Evaluation Test for 3D Computer Graphics Content Production Capability Based on Simulation Methodology

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Abstract

Through 15 years' experience with the Certification Test of Computer Graphics by the Computer Graphic Arts Society, we have felt importance of a new style of test, namely simulation test (ST). The goal of ST is to evaluate the examinees' knowledge and skills using simulation methodology. We conducted an experimental test session of ST in November 2005. In this experimental session, we also conducted a Paper and Pencil Test (PPT) for comparison. An assignment is shown to 75 testees by a storyboard. The testees read the storyboard, then, create answer work using ST software which we developed for this session. The testees would select and deploy characters, props, lights, and cameras, all of which has prepared to set parameters for the position, degree, focal length and etc. according to the timeline. The evaluation was conducted to check whether the testees' answer work is matched to the correct answer work. We analyzed results of both ST and PPT. We especially focused on the score difference and progress difference due to the level of proficiency of our testees operating ST software, and the correlation between their learning experiences and score, and on correlation between ST and PPT scores. From the results, we confirmed that the correlation between the scores of both ST and PPT was observed among all the testees, and that the scores of ST show the possibility of evaluating accumulation of skills of the testees to be able to brush up creativity for moving image content production with 3D computer graphics.

Categories and Subjects Descriptors (according to ACM CCS): K.7.3 [Testing, Certification, and Licensing], K3.2 [Computer and Information Science Education]: Accreditation, I.3.m [Miscellaneous]

1. Introduction

Is it possible to establish a method of evaluating one's ability to create a better story-telling moving picture content? Can creative skill of story-telling moving picture content might be, in a way tested, evaluated and certificated? This has been one of the most important issues for us since the start of Computer Graphics Society in Japan. Computer Graphic Arts Society have conducted the Certification Test of Computer Graphics since 1991. The test was authorized by the Ministry of Education, Sports, Science and Technology in 1993 and we expanded the scale of the test to three divisions known as CG Division (CG Certification Test), Image Processing Division (IP Certification Test) and Multimedia Division (MM Certification Test) [Miy98]. So far, nearly 240,000 people have been certified out of a cumulative total of about 550,000 examinees. The examinees are mostly students of professional schools and universities, and creators and software engineers. Some universities and professional schools admit the results of the tests as their curriculum units,

The original purpose of the Test was to evaluate the examinees' knowledge of computer graphics. At that time computer graphics was rapidly changing its shape. Latest knowledge and information were not easy to pick-up for education and training organizations, even defining the meaning of technical terms were confused. The tests along with their textbooks and reference materials have helped on how to provide desired levels of knowledge to the novices, on how to decide curricula for universities and professional schools, on how to maintain the standard of computer graphics education. While the original purpose of the Test remains as important as before, there has been growing demand for a new test to serve as creative job skill evaluation from students and teaching staff people [Miy05].

We totally revised our tests in November 2005 and started the CG Creator Certification Test as one of the various new tests. It is for evaluating knowledge for modelers, animators and CG creators working on moving picture content production with 3D computer graphics [Cpe06]. The CG Creator Certification Test, grades 2 and 3, are to measure knowledge by means of paper-and-pencil-test (PPT) method. We, however, faced a difficulty. Only this method would not be enough to fulfill our goal of evaluating skills of creating a better quality moving picture content. We have to develop a new method.

Now that power of personal computers has reached to a level of real-time simulation of complicated moving pictures, we started to explore testing methods for creativity by using simulation methodology. Tokyo University of Technology has been developing a software called a Diorama Engine which will allow a user to deploy registered objects and lights in 3D space and move their position as the user directs according a scenario (screenplay) and its time line. We exploited Diorama Engine to create a simulation test software [KNO*06].

Story-telling moving picture content production is processed based upon the production documents such as scenario, design sheets and storyboards. The modelers, animators and CG creators will do their job of creating models, animation and constructing scenes with their creativity using 3D computer graphics software. Their creativity is regulated, stimulated, inspired and generated by the production documents. We try to create a test which will simulate the actual production process as mentioned above. The method of this test is defined as a simulation test (ST).

In this ST, examinees are evaluated on how to read a storyboard and how to deploy characters and props in a scene. Also, the examinees are evaluated on how to locate cameras and lights, how to compose a camera view, and how to move a camera. In this paper, we explain the experiments we have conducted and report the results of the analysis from ST. Through our discussion, we will especially focus on the score difference due to the level of proficiency of our testees operating ST software, the correlation between their learning experiences and score, and on the correlation between ST and PPT scores.

2. The Certification Test of Computer Graphics by the Computer Graphic Arts Society

The Certification Test of Computer Graphics classifying the constitution into the CG Engineer Certification and CG Creator Certification. Table 1 shows how the certification test is divided.

The CG Engineer Certification Test aims at evaluating the knowledge and skills necessary for engineer to develop technological products like software. Both grade 1 and grade 2 are separated into two divisions: Computer Graphics and Image Processing. Grade 3 is formulated in such a way as to enable evaluation of the basic knowledge common for both divisions. There are written tests and skill tests in grade 1. Multiple-choice PPT is employed for both grade 2 and grade 3. Table 2 shows the range of questions for the CG Division, grade 2.

Table 1: *Certification Test Setup for Computer Graphics.*

CG Creator Certification		CG Engineer Certification	
DMP Div. Grade 1	WD Div. Grade 1	CG Div. Grade 1	IP Div. Grade 1
DMP Div. Grade 2	WD Div. Grade 2	CG Div. Grade 2	IP Div. Grade 2
Grade 3		Grade 3	

DMP: Digital Moving Picture , WD: Web Design, CG: Computer Graphic ,IP: Image Processing.

Table 2: *Range of questions for CG Engineer Certification Test, CG Division, Grade 2.*

Digital camera model	Digital camera models/CG and image processing
Coordinate transformation	2D coordinate transformation/ 3D transformation/projection/viewing pipelines
Modeling	Shape modeling/solid models/ local deformations of boundary representations/ curves and curved surfaces/polygonal curved surface representations/other
Rendering	Realistic representation/hidden surface removal/ shading/shadowing/ global illumination modeling/ mapping
Animation	Camera-controlled/key-frame animation /character animation/real-time animation/incorporation of live-action footage/other
Image Processing	Digital image/2D image generation and drawing/pixel-by-pixel grayscale and color conversion/geometric image transformation/other
Visually appealing graphics	Image-based rendering/non-photo realistic rendering/visualization
CG systems	CG software/real-time 3D CG systems/3D data input devices/3D displays/other
Related knowledge	Perceptions/intellectual property rights/history of computer graphics

CG: computer graphics

The CG Creator Certification Test aims at evaluating the knowledge and skills required on content creators. Both grade 1 and grade 2 are separated into two divisions: Digital Moving Picture and Web Design. Grade 3 is formulated in such a way as to enable evaluation of the basic knowledge common for both divisions. There are written tests and skill tests in grade 1. Multiple-choice PPT is employed for both grade 2 and grade 3. Table 3 shows the range of questions for Digital Moving Picture, grade 2. Figure 1 is part of the question relevant to camerawork delivered in the Digital Moving Picture Division, grade 2 test conducted in November 2005.

Table 3: *Range of questions for CG Creator Certification Test.*

Photograph	Photographic representation/lighting
Video shooting	Categories of video products and approaches/ camerawork
Editing	Basics of video editing/practical aspects of video editing/video and audio/video editing systems
Modeling for CG content	Basics and practical aspects of modeling
Material for CG content	Material representation
Animation for CG content	Animation techniques /character animation/facial animation
Scene construction for CG content	Scene layouts/lighting/rendering/composite
CG content production work	Production staff/production workflow
Mathematical modeling	Mathematical modeling/ modeling techniques/ motions and changes
Technology for production	Equipment and software for CG Production/ knowledge of different formats
Intellectual properties	Basics of intellectual property rights/copyright/ industrial property rights and the unfair competition prevention law

CG: computer graphics

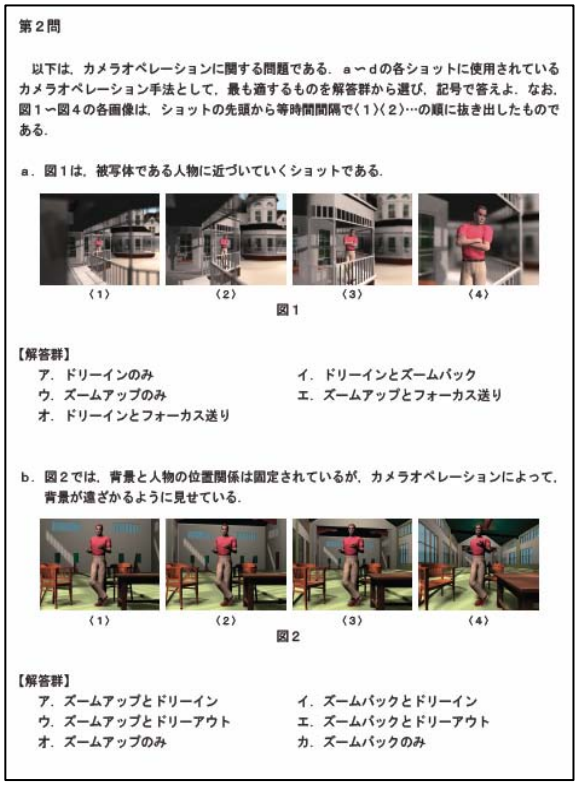


Figure 1: *An example of a question for the Digital Moving Picture Division, Grade 2. The question asks examinees to select an appropriate term of the camera work used for the shots was shown by the images.*

3. Experiment of Simulation Test

The goal of ST is to evaluate the examinees' knowledge and skills using simulation methodology.

3.1. Outline of Experiment

An assignment is shown to testees by a storyboard. The testees read the storyboard, then, create answer work using ST software. The testees would select and deploy characters, props, lights, and cameras, all of which has prepared to set parameters for the position, degree, focal length and etc. according to the timeline. Since both real-time rendering and a preview are enabled by ST software, the testees can proceed with the answer work while confirming the key-frame animation. The answer work which each testees submit is a scene data which enable to reconstruct a final 3D Computer graphics content. The evaluation was conducted to check whether the testees' answer works are matched to the correct answer work with the position of the characters, props, lights and cameras, where to start the scene, where to end the scene, number of frames.

There were 75 testees from freshmen to graduate students mainly focused on the students in School of Media Science, Tokyo University of Technology. Approximately 65% had operating existing 3D computer graphics software. All of them were interested in moving picture content production with 3D computer graphics.

Before conducting ST, we provided some time for testees to understand how to operate ST software and for some practice. By dividing testees into three groups of A, B and C, we decided to measure the degree of difference in the technical explanation of the procedure, and thus their comprehension of using ST software, and in the time spent for practice, which influenced their score. In addition, in order to investigate the correlation between ST and PPT, we made a request of the testees to spend fifteen minutes solving PPT questions related to camera work and lighting. The Certification Test of Computer Graphics, grade 2, question 31, conducted in the first term of fiscal 2003 and grade 3, questions 4 and 24, in the first term of fiscal 2002 were used as a base to prepare this question [Cpe04] [Cpe03]. Table 4 shows the process of the experiment in groups A–C.

Fifteen minutes were given for ST assignment production (hereinafter referred to as the 15-minute ST). Instruction was given afterwards for additional production within the time limit (hereinafter referred to as additional production ST), and the respective work results were scored. Operational instruction was given and practice was allowed for Twenty-five minutes before initiating the work for the assignment by group A. Twenty-five

minutes of free operational practice was given for group B in addition to the same procedures as were given to group A. Twenty-five minutes for practice to answering a example assignment was given for group C in addition to the same procedures as were given to group B. As a result, the additional production time turned out to be thirty, fifteen, and five minutes, respectively, for groups A, B, and C.

Table 4: *The process of the experiment in groups A–C.*

Time required	Work description	Group		
		A	B	C
25 min	Test outline explanation and questionnaire	Execute		
15 min	PPT	Execute		
25 min	ST software operation explanation and practice	Execute		
25 min	ST software operation free practice	Non Execute	Execute	
25 min	Example practice	Non Execute		Execute
15 min	Assigned production	Execute		
A: 30 min B: 15 min C: 5 min	Additional production	Execute		

PCs and display monitors were used for ST software environment operated by keyboard and mouse. The 3D Computer Graphics software used in ST software is designed in order to meet the requirements of the proposed scene works. Namely, the software is capable of operating characters, props, lights, and camera positions in a very limited manner. The software is capable of displaying real-time animation with specified parameters of position, degree, focal length and etc. according to the timeline.

The graphical user interface and function are customized for this software reflecting the small-scale-test results [MN05] from ST conducted in March 2005 based on the Diorama Engine [KNO*06]. Figure 2 shows the screen image by ST software. On the lower right is a window for selecting characters, props, lights, and cameras for use in the test. The 3D space operation window is on the upper left where selected characters and camera positions and direction are set. The timeline window is on the lower left where the number of seconds from the start time is specified by the respective characters and cameras. On the upper right is the window for animation preview and confirmation.

3.2. Method of Assignment Design and Evaluating the Answer works

The assignment was presented by the storyboard. A general storyboard is drawn by hand with a black pencil. However, a pencil picture tends to express itself only ambiguously for a test assignment causing some difficulty in evaluating determination [MN05]. Therefore, we decided to use ST software to make images for the correct answer work in advance, utilizing this as a storyboard images. By this method, it became far easier to direct the character and set positions, color changes from the lighting, and framing. Moreover, a decision was made to insert the plot and depiction into the assignment storyboard to the extent necessary. Table 5 shows the storyboard, items to be evaluation, and point allocation. This storyboard is for an assignment creating 25 seconds of a one-scene content consisting of five cuts. The following explains the contents of the assignment by cut.

Cut 1: The characters and props appearing in the scene are read from the images and descriptions inserted in the storyboard. Then, by using ST software, the female character is selected, properly deploying her position in the 3D space according to the direction. Likewise, one of the ceiling spotlights is set to illuminate her face. Additionally, lighting is effectively adjusted for the wall and the ceiling by selecting and properly positioning two-point lights. The camera is selected, and properly deploying and set up five seconds for the zoom in from the establishing shot to the directed framing.

Cut 2: The shot is created in which the male B standing on the left in a room approaches a spot where the male A and the female character are conversing. Six seconds are set for the camerawork following the scene from behind the male B. It is also directed at this very moment to set one of the ceiling spotlights to illuminate the B's face at the very final step of his movement.

Cut 3: Two seconds are set for the camerawork to shoot the female in close-up from the point of view of the male B.

Cut 4: Two seconds are set for the camerawork to shoot the male B in medium close-up from the point of view of the female.

Cut 5: Ten seconds are set for the camerawork of tilting the camera down onto the object while performing upward crane shooting of the dialogue scene among the males A, B, and the female character.

These assignments are designed for the testees to experience and perform the work simulation of scene construction, which is a part of the processes of moving picture content production with 3D computer graphics. That is, they are intended to evaluate testees' knowledge and skills in reading a storyboard, selecting and deploying characters, props and lights, and composing a camera view. The initial setup data was provided to the testees. It consists of a room to be staged with basic props like partitions, lighting, a sofa, etc. and the characters, namely, male A and B as shown in Figure 3. The data gives the relative positions among

props and characters used as a basic standard to creating the assignment. Figure 4 shows an example shot for Cut 1 with the props and characters according to the assignment.

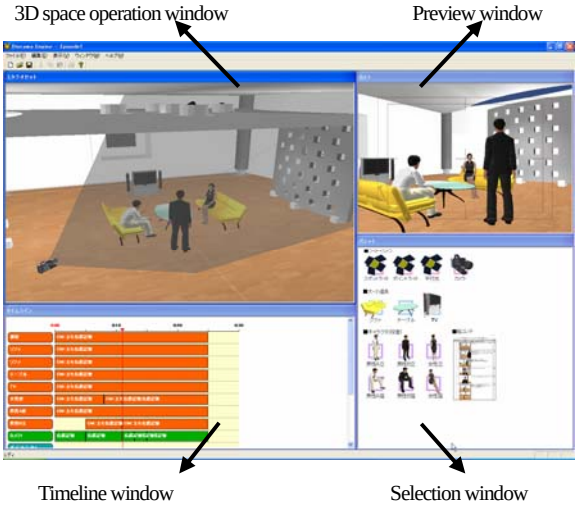


Figure 2: *The screen image by ST software is an example of creating assignment (Cut 2) of ST.*

Figure 3: *The initial setup given to the testees.*

Figure 4: *An example shot from Cut 1.*

We set up items of evaluation point for the standard as shown in Table 5 focusing on the basic characters and props composing a scene, selection, position, and direction of the lighting and on the number of seconds for animation production. Furthermore, the selection of cameras, framing, camerawork, and the number of seconds were used as items to be evaluation by the respective cuts. A point-addition scoring system that adds one point to the respective items to be scored was employed for allocation of marks totaling 41. Visual collating between the answer work by the testees and one of the correct answer work made in advance was adopted for the scoring.

4. Analysis of Scoring Results of Simulation Test

We analyzed results of 15-minute ST, additional production ST, and PPT by 54 testees out of 75, because some of them failed store their results properly. Table 6 shows the scoring results of ST and PPT by the respective testees groups of A, B and C.

4.1. Differences Due to ST Software Skill Level

4.1.1. ST Score Difference

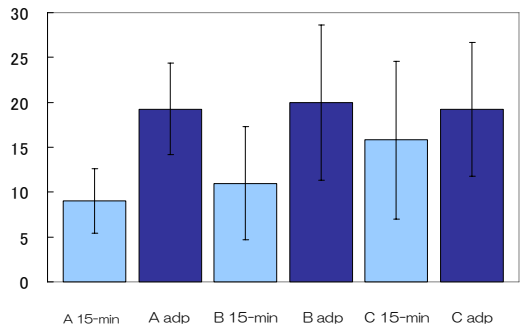
The mean scores in 15 minutes improved in the order of group A < B < C as shown in Figure 5. The time for the explanation and practice by group A is 25 minutes, group B is 50 minutes, and group C is 75 minutes. Testees with more practice time scored higher. The results of the Welch's *t*-test on the mean scores are p=0.165 between group A and B, p=0.0239 between group B and C, and $p=1.81\times10^{-3}$ between A and C. The results of group C are significantly better than the other two groups A and B.

The mean scores for 15-minute ST and additional production ST increased for each group. The results of the paired *t*-test on the mean scores are $p=2.90\times10^{-5}$ within group A, $p=2.52\times10^{-7}$ within group B, and $p=1.68\times10^{-3}$ within group C. This shows that a higher score can be obtained by working on the assignment if more time can be spent. In other words, 15 minutes was insufficient to complete this assignment. It might have been necessary to secure a little more production time.

The standard deviations of the score for 15-minute ST and additional production ST increased, namely, from 3.61 to 8.63 in group A, from 5.09 to 8.75 in group B, and from 6.30 to 7.43 in group C. The difference in the testees' scores increased when the production time increased. All testees might have been able to raise the accuracy of the work if enough time were given. The time of 30 to 45 minutes may be required for answering this assignment. All testees failed to show their full potentials.

Table 6: *Scoring results classified by the testee group.*

	15-min Score			Additional Production Score			PPT Score		
Group	A	B	C	A	B	C	A	B	C
Testee Number	18	22	14	18	22	14	18	22	14
Raw Score Total	41	41	41	41	41	41	16	16	16
Lowest Mark	3	0	6	7	3	6	0	4	5
Highest Mark	17	20	27	34	36	30	16	14	16
Average	9.00	10.95	15.79	19.28	19.95	19.21	11.06	9.50	11.00
Standard Deviation	3.61	5.08	6.30	8.63	8.75	7.43	3.40	2.52	2.96



15-min: 15 minutes ST, adp: additional production ST

Figure 5: *Average score shift in 15-min. ST and additional production ST*

Table 7: *Testees' progress estimated from the camera selection.*

Groups	ST	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5
A	15 min	89%	22%	0%	0%	0%
	Additional production	94%	83%	61%	56%	44%
B	15 min	91%	27%	9%	0%	0%
	Additional production	95%	77%	55%	36%	32%
C	15 min	93%	64%	43%	14%	0%
	Additional production	93%	86%	64%	36%	36%
All	15 min	91%	35%	15%	4%	0%
	Additional production	94%	81%	59%	43%	37%

Table 8: *Testees' progress estimated from the maximum score average difference.*

Groups	Cut undertaken in 15-min ST	Cut undertaken in additional production ST
A	1.056	3.222
B	1.455	3.045
C	2.286	3.071
All	1.537	3.111

4.1.2. Progress Difference

We investigated the pace of testees' operation for each group. To determine whether a testee worked on a certain cut of the assignment, we checked the camera selection. The testee was judged to have reached a cut if a camera for the cut was selected. Table 7 shows the results. The cuts undertaken by more than half testees in the 15-min ST were Cut 1 taken by 89% and 91% of Group A and B, respectively, and Cut 2 taken by 64% of Group C. In the additional production ST, 56% of Group A testees reached Cut 4, while 55% of Group B and 64% of Group C reached Cut 3.

For determining whether a specific cut had been set out, we focused on the maximum score average difference bounded by a cut, i.e., the maximum gap between the score averages before and after the cut. Table 8 shows the results of the completed cut, determined by maximum score average difference. The numbers of cuts completed in the 15-min ST were 1.056, 1.455 and 2.286, for Groups A, B, and C, respectively. Groups A, B, and C, for the additional production ST, completed 3.222, 3.045, and 3.071 cuts, respectively.

We can speculate that the testees with longer practice time must have worked on more items of the assignment as a reason for the results from the 15-min ST. A similar comment can be applied to the results from the additional production ST, showing again the longer time spent, the more items of the assignment undertaken. The mean value for all Groups A, B, and C shows that 59% of the testees got down to Cut 3 and below the majority for Cuts 4 and 5. This means only a few testees capable of deftly dealing with the items of assignment could work on Cuts 4 and 5. It is, again, concluded that the time given to the testees were not sufficient for working on all the assignments.

4.2. Differences Due to Learning Experience

We analyzed the results data from 54 testees in terms of their respective learning experience. Table 9 shows the scores from ST and PPT by the respective academic years of freshmen and

sophomores, and juniors and seniors.

4.2.1. Score Difference

The score average from the additional production ST was 17.8 for freshmen and sophomores while that for juniors and seniors was 23.6. It demonstrates higher scores by the testees with more academic years. The respective score averages from PPT were 9.79 for freshmen and sophomores and 11.9 for juniors and seniors. It also shows higher scores by testees with more academic years. The results from the Welch's *t*-test on the score averages were p=0.0135 for the additional ST and p=0.00689 for PPT, respectively, revealing a significant gap between both the group of freshmen and sophomores and that of juniors and seniors.

4.2.2. Progress Difference

Determination of whether a certain assignment was undertaken was evaluated by if the camera was selected for the respective cuts in a similar fashion as in Section 4.1.2. Table 10 shows the scoring results. The cut undertaken by more than half testees in the 15-min ST was Cut 1 taken by 89% of the freshmen and sophomores and by 94% of the juniors and seniors. In the additional production ST, 53% of the freshmen and sophomores and 75% of the juniors and seniors reached to Cut 3.

Likewise as in Section 4.1.2, Table 11 shows the completed cuts estimated by maximum score average difference. The numbers of completed cuts in 15-min ST were 1.5 and 1.625 undertaken by freshmen and sophomores and by juniors and seniors, respectively. Those in additional production ST were 2.921 for freshmen and sophomores, and 3.563 juniors and seniors. There were no significant differences between the group of freshmen and sophomores and that of juniors and seniors.

4.3. Characteristics of ST

4.3.1. Characteristics of the Assignments

We classified ST assignments into three categories: positioning of characters and props, lighting, and camerawork to examine the correlation with the total score. Table 12 shows the correlation factors among the total scores and the respective categories, resulting in 0.737 for positioning, 0.237 for lighting, and 0.969 for camerawork. The table demonstrates that positioning and camerawork are highly correlated to the total scores while lighting shows a low correlation.

We checked the difference of the score average of the freshmen and sophomores against the juniors and seniors. The results of Welch's *t*-test are p=0.020 for positioning, p=0.303 for lighting, p=0.031 for Cut 1, p=0.0009 for Cut 2, p=0.031 for Cut 3, p=0.718 for Cut 4 and p=0.400 for Cut 5. There are significant differences among the positioning and Cuts 1, 2, and 3. However, lighting and Cuts 4 and 5 do not show the significant differences. The reason for this can be speculated by the existence of testees with low scores despite the high lighting scores. There were some testees who did excellent in lighting but couldn't go further ahead and most likely, we can surmise they needed a little longer time for working on the entire assignments this time. The reason Cuts 4 and 5 do not affect the scores is due to the fact that the majority of testees had not reached these assignments due to the shortage of production time.

Table 9: *Score results in terms of testees' learning experience.*

	Additional production ST		PPT	
	Freshmen – Sophomores	Juniors – Seniors	Freshmen – Sophomores	Juniors – Seniors
Testee Number	36	17	17	36
Perfect Score	41	41	16	16
Lowest Mark	3	11	0	8
Highest Mark	34	36	16	16
Average	17.816	23.625	9.789	11.875
Standard Deviation	8.140	7.145	3.112	2.125

Table 10: *Testees' progress estimated from the camera selection.*

Groups	ST	Cut 1	Cut 2	Cut 3	Cut 4	Cut 5
Freshmen – Sophomores	15 min	89%	34%	18%	3%	0%
	Additional production	92%	76%	53%	42%	34%
Juniors – Seniors	15 min	94%	38%	6%	6%	0%
	Additional production	100%	94%	75%	44%	44%
All	15 min	91%	35%	15%	4%	0%
	Additional production	94%	81%	59%	43%	37%

Table 11: *Testees' progress estimated from the maximum score average difference.*

Groups	Cut # undertaken in 15-min ST	Cut # undertaken in additional production ST
Freshmen – Sophomores	1.500	2.921
Juniors – Seniors	1.625	3.563
All	1.537	3.111

Table 12: *Score Correlation Factor.*

	All assignments	Positioning	Lighting	Camerawork
All assignments	1.000			
Positioning	0.737	1.000		
Lighting	0.237	0.046	1.000	
Camerawork	0.969	0.618	0.062	1.000

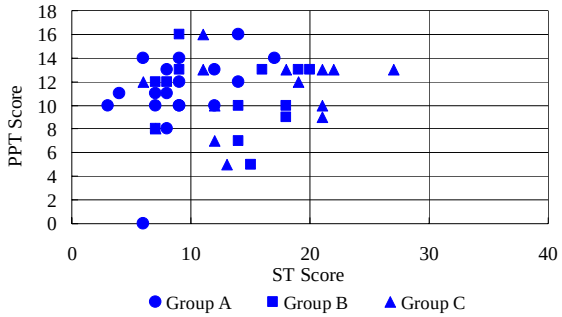


Figure 6: *Correlation between 15-minute ST scores and PPT scores.*

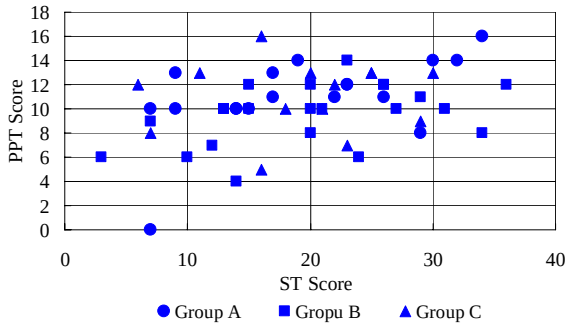


Figure 7: *Correlation between additional production ST scores and PPT scores.*

4.3.2. Correlation between ST and PPT Scores

PPT contains the problems of the camerawork and lighting with 16 questions in total. Figure 6 shows the correlation of the scores between the 15-minute ST and PPT. The correlation coefficient of the scores for the 15-minute ST and PPT was 0.221 , which means a weak correlation. Figure 7 shows the correlation of the scores between the additional production ST and PPT. The correlation coefficient of the scores for the additional production ST and PPT was 0.369 indicating a relatively positive correlation.

By limiting to the juniors and seniors, the correlation coefficient between the additional production ST and PPT results in -0.05, which means no correlation. We can think that the scores by juniors and seniors were saturated at a high level. As Table 9 shows, PPT score averages are 9.79 for freshmen and sophomores and 11.88 for juniors and seniors with the latter making higher marks. The standard deviations are 3.11 for freshmen and sophomores and 2.13 for juniors and seniors. The PPT can separate the group of juniors and seniors from that of freshman and sophomores. However, it is not capable of separating the levels of knowledge and/or skills among the juniors and seniors. On the contrary, the standard deviations of the additional production ST are 8.14 for freshmen and sophomores and 7.15 for juniors and seniors. Judging from these results, we can speculate that ST has turned out to be a test to measure some different knowledge and/or skill from PPT.

5. Conclusion

This paper has presented an overview of the Certification Test conducted by the Computer Graphic Arts Society, making a proposition concerning ST as a new evaluation method for the level of knowledge and skills for moving picture content production with 3D Computer Graphics. We have had a discussion about testing, designing ST assignments, evaluation standards, and analysis results.

From the experiment results, we confirmed first of all that the different levels of testees' skills operating ST software had an achievement gap, resulting in different ST scores. Moreover, we must say that the fifteen minutes allocated for assignments this time was too short for production, scuttling all the testees' answer works halfway due to the shortage of time. However, we found out that the number of assignment items they can get down to tends to widen the score gap.

Secondly, from the analysis results of the correlation between learning experience and scores, we understood that the testees with more academic years could attain higher scores. That is, we confirmed that we could measure the difference between the group of freshmen and sophomores and the one of juniors and seniors. The score averages from the first and the second groups verified the significant gap.

As for the characteristics of ST, the correlation between the total score averages from all the assignments and those by the type showed a higher value for positioning and camerawork and lower for lighting. Assignment of the score averages obtained by the group of freshmen and sophomores and those by the one of juniors and seniors by the respective assignments showed a significant gap in Cuts 1, 2, and 3 for positioning and camerawork and no difference in Cuts 4 and 5 for lighting. Although the correlation between ST and PPT scores was observed among all the testees, PPT scores by juniors and sophomores are saturated at

a high level. ST may have some different capabilities of separating the testees' knowledge and/or skills.

Even after conducting the experiment, we are not sure enough whether ST would meet to our long waited desire to develop a new style of test for creativity or not. The difficulty lies in the fact that the right answer works of each assignments of this kind may have more than one. This is not like 1 plus 1 is 2. But there are reactions from the students that ST made them realize the importance of, for instance, deployment of characters, camera position, lighting, timing , and so on. Are these part of creating capability? We have no definite answer to that. But, we certainly think that without having these understandings, creativity for story-telling content would not be enhanced. In this sense, giving an opportunity to experience this kind of test to the novices would be good, especially to those who have no-chance of being taught by experienced professional teachers or to those who cannot receive OJT from the production houses. In a way, the simulation method will create a new training curriculum. We will keep on exploring to develop better tests on various circumstances, and to develop better ways of evaluating young people's skill for creating various content for encouraging students to get into ever increasing demand for better quality content.

We are planning to redesign the testing time and the contents of assignment based on the experiment analysis results. For instance, we are thinking of setting sufficient assignment production time and examining whether to facilitate measurement of the comprehension degree instead of examinees' deftness. We are thinking of examination of the scope for not only formulating multiple assignments with plot as content but also designing independent ones along with the positioning, lighting, and camerawork for the purpose of evaluating elementary knowledge and production skills.

References

[Cpe03] Committee of Problem Collection Editing: CG Certification Test problem collection, Grade 3. Computer Graphic Arts Society(2004).

[Cpe04] Committee of Problem Collection Editing: CG Certification Test problem collection, Grade 2. Computer Graphic Arts Society (2004).

[Cpe06] Committee of Problem Collection Editing: the CG Creator Certification Test problem collection. Computer Graphic Arts Society (2006).

[KNO*06]M. Kaneko, T. Nakamura, N. Okamoto, K. Mikami, A Study For Digital Production Assistance By Using A "Diorama Engine" And A "Mise-en-Scene Engine", Proc. International Workshop on Advanced Image Technology 2006 (2006), CD-ROM.

[MN05] MIYAI A., NAKAMURA T.: Evaluation Methodology of Computer Graphics Education for Visual Media Contents Production. CJJCGE 2005 (2005), pp. 169-175.

[Miy05] MIYAI A.: The Certification Test of Computer Graphics in Transition; From a Vehicle of Education to a Jab Skills Evaluation Scale. CJJCGE 2005 (2005), pp.288 -293.

[Miy98] MIYAI A. : The Certification Test of Computer Graphics and it Roles. The Journal of the Institute of Image Information and Television Engineers (1998), Vol.53, No.3, pp. 329-331.

Table 5: *Assignment and evaluation standard.*

<table>
<tr><th colspan="6">Assignment</th><th colspan="2">Evaluation Item</th><th>Point Allocation</th></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="5">Refer to the storyboard to select and deploy what is lacking in the characters and props composing the scene. Create answer work expected in the respective cuts by means of rotation and movement the animation of the lighting, camerawork, and characters.
Incidentally, the following items from (1) to (5) are the points that must be reading from storyboards.

(1) Ensure deploying of the lighting, props, and characters that are lacking in appropriate positions in 3D space.
(2) Five lights are set on the ceiling. Two of them are not adjusted for the direction. Perform lighting for the two characters, respectively, using these two lights. Meanwhile, when a character or characters move, lighting can be set at the final position of the moving.
(3) Perform the lighting for the wall and the ceiling.
(4) Create rotational and shifting animation of the characters expected from the respective cuts.
(5) Do the camerawork for the specified number of seconds for the framings expected by the respective cuts.</td><td>Sofa

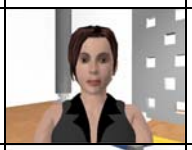
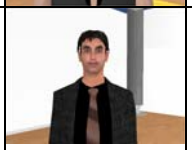
Table

Female character

Male character

Point light

Point light

Spot light
Spot light</td><td>Selection
Position
Selection
Position
Selection
Sitting position
Turnabout position
Within 3 sec
Moving position
Within 6 sec
Selection
Position (Right)
Selection
Position (Left)
Female face
Male B face</td><td>1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1</td></tr>
<tr><td>Storyboard</td><td colspan="7"><table>
<tr><th>Scene</th><th>Cut</th><th>Screen</th><th>Description</th><th>Time</th><th colspan="2"></th></tr>
<tr><td>1</td><td>1</td><td>  </td><td>●The male A and the female characters are conversing in a room.
●The lighting set in the center of the wall of the backside of the partitions on both the right and left in the room fully illuminates the backside of partitions concomitantly forming a semicircle of light on the ceiling.
●The characters' faces are illuminated by the lighting set on the ceiling.
●The camera zooms in on the subject from the position of an establishing shot.</td><td>5sec</td><td>Screen composition</td><td>Camera selection
Camera position
Zoom in
Fixed position
5 sec</td><td>1
1
1
1
1</td></tr>
<tr><td></td><td>2</td><td> 
  </td><td>●The male B approaches the conversing the male A and the female from the left of the room.
●The camera narrows the distance to the male A and the female while following the male B from behind.
●Approaching the male B gives an eye to the female. The B's face is being illuminated by the ceiling light.
●The female notices approaching the male B and turns around.</td><td>6sec</td><td>Screen composition</td><td>Camera selection
Camera position
Fixed field angle
Follow shot
6 sec</td><td>1
1
1
1
1</td></tr>
<tr><td></td><td>3</td><td>  </td><td>●The camera is the male B's point-of-view and female's close-up shot.</td><td>2sec</td><td>Screen composition</td><td>Camera selection
Camera position
Fixed field angle
Close-up shot
2 sec</td><td>1
1
1
1
1</td></tr>
<tr><td></td><td>4</td><td>  </td><td>●The camera is the female's point-of-view and the male B's medium-close-up shot.</td><td>2sec</td><td>Screen composition</td><td>Camera selection
Camera position
Fixed field angle
Medium-close-up shot
2 sec</td><td>1
1
1
1
1</td></tr>
<tr><td></td><td>5</td><td> 
  </td><td>●The last scene of the dialogue among the males A, B, and the female.
●The camera is tilting the camera down onto the subject while performing upward crane shot of the dialogue scene among the males A, B, and the female character.</td><td>10 sec</td><td>Screen composition</td><td>Camera selection
Camera position
Fixed field angle
Crane up and tilting down shot
10 sec</td><td>1
1
1
1
1</td></tr>
</table></td></tr>
</table>