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LEARNING PROGRAMMING USING OBJECTS-FIRST APPROACH THROUGH FOLKTALES

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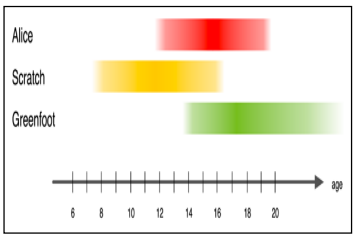
Graphical abstract



Abstract

Teaching programming to the amateur programmers and non-programmers with design and educational technology background are tough. Needless to say, it is pertinent for them to have some basic programming skills. We realized the needs to motivate the potential programmers therefore, proposed the integration of folktales in learning programming. This paper shares an approach of teaching programming using the folktales to create awareness also to simulate the amateur and non-programmers interested with folktales at the same time motivated to complete a creation of digital story using 3D programming software, Alice and Unity. Mixed-methods approach revealed participants' positive behavior towards learning programming although it was perceived difficult. The finding also indicates that they can understand the programming language and successfully explored the software to create a digital story.

Keywords: Digital story, non-programmers, Alice, unity, mixed-methods

1.0 INTRODUCTION

Various researches have been carried out to motivate non-programmers to learn programming languages [1], [2]. The importance of the programming language is seen with the skills and knowledge required to create Internet applications and also creative content for the evolving mass-consumption mobile devices such as Ipad, smartphones and other. Learning programming for non-programmers are especially challenging and we seek alternatives to lower the learning gap for programming language among the non-programmers.

The increasing prominence of Web 2.0 and ultimately Web 3.0 are sweeping the younger generation into a highly dynamic entertaining world whereby most of the physical appearance involves highly interactive and virtually designed objects, mostly in the 3-Dimensions. We instilled intrinsic motivation within the students by justifying the need to sustain their interest towards folktales. We have proposed the integration of folktales with programming for the non-programmers and amateur programmers using the object-first teaching approach. Objects-first "emphasizes the principles of object-oriented programming and design from the very beginning. It allows user to visualize the programming language with the notions of objects and inheritance [33]. It is the goal of this paper to shed light on how to sustain the interest of non-programmers and amateur programmers towards programming language by shifting their role as a folktales reader to become digital storyteller using 3D programming software.

2.0 SUSTAINING FOLK STORIES

2.1 ICT-The Threats and Alternatives

Folktale is a form of traditional story telling that exist long time ago when Information Computer and Technology (ICT) and technology were not present. It serves to entertain and to impart values to the younger generation [3] and often come in form of story narration carried out by parents due to illiteracy

[4]. Although the publication of folktales seems to be very high generally [6], the publication for these titles in Malaysian industry was very slow [7]. It was probably due to of the way it was packaged [8]. Threats were obviously seen with the almost diminishing traditional cultural heritage due to lesser economic value it carries, on top of the needs for financial support for the cultural activities [8]. Wayang Kulit, for instance, nearly became a dying art with the presence of animation until approaches carried out by concerned parties to sustain the cultural of Wayang Kulit either through workshops [9] or technology related activities [10], [11].

Giving the importance of folktales, various proposals have also been taken up to sustain the interest of younger generation at preschool by adopting it in literature to nurture the interest of reading [5], [12]. The influence of ICT to sustain the interest and value in the folktale has been revealed through a study on children aged 5-12 years old [13]. E-book, another potential prospect has also been another approach. World of Tales [14], for instance has extensive collection of the world's folktales in hypertext format. However, an unpublished study [15] cautioned that too much reading from the electronic devices such as monitor screen or e-book can result in weak reading skills among the children. We uptake this challenge and suggest that instead of allowing a reader to assume passive role on electronic devices, the reader should transform his/her role to be an active director of a folk tale. This is possible to be done when they become a programmer of the digital story. This study takes motivation based on various positive findings on how ICT has benefit in promoting and sustain the interest of teaching and learning [16], [17].

2.2 Tools for Digital Story Telling

The advancement of technology in our lives has changed the way storytelling is being communicated. The use of digital tools allow each story to be narrated interestingly with visual, animation and also audio. The Google search suggests two web sites offer the best top-10 tools for creating digital storytelling, Technology Tidbits [18] and Educators Technology [19]. The program proposed from the listing unfortunately were not selected in this study because they mainly serve 2-D and their functions are limited within the working environment. Similar to toys, software was also categorised according to the age of uses. Figure 1 shows the ideal age for using the programming software [20]. It only compare between Alice [21], Scratch [22] and Greenfoot [23].

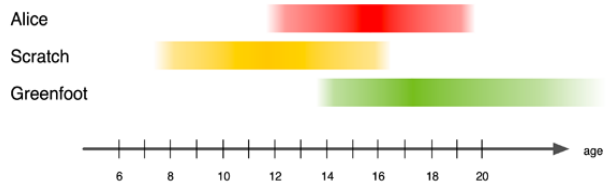


Figure 1 Target age groups for Alice, Scratch and Greenfoot

3.0 RESEARCH METHOD

3.1 Setting and Participant

The purpose of this study was to investigate the behavior of the amateur and non-programmers to create a digital story based on an existing folktales using 3-D programming software. At the same time, the participants learnt fundamental programming through exploring the variable, methods and function of programming. The pilot study was conducted in a private university in Malaysia and involved a focus group of nine postgraduates. The project was on individual basis.

Due to the smaller scale, this study adopted mixed-methods research design to overcome the weakness of purely quantitative data [24]. The questionnaires for the quantitative questionnaire were adapted from [25]. The following open-ended survey, qualitative data was collected to enrich the quantitative data. Similarly to [26], the mixed-methods approach was to describe the students' behavior towards the adoption of the software proposed in this study.

3.2 Selection of Software

Since the younger generation often prefers 3D visuals so we have considered Alice to be used as the developing software instead of Scratch. The reason was also partly of the age factor revealed in Figure 1. We did not considered Greenfoot although it meets the age requirement because it does not have many 3D objects in the library as compared to Alice. The availability of 3D objects in the library is important in this study because it is convenient for the participants whom had about three weeks to create the digital story.

Two participants (n=2) included Unity [27] in this study because of prior skills one had meanwhile another participant wanted to adopt the software due to its capability in creating games for apps. The rest of the participants (n=7) used Alice as the programming tools. This study adopted purposeful sampling whereby the students were given a task of creating a digital story based on a folktale using either Alice or Unity programming software.

The software selected for the study was due to the reason it serves as part of the course requirement to learn the programming language. Besides, it features on 3-D which would be interesting to the younger generation. The participants were asked to create an interactive virtual world of Malaysia folktales. They were Web sites were provided to the participants in order for them to understand more about folktales:

- Definition of folk story
- Research on folk story
- The Story of the Coconut Tree
- Outwitting a Crocodile

3.3 Procedures

The focus of this study was to interpret the story in a folktale and translated them into an interactive digital story. Figure 2 shows a dynamic flow work for non-programmers to create the digital story based on a folktale.

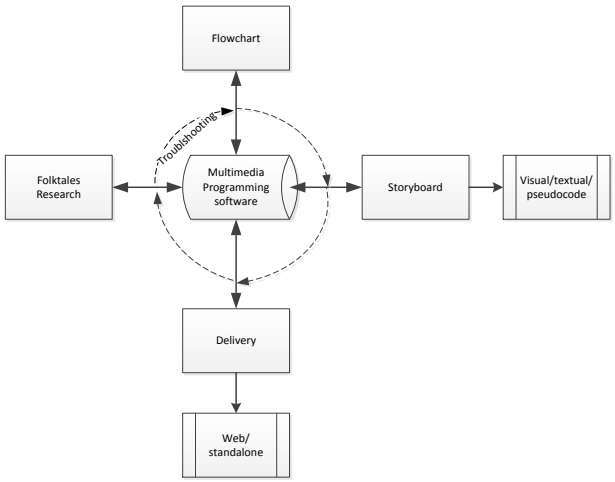


Figure 2 Conceptual framework for programming

The process started with *Folktales Research* where the user checks the availability objects that can be used in the folktales. This will avoid spending long time and meet with hurdles to create own object due to incompetency. Next, the user will proceed to the *Flowchart* phase where they translate the folktale narratives into storylines from a reader's perspective and produces sketches of flowchart accordingly to the logic in the folktales. This step will ensure clarity of story to be translated in the programming software. They further extend it with sketches of storyboard in the *Storyboard phase* in either visual, textual or pseudo code form. This step reduce the amount of time spend on reproducing the storyboard on paper. The final step is the *Delivery* whereby the user will decide how to export their multimedia programming work to desirable platform for viewing pleasure.

The phases were centre to the multimedia programming software due to the nature of software of today which allow quick and flexible editing. Problems faced by the user often could be solved by entering the error message to Google.

3.4 Mixed-Methods Data Analysis, Results and Discussion

Table 1 shows the demographic of the respondents participated in this study.

Majority of the participants (55.6%) were female. The participants received fairly amount of exposure on the programming language and has spent approximately 2-5 times a week to learn the software in this study.66.6% of the participants rated their level of programming as average while 33.4% found it difficult to learn. However, upon the completion of study, majority of the participants (83.3%) acknowledged that they have become intermediate user although the remaining 16.7% felt they are still a novice user.

Table 1 Demographic characteristic of respondents

Demographic Profiles	Frequency	Percentage (%)
Gender (n=9) Male	4	44.4
Female	5	55.6
Exposure on programming language (n=7)	No-3	42.9
	Yes-4	57.1
Time spent on programming software during this study (n=7)	Once a week-3	42.9
	2-5 times a week-4	57.1
First time exposure, perceived level of programming (n=6)	Difficult-2	33.4
	Average-4	66.6
	Easy-0	0
After study, perceived programming competency (n=6)	Highly experienced -0	0
	Novice User -1	16.7
	Intermediate User-5	83.3

In the qualitative data, * indicates the participants who used Unity.

Table 2 Attitude towards usage

Items	Mean	SD
I believe it is a good idea to use the programming software for my coursework.	3.4444	1.1304
I like the idea of using the programming software.	3.1111	1.0541
Using the programming software provided me with a lot of enjoyment.	2.6667	0.7071
Overall, I enjoyed using the programming software.	3.0000	1.0000
I have a generally favourable attitude toward using the programming software.	3.3333	0.8660

Table 2 shows the mean value for the items that were categorized under attitude towards usage, 1 indicates *Strongly Disagree* while 5 indicates *Strongly Agree*. In general, the participants have rather positive attitudes (mean value above 2.500) in using the programming software. Most of them had a

favourable experience and enjoyed the process of creating the task given using the programming software.

On the qualitative aspect, the students were asked "How has the programming software made learning programming fun for them?" Some of the useful insights were:

- ** With lots of preset actions.*
- *The interactivity.*
- *It is easy to learn and more interactions. Easy to navigate & animate.*
- *Provide GUI.*
- *I can easily try and error when learning the programming software.*
- *The 3d environment seems to distract me from the idea of learning programming when I am actually learning without wholly realising.*
- ** wasn't fun because it requires lots of time to learn but when there are results in outcome, it gives me satisfaction feeling.*
- *It's never fun when you learning programming software through Alice*

Table 3 Behavioral intention to use

Items	Mean	SD
I intend to use the programming software frequently for my coursework.	3.1111	0.7817
I intend to use the programming software as often as possible.	2.7778	0.9718
I plan to use the programming software in the future.	3.0000	0.8660
I expect my use of the programming software to continue in the future for 3D and interactive projects.	3.1111	1.1667

Table 3 shows the mean value for the items that were categorised under behavioural intention to use. All items yielded high mean values showing a strong intention to use the programming software. However, it can be noted that the participants were not so keen to use the software as often as possible (mean=2.7778), perhaps due to the nature of the software that is not meant for everyday usage.

Table 4 Perceived ease of use

Items	Mean	SD
Overall, I found the programming software is easy to use.	3.1111	0.7817
Learning to use the programming software was easy for me.	3.0000	1.1180
My interaction with the programming software interface was clear and understandable.	2.8889	0.6009
It was easy for me to become skilful in using the programming software.	2.6667	0.7071

Table 4 shows the mean value for the items that were categorised under perceived ease of use. The participants viewed the programming software as easier to be used as indicated by the high mean values for all items. Nevertheless, the participants believed that it was not an easy task to be skilful in using the software (mean=2.6667). This could be due to their perception on the complexity of the software.

The students were further probed in order to understand why the software had hindered their interest to learn programming. The question directed was: "Were there any challenges in learning the software that stopped you from learning?" The respondents revealed the following:

- *Repetition of Alice to show the 3d from first after any small changes.*
- *Yes it is time consuming.*
- *Syntax error.*
- *The software crashes quite often.*
- *The recurring glitches and errors were the challenges.*
- *Yes. The list is infinite*
- *No all the tutorials are in the websites.*
- **I have no difficulty learning basics of software but have difficulty to learn advance programming software due to the technical calculation.*
- **Confusion between codes.*

A question was probe "How has the programming software made learning programming easy for you?" Majority of the respondents revealed positively except one respondent who perceived the Alice software was difficult to learn:

- *Alice is user friendly and easy to learn.*
- *The 3d as objects makes it easy to interact with.*
- *All the predefine function are provided.*
- *Provide guideline and steps. The software includes drag and drop programming features.*
- *It is based on a drag and drop concept.*

- *I could understand the foundation of programming (if/else/then/etc) through Alice.*
- **Simplifying the workflow.*
- **Programming software is programmed to suit human behaviour and how human thinks. This made learning programming easy for me.*
- *It hasn't*

Table 5 Personal innovativeness

Items	Mean	SD
I think it is very interesting to learn new things like the programming software.	4.1111	0.9280
Generally speaking, I like to accept new things.	4.0000	0.8660

Table 5 shows the mean value for the items that were categorised under personal innovativeness. Although there were only two items under this category, it shows a very high motivation for the participants to be innovative. Both items obtained a very high mean value.

The following qualitative feedback for the question "Did the programming software motivate you to learn programming?" was also obtained.

- *Yes I like to learn programming future.*
- *Yes I am looking to gain more knowledge in programming.*
- *Yes it makes learning programming a little bit easier.*
- *Yes because of the flexibility of using the models of predefined functions*
- **it did motivate me as I can product an interactive prototype product.*
- **No. it was not through a proper channel. Timing was not good enough.*
- *No. Need to have a simplified manual or tutorial for beginners from professional or experienced programmer.*
- *Not really. Unless it provides additional commands to expedite the programming process.*
- *Nope*

Although the participants noted their willingness to learn new things, the qualitative data revealed opposite. Participants revealed that the software was difficult to learn although guidance was provided to them and the many free resources are available on the Web. One reason to the lack of motivation was due to the time limitation. Nevertheless, one of the participants went beyond the project brief and created a folktale based on *BawangPutih, BawangMerah and* distributes it on the Web, http://re-tale.in-action.info:

The purpose of the website is to provide foundation overview of the Nusantara folktale, "Bawang Putih, Bawang Merah", whilst encouraging users with or without prior programming background into participating in the act of conserving the folktale through digital storytelling in Alice 2.3.

Table 6 Perceived usefulness

Items	Mean	SD
Using the programming software improved my performance in programming.	2.8889	0.9280
Using the programming software increased my productivity in creating interactive products.	3.0000	1.2247
Using the programming software enabled me to accomplish 3D programming more quickly.	3.2222	0.9718
I found using the programming software is useful in learning programming.	3.2222	1.3017
Using the programming software enhanced my effectiveness in learning multimedia programming	3.7778	0.9718

Table 6 shows the mean value for the items that were categorised under perceived usefulness. The participant generally viewed the software as useful in helping them to complete the interactive multimedia tasks. All items yielded high mean values and the participants perceived the software as a tool to enhance their effectiveness in learning multimedia programming.

Students were also asked "How do you see the usefulness of learning multimedia programming?" and their responses indicate positive rewards and usefulness in their potential job in educational technology:

- *To design 3d game or animation with Alice it is useful.*
- *For advance work would be fine.*
- *It is very useful.*
- *Make learning easy e.g. you can see object and images not just some boring text.*
- *It is important for the final year project.*
- *It might benefit me in my future multimedia coursework.*
- *It is beneficial for multimedia artists/researcher in understanding the underlying codes instead of just understanding the aesthetical needs.*
- *Learning multimedia programming lets me create a prototype of product interactivity*
- *more variety, easy to learn and absorb information more quickly, entertaining and fun*

Table 7 Overall comparison

Categories	Mean
Attitude towards usage	3.1111
Behavioural intention to use	3.0000
Perceived ease of use	2.9167
Personal innovativeness	4.0556
Perceived usefulness	3.2222

Table 7 summarises the mean values for each category. The overall mean for the categories were obtained to illustrate the perception of the participants on the programming software.

4.0 DISCUSSION AND CONCLUSIONS

The finding revealed very low perceived ease of use by the participants. They struggled to learn the programming language and over some technical issues pertaining to the limitation of the software together with their peers. Nevertheless, they value the software in creating a digital story in their projects. This finding reveals the importance of having positive mind towards learning new software, especially one as difficult as programming language.

Research that implied on the importance of using ICT to create the folktales for audience as young as preschoolers [6] should be incorporated in current curriculum because it can increase the intrinsic motivation of a student. The motivation for a reader in creating digital story using programming software without any programming background should be encouraged because there is a high demand of programming skills and knowledge in the industry [28].

Learning programming using object-oriented software no doubt does not create huge hindrance to learning for the non-programmers because the software was designed to cater for novice programming language [29]. However, Alice has constantly improved their software functionality to help non-programmer to learn at ease [30]. The age of learning programming software was not a major concern because this study revealed that the success behind the digital story was the motivation of participants to complete the interactive project.

The mixed-methods did not include the study of age and gender due to the study that revealed that gender does not affect the competency of learning programming. However, academic ability and types of learning style had some affect the programming knowledge [31]. This relates to the findings that the participant, who learned Unity during the first time, did not find it fun because it requires lots of time to learn. However, as learning progress with positive results, it also yields satisfaction feeling that encouraged bigger scope of production. This study does not claim the replacement of conventional format such as printed materials because it is acknowledged that some rural places might not have access to the technology and broadband [17]. We are suggesting the programming storytelling as a more engaging method of inspiring the younger generation to embrace the beauty of folktales.

The programming software enables the creation of an interesting yet engaging work which can sustain the interest of the younger generation. In Alice, dialogs are easily created within a mouse click. Participants could also conveniently carry out voice-over to narrate their story.

The disadvantages of Alice software was it support low polygon count unlike Unity. In addition, it could not remain the level of higher interactivity once export to movie file. The participant had overcome it by exporting the digital story to movie format and the digital folktale was showcased through YouTube using its interactive feature. Here is a link to the part 1 of Bawang Putih Bawang Merah (https://www.youtube.com/watch?feature=player_embedded&v=APf4k3SywSA)

By offering the digital story on a Web platform, http://re-tale.in-action.info indicates:

The website also serves as a virtual heritage repository that archives the folktale from different context across the region.

The delivery platform was expanded with the interoperability of Internet. This enables the digital stories to be shared and receive feedback from other online readers. Just as how fast the *Facebook* has bloomed in the social network media, this is another possibility for folktales. With active competition between *Facebook*, *Instagram* and other social media network, folktales may arise as another potential area if more innovative proposal obtained [32].

The learning curve for learning the programming language at the same time to create a digital storyline may be higher than expected. Nevertheless, it is still a possible direction looking at the demand for programming skills in the market. Dealing with programming tools at the same time creating a digital storytelling indeed can fulfill the satisfaction of a user.

References

[1] Dunsmore, H. 1980. *Designingan Interactive Facility for Non-Programmers*. New York, USA: ACM.
[2] Ring, B.A., J.C. Giordano and J.S. Ransbottom.2007. *Problem Solving Through Programming: Motivating the Non-Programmer*. New York, USA.
[3] Hasuria, C. O., H. Haslina, and G. Aniswal. 2009. *The Sustainability of the Translation Field: In the 12th International Conference on Translation*. Kuala Lumpur: Persatuan Penterjemah Malaysia.
[4] Omar, M. Blog Correspondent of ASEAN-Korea Centre. [Online] From: http://blog.aseankorea.org/archives/2443 [Accessed on January 16, 2012].
[5] Rahmat, H. 2006. *Peranan dan Perkembangan Sastera Kanak-kanak*. Kuala Lumpur:Dewan Bahasa dan Pustaka.
[6] Chew, F. P. and Z Ishak. 2010. Malaysia Folk Literature in Early Childhood Education. In *Proceedings of World*

Academy of Science, Engineering and Technology. 66: 557-564.
[7] Selwyn, N. 2009. The Digital Native: Myth and Reality. *Aslib Proceedings*. 61(4): 364-379.
[8] Aziz, A. 2011. The Weeping Cradle Kelantan's Diminishing Arts, In: South - East Asia: Art, Cultural, Heritage and Artistic Relations with Europe/Poland. [Online] From: http://umkeprints.umk.edu.my/584/1/SKMBT_50112070923130.pdf.
[9] Jaafar, S. New Strait Times, Wayang kulit lover sets up gallery to revive dying art. [Online] From: http://www.nst.com.my/nation/general/wayang-kulit-lover-sets-up-gallery-to-revive-dying-art-1.196698 [Accessed on 06 January 2013].
[10] Fu, G. 2009. Untitled, Launch of ShINE@Fuhua, 2009, Fuhua Primary School. [Online] From: http://www.moe.gov.sg/media/speeches/2009/05/30/speech-by-ms-grace-fu-at-the-l-3.php.
[11] Hasnizam, A.W. 2007. The Integration and an Experiment of a Traditional Wayang Kulit Performances and Electroacoustic Music. *Electroacoustic Music Studies Network Conference - The Language of Electroacoustic Music*. Leicester, U.K. June 12-15, 2007. 1-7.
[12] Rahmat, H. 2006. *Peranan dan Perkembangan Sastera Kanak-kanak*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
[13] Azan, M. Z. N., M. N. N. Yuhanis and G. Munirah. 2010. Promoting Socio-Cultural Values Through Storytelling Using Animation, INTECH. [Online] From: http://www.intechopen.com/articles/show/title/promoting-socio-cultural-values-through-storytelling-using-animation.
[14] Andonov, V. 2008-2013. World of Tales-Stories for Children, Folktales, Fairy Tales and Fables from Around the World. [Online] From: http://www.worldoftales.com/.
[15] Blythe, S. G. When it has gone, it has gone–Why Pupils Who Turn to E-Books are Weaker Readers. [Online] From: http://sallygoddardblythe.co.uk/when-it-has-gone-it-has-gone-why-pupils-who-turn-to-e-books-are-weaker-readers/ [Accessed on 17 May 2013].
[16] Piah, H. M. 2003. *Sastera Rakyat Malaysia, Indonesia, Negara Brunei Darussalam: Suatu perbandingan*. Kuala Lumpur: Dewan Bahasa & Pustaka. 5.
[17] Leo, M. Y. 2004. Official opening speech-In Proceeding of Seminar-cum-Workshop on Children's Book Publishing in the Next Millennium. Kuala Lumpur: Dewan Bahasa & Pustaka. 10-13.
[18] Dkapuler. Top 10 Sites for Digital Storytelling. [Online] From: http://cyber-kap.blogspot.com/2010/05/top-10-sites-for-digital-storytelling.html [Accessed on May 2012].
[19] Kharbach, M. 2013. A List Of The Best Free Digital Storytelling Tools For Teachers Digital Storytelling. [Online] From: http://www.educatorstechnology.com/2012/06/list-of-best-free-digital-storytelling.html.
[20] Ian, U., S. Cooper, M. Kolling, J. Maloney and M. Resnick. 2010. Alice, Greenfoot and Scratch-A Discussion. *ACMTransactions on Computing Education*. 10(4): 17.
[21] Cargenie, Mellon University, 1999-2003 [Online] From: http://www.alice.org/index.php.
[22] Peppler, K. A. and Y.B. Kafai. Creative Coding: Programming for Personal Expression [Online] From: http://download.scratch.mit.edu/CreativeCoding.pdf.
[23] Michael K. 2010. *Introduction to Programming with Greenfoot: Object-oriented Programming in Java with Games and Simulations*. Upper Saddle River, N.J: Prentice Hall. 190.
[24] Abbas, T. and C. Teddlie. 2003. *Handbook of Mixed Methods in Social & Behavioral Research*. Thousand Oaks, Calif: SAGE Publications. 768.
[25] Kuo, Y. F. and S.N Yen. 2009. Towards an Understanding of the Behavioral Intention to Use 3g Mobile Value-Added Services. *Computers in Human Behavior*. 25(1): 103-110.
[26] Wragg, E. C. 2012. *An Introduction to Classroom Observation*. In Ted W. – Classic (Ed.). London: Routledge.
[27] Blackman, S. 2012. *Beginning 3d Game Development with Unity*. Berkley: APRESS.
[28] Jonathan, C. and N. Ensmenger. 2011. The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise. *Enterprise and Society*. 12(4): 924-926.
[29] Ko, A. J. 2003. Preserving non-programmers' motivation with error-prevention and debugging support tools. In *Procedings of IEEE Symposia on Visual Languages and Human-Centric Computing*. Auckland, New Zealand. October 28-31, 2003. 271-272. IEEE Press.
[30] Gross, P. A., M. S. Herstand, C. L Kelleher and J. W Hodges. 2010. A Code Reuse Interface for Non-Programmer Middle School Students. In *Proceedings of the 15th International Conference on Intelligent User Interfaces*. Hong Kong, China. February 7-10, 2010. 219-228.
[31] Lau, W. F. Wilfred and A. H. K. Yuen. 2009. Exploring the Effects of Gender and Learning Styles on Computer Programming Performance: Implications for Programming Pedagogy. *British Journal of Educational Technology*. 40(4): 696-712.
[32] Garside, J. 2013. Facebook loses millions of users as biggest markets pea. [Online] From: http://www.guardian.co.uk/technology/2013/apr/28/facebook-loses-users-biggest-markets.
[33] Stephen, C., D. Wanda and P. Randy. 2003. Teaching objects-First in introductory computer science: addressing different learning styles in teaching operating systems concepts. *Sigcse Bulletin*. 35(1): 191-195.