm expectation. The interpretation of each relationship statement below is the combination of components suggested by GBLe and how the authors understand their relation with the other domains of framework such as learning theories, game play and subject-matter domain. Hence, this self-reflection aspect is the goal of hermeneutic method and interpretivism paradigm approach [68]. In addition, the support for the interpretations is provided as the quoted responses from GBLe.

RI. The GBLe completely agree that EG should adapt player's learning process to enhance the learning experience of learners. Experience can also be called flow experience from GP domain. It is relatively used in parallel with interactivity of the game and how the learners are motivated to continue their flow of learning without dropping concentration. In addition, learning theories such as behaviorism, cognitivism, humanism, experiential, procedural thinking, guidance learning, engagement, authentic, and transfer can be involved as theoretical aspects in this relationship. Thus, this relationship is *not amended* and it contains elements from GE, SM and GP.

R2. The GBLe agree that learners/students would be more eager to learn if the graphics are richer, multi-tasking interface and competitive environment increases learner's self-determination. EG has become richer in perspective of interface and multi-tasking. With the networks and multi-player gaming techniques, this can allow competition, collaborative, self-efficacy, engagement, creativity and the learner's full ability of concentration towards the assessment provided. With this, theoretical aspects such as experiential, cognitivism, discovery, humanism, actor-network technology, cooperative, social, and behavioral learning; can also help boost up the components of relationship statement. Thus, this relationship is **not amended** and it contains the elements from GE, and SM domains.

"Determination to complete the game or increasing and maintaining Motivation." [EXPERT_5]

R3. Although majority of GBLe agree that learning environment will provide a productive outcome if it is multi-user, there are 3 disagreements. It is also accepted that a single-player games may not be a bad idea. With researcher's understanding, if the EG is being introduced with a new concept of learning, and then single-player may be a good approach for starters. However, many literatures published supportive results towards multi-player environment to allow interactive and collaborative learning environment with their benefits to learners in gaining knowledge. This concept also involves learning theories such as social learning, collaborative learner, problem-based learning, constructivism and humanism learning theories. Thus, the relationship is amended and it involves components from GE and SM dimension. Thus, the relationship is **amended** and it involves components from GE and SM domain.

"Single-player games can be useful for educational contexts too." [EXPERT_3]

"It can be individualized." [EXPERT_5]

R4. The GBLe agree that the learners prefer rich graphics, animated designs, and interfaces which shows multi-type of information displayed for their convenience to achieve the goals that are required to be completed. This also needs a multi-tasking interfaces, responsive and interactive environment for the learners to engage. Furthermore, the theoretical aspects which can improve the environment and its elements are cognitivism,

humanism, programmed instruction, social, cooperative learning, experiential, discovery, case-based, extraneous cognitive load, and even instructional learning. Thus, this relationship is **not amended** and it contains elements from GE and SM.

"It depends on which type of learners you are referring to." [EXPERT_3]

R5. Although none of the GBLe disagree that rich graphic can also be a distraction to learners if they wish to focus, there is a conflict of thought on how well the interface should be decorated so it doesn't look messy or how the content of the interface is presented in order to present the features with subject's content clearly. This can be improved by inserting theoretical aspects constructivism, flow theory, humanism, direct instruction, scaffolding, authentic, instructional, and activity theory. Thus, this relationship is **not amended** and it contains elements from GE and SM domains.

Too much 'decoration' will make the interface look mess. [EXPERT_7]

It depends on how those features were sequenced and presented. [EXPERT_3]

R6. None of the GBLe disagree that games and stories a two different aspects. While game provides interaction and collaboration, and stories provide narrative context; it is not new that narrative context is one of the important factors that needs to be embedded in the EG. This also means that EG has the nature to tell stories, contain narrative elements, and show narrative structural sequences. With that, the theories that could relate to this relation are constructivism, elaboration, cooperative, engaged, debriefing, guidance, conditional, discovery, transfer, activity, instructional and zone proximal development theory. Thus, this relationship is **not amended** and it has elements from GE and GP domains.

R7. Majority of GBLe agree that relationship between reader/story is different with that to player/game, while, one GBLe disagree. Interpretive context provides formal learning which tells stories that contain the narrative element, hence, this provides structural learning sequences for learners. This relationship must be considered if the developers consider inserting narrative context into the game. Furthermore, this may be enhanced by considering the direct instruction, elaboration learning, authentic learning, and

cognitive development. This will allow reflecting to narrative context of EG where stories contain narrative element and structural learning to provide a sequence to learners with interactions. With respect to suggestions, the relationship is **amended** and it involves components from GE and SM domains.

R8. All GBLe agree that a well-designed game can expose learners with the complex task and professional diagnostic feedback to provide narrative efficiently. It is highly recommended by experts. Feedback is mentioned in literature with different synonyms such as immediate, unambiguous, adequate and adaptive feedback, contextual, frequent, and constructive feedback. Feedback is used in many different aspects, but it is mainly to provide the learners with how they achieved their learning progress throughout the flow of learning. To improve the feedback content through a narrative context, theoretical aspects such as scaffolding, elaboration, cognitivism, flow theory, recursive cycle, problem-based, and experiential. Thus, this relationship is **not amended** and it contains components from GE, SM, and GP domains of the multi-domain framework.

R9. It is agreed by the GBLe that complex games are able to provide new strategies and solve the ethical dilemma for learners. A complex game requires a player to learn a wide variety of frequently new and challenging skills and strategies. Hence, this is to master these skills and strategies by advancing through dozens of ever-harder “game levels.” This also involves game character selection where the game might choose the character according to the race, gender, religion, or profession, to eventually determine the ultimate goals. This can also relate with theories such as constructivism, cognitivism, social learning, procedural thinking, discovery, bloom’s taxonomy, activity theory, authentic learning, instructional, and goal-directed action learning. Thus, this relationship is **not amended** and it contains components from GE, SM, and GP.

“What do you mean by complex games? So according to the level of studies, then this is where we can agree. But for the ethical dilemma, not confirmed.” [EXPERT_2]

“Complex is a relative term, as it could be complex to you but simple to me.” [EXPERT_33]

“It depends on the experiences and personality of the learner.” [EXPERT_5]

R10. There are 3 disagreements towards the statement that digital games are able to teach the ‘future skills’ (collaboration, problem-solving, and communication) for future jobs. A suggestion to the skills stated above, GBLe stated that digital games also teach social, career skills, and activities that allow development of particular skills that is required. Furthermore, the learning outcome of a particular activity is also depending on what is being learned or taught by the EG. Hence, the quality of EG needs to be polished while it is being designed and developed. There are learning theories that can be integrated to accomplish the future skills such as collaborative learning, problem-solving learning, constructivism, social development, social learning, engaged learning and humanism learning. Therefore, the relationship is **amended** and it involves components from SM and GP.

“It also teach social and career skill.”
[EXPERT_7]

“It depends on the intended learning outcomes and the quality of the digital games.” [EXPERT_3]

“There are other activities, which can allow the development of the intended skills.” [EXPERT_5]

R11. One GBLe disagrees that a learning environment should be discovery and also memorizing at certain partitions of a task-solving process. It is known that discovery factor allow the learners to engage thoroughly and use their critical, creative, complex, and innovative thinking. This also adds the level of skill of the game and the skill level which the learner holds. The learners also tend to learn sense of control over activity and understand the context of games. It may have the factor to be friendly, gamification elements, emotive flow, and rich graphics. The relationship is also integrating theories such as discovery learning, cognitivism, constructivism, procedural thinking, cognitive development, social development, engaged learning, transfer, authentic learning, cognitive load theory (memory load), and behavioral learning theories. Thus, this relationship is **amended** and it involves components from GE and GP domains.

R12. The GBLe agree that well-designed games are able to provide diagnostic feedback and integrated learning experience in the actions that

the learners take. Other components such as gamification elements, usability factor, collaborative, instructional message, problem-solving components and immersive factor can enhance the learning experience through the actions which learners use to solve the activity/task. The learning theories that can enhance the feedback and learning experience for learners are flow theory, constructivism, cognitivism, procedural thinking, engaged learning, cognitive development, experiential, mastery-based learning, activity theory and goal-directed action learning. Thus, this relationship is *not amended* and it contains components from GE, GP, and SM domains.

"This requirement is true for any instructional material regardless of the strategy." [EXPERT_5]

6. RESULTS WITH EMERGING ELEMENTS

The interpretive results and discussion section revealed that there are four (4) implicit relationship statements that needed amendments before they can be declared as explicit. Note that the amendments took place either because one or more experts disagreed with the relationship statement or added components into the relationship to enhance its understanding. There were twelve (12) relationship statements that were validated and interpreted.

Table 6. The Amendments made to four implicit relationships

No.	Explicit Relationship Amended
3.	Learning environment is productive in both cases: singles user and multi-user.
7.	In narrative context , the relationship between reader/story is different to that between player/game.
10.	Digital games are able to teach the "future skills" for future jobs such as collaboration, problem-solving communication, learning outcome, social skills and career skills .
11.	A learning environment should be discovery of new rules, ideas, and memorizing .

Before the amended explicit relationship statements are presented, the authors categorized the discussion in five types of responses and it also highlights the explicit relationships statements and the highlighted #3, #7, #10, and #11 relationship statements are amended (see Figure 10).

This shows that GBLe strongly disagree with the relationship statement #3, #10, and #11, hence, they has been amended accordingly. There is

disagreement over relationship #3, #7, and #10. Thus, with discussion and interpretation, they have been amended. Overall, the results show that 93% of feedbacks were positive (strongly agree, agree, neutral) towards the relationship statements (See Figure 10). Hence, they are successfully validated and explicitly mentioned in Table 6 for game developers to understand game play domain in relevancy with other domains.

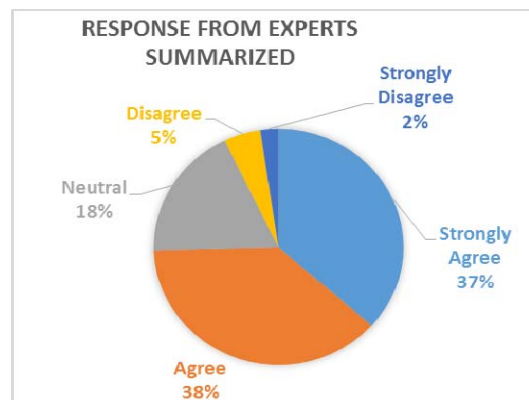


Figure 10: Elements to create effective environment

6.1 Analysis and Modelling of Open-Coding & Emerging Codes

To further enhance and provide the nodes, sub-nodes, and emerging nodes illustration, each relationship was coded through the Experts response and the elements were linked with the relationship. All the relationships are the sub-themes of Game Environment domain. Each expert response is recorded according to their views during the expert interview session. Lastly, this shows what elements are mostly agreed upon during the interview session.

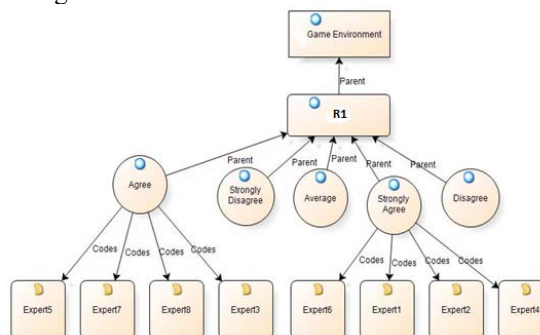


Figure 11: Relationship: 1 (R1), Emerging nodes and coding of Experts

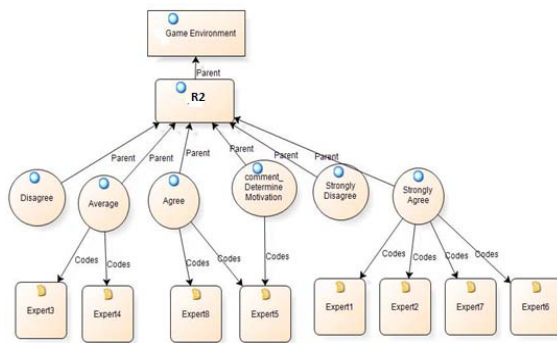


Figure 12: Relationship: 2 (R2), Emerging nodes and coding of Experts

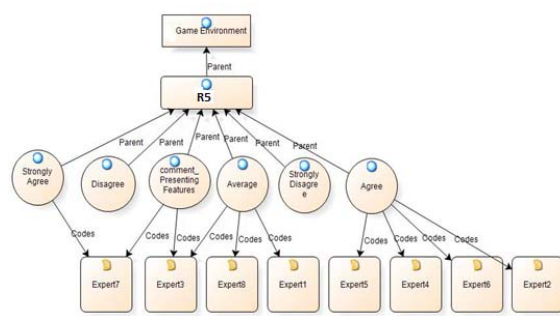


Figure 15: Relationship: 5 (R5), Emerging nodes and coding of Experts

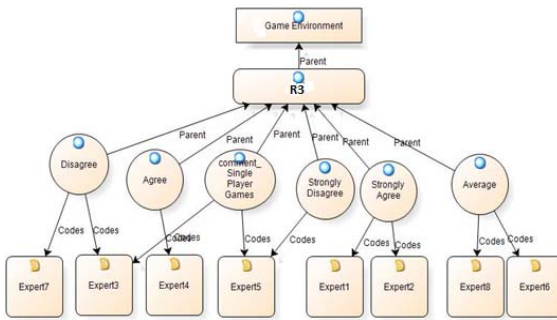


Figure 13: Relationship: 3 (R3), Emerging nodes and coding of Experts

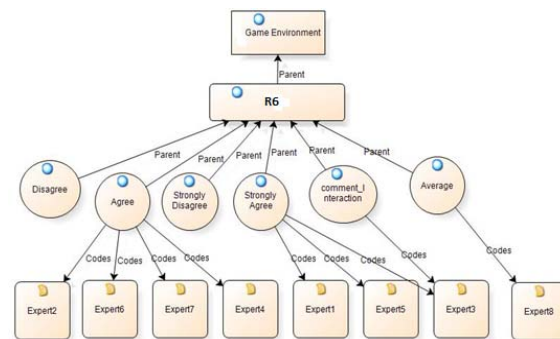


Figure 16: Relationship: 6 (R6), Emerging nodes and coding of Experts

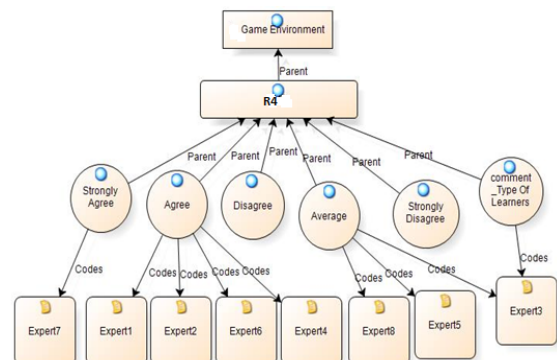


Figure 14: Relationship: 4 (R4), Emerging nodes and coding of Experts

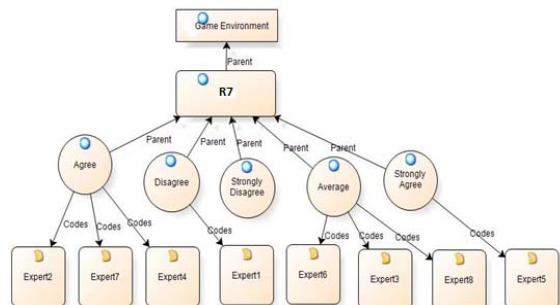


Figure 17: Relationship: 7 (R7), Emerging nodes and coding of Experts

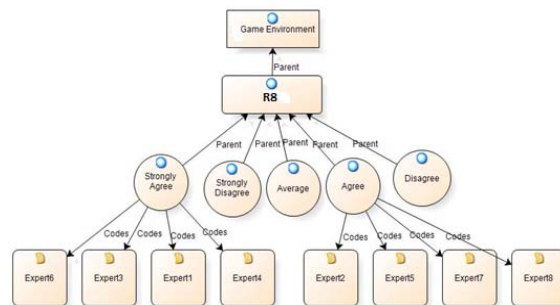


Figure 18: Relationship: 8 (R8), Emerging nodes and coding of Experts

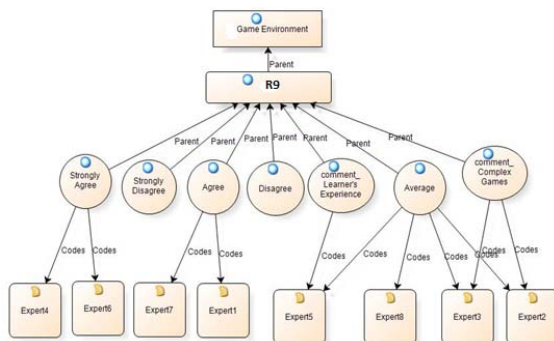


Figure 19: Relationship: 9 (R9), Emerging nodes and coding of Experts

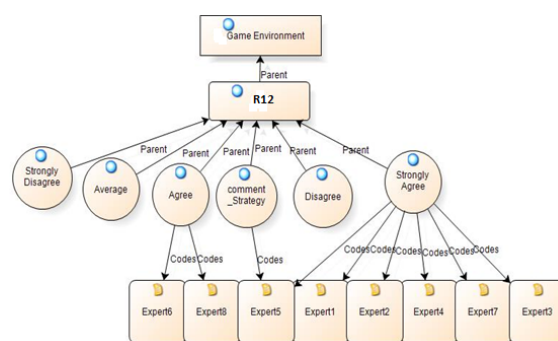


Figure 22: Relationship: 12 (R12), Emerging nodes and coding of Experts

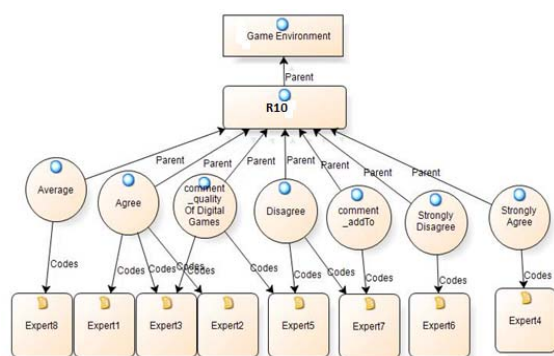


Figure 20: Relationship: 10 (R10), Emerging nodes and coding of Experts

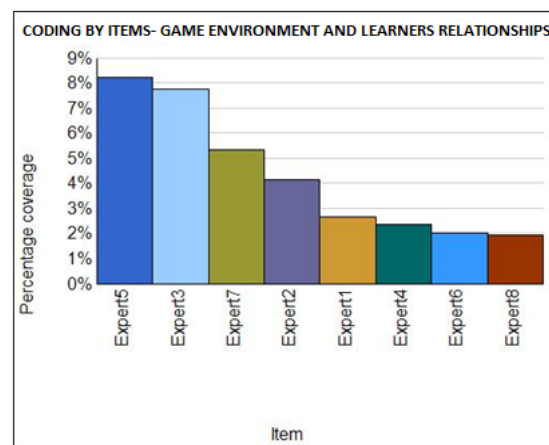


Figure 23: Coding by Expert Analysis

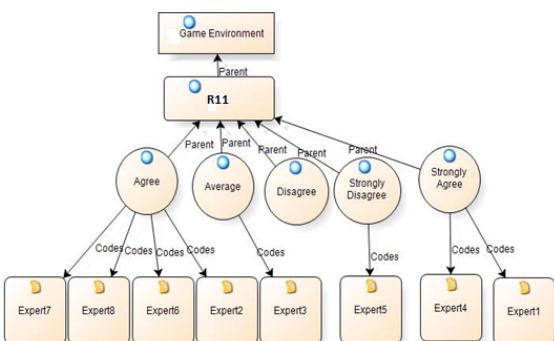


Figure 21: Relationship: 11 (R11), Emerging nodes and coding of Experts

Figure 23 shows the percentage of experts number who have rigorously accepted the elements mentioned in the relationships during the interview sessions. With the results, Expert_5 seemed to have much professional and in-depth information to understand the necessity of the relationship.

7. CONCLUSION

This article provides a thorough interpretation and interrelation between learners and game environment in EG. The authors have proposed and explained on the multi-domain framework which includes four major domains that must be considered in developing process. Vaguely presented relationships were extracted and mapped onto the framework to provide implicit relationships. This article discusses twelve (12) implicit relationships based on game environment and learners. Consequently, eight (8) game-based learning experts were interviewed to validate and verify relationships significance. Thus, the results were interpreted using hermeneutic method of interpretivism paradigm in qualitative philosophical

perspective. The findings indicate and show that four (4) implicit relationships needed amendments before declaring them as explicit. To conclude, there are twelve (12) explicit relationships with game environment and learner's interest that shall be considered by the game developers to achieve a motivational outcome.

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