



Online Group Embedded Figures Test and Student's Success in Online Course

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Abstract

A growing number of students are enrolling in distance learning online college degree programs these days and MOOC (Massive Open Online Course), an online course aimed at unlimited participation, enables free university-level education on an enormous scale. Despite many exciting developments and applications of online courses, however, online education is not for all students: MOOCs classes have average completion rates of less than 13% and recent study of Washington State community college students showed that the students who took online courses were more likely to fail or drop out of the course than students who took the same course in person. It is partly because an online learning style is considerably different from a traditional class-based learning style and many students fail to adapt the online learning style as each individual perceives, interact with and respond to the learning environment differently. Given the growing popularity and benefits of online learning, improving the success rates of online learners will be extremely beneficial to each individual student and educational institution. In this paper, we examine the possible correlation between individual's cognitive perceptual ability and the success rate in online course by using Group Embedded Figures Test (GEFT) as a research tool. GEFT is a perceptual test originally developed to test a subject's cognitive ability to locate a simple shape embedded within a complex figure. GEFT is also used as an assessment tool for other purpose exploring analytical ability, social behavior, and problem solving style. To conduct the research, we first redesigned Online Group Embedded Figures Test (OGEFT), a web based testing tool to administer the Group Embedded Figures Test (GEFT) over long distances. OGEFT, initially developed in 2006 using Java Applet, was newly designed using the latest web technology (HTML5, CSS, jQuery) in 2014 to resolve the browser compatibility issue and adding an auto-grading feature to conduct the research for widespread geographic population at the minimum efforts. Seventy-five students at the Fairfield University participated the experiment and our preliminary experimental results showed a meaningful relationship between the score of GEFT and the success rate of the online course of individual student. We plan to have extensive research to larger populations to verify the results to support the idea of using GEFT score to advise students properly before they are taking online course. Statistical analysis and future plan are also discussed.

1. Introduction

Online education has become a preferred option to many people, especially for working adults to obtain a degree from their home at their convenient learning schedule. However, not all online students are successful in their online education program. MOOCs classes have average completion rates of less than 13% and recent study shows that more students on online courses fail or drop out of the course than students in traditional classroom. It is because the online learning style is considerably different from a traditional class-based learning style and many students fail to adapt the online learning style as each individual perceives, interact with and respond to the learning environment differently. This paper examines the correlation of the individual's learning style based on cognitive perceptual style with his/her success rate in online courses. One of the widely used instruments to identify the cognitive style of an individual based on this model is Group Embedded Figures Test (GEFT). For the experiment, an online web tool of this instrument was developed and a comparative study was conducted to examine the correlation between the OGEFT score and the success rate of an individual in online courses.

1.1 Field independent/dependent cognitive styles and Learning styles

The field dependence-independence cognitive style is arguably the most widely researched cognitive style in our history. Field Independence (FI) / Field Dependence (FD) refers to how people perceive and memorize information [1]. Field Independence hinges on the perceptual skill of "seeing the forest for the trees." A person who can easily recognize the hidden castle or human face in 3-D posters and a child who can spot the monkeys camouflaged within the trees and leaves of an exotic forest in

colouring books tend toward a field independent style. The "field" may be perceptual or it may be abstract, such as a set of ideas, thoughts, or feelings from which the task is to perceive specific subsets. Field independent learners are more able to break a problem into its components in order to choose the components that are more significant for making the right decision and concentrate on them [2]. To put it in other words, they have the gift to decompose a whole into constituent elements that leaves them with the opportunity to focus on, transform, and generally manipulate the constituents independently of one another. The downside to these qualities is that these people are likely to be aloof and not gregarious, which results in a less effective relationship with others. Field dependence is, conversely, the tendency to be "dependent" on the total field so that the parts embedded within the field are not easily perceived, though that total field is perceived most clearly as a unified whole [3]. FD individuals see the world as a whole and do not tend to attend any part of it selectively. They are deemed to be person-oriented, interested in people and sensitive to them. FD people tend to experience events globally in an undifferentiated fashion. These people tend to identify with a group, exhibiting a social orientation in which they are more perceptive and sensitive to social characteristics such as names and faces than are FI persons, but they are also more susceptible to external influence and more markedly affected by isolation from other people. The way each individual learns things in general and the approach she/he adopts when dealing with problems is said to depend on a somewhat mysterious link between personality and cognition; this link is referred to as cognitive style [4]. When cognitive styles are related to an educational context, they are generally referred to as "learning styles," cognitive, affective, and physiological traits. It is extremely beneficial to know the preferred, or most effective, learning style of each individual because it equips him/her with the knowledge of what works best for her/him as well as how to adjust her/his surroundings and implement strategies to be the most successful he possibly can be.

1.2 Learning styles and Group Embedded Figures Test

Group Embedded Figures Test (GEFT) is a pencil-and-paper assessment test with a thirty-two-page booklet developed by Witkin and his associates to investigate FI/D of the subjects [5]. The subjects are provided with simple visual figures embedded inside progressively more complicated visual figures and expected to locate the hidden simple form or figure in the more complex one in a given time (12 minutes). A sample test is displayed in Fig. 1. The GEFT booklet provides directions along with some examples to illustrate the test taking procedure for subjects in first several pages and contains questions in three sections: The first section is intended to make students familiar with the test, and the other two parts are the body of the GEFT. The first section has 7 easy questions with the time limit of 2 minutes for practice, and the items in this section are not included in the actual score. The real task begins at the second set and into the third one, where the test takers have to make their challenging inquiries in each 9-itemed set within the time limit of five minutes for each. As a result, the total number of questions counted is 18, each with an embedded simple figure. Based on the number of correct answers given by students, the scores on GEFT may range from 0 to 18. Those who tend to rely on external cues are less able to find the simple figures so are Field Dependent, and those who rely on internal cues are more able to find figures, hence, Field Independent. Those who score above 12 out of 18 are classified as Field Independent and those with a score of 11 and less than 11 are branded as Field Dependent cognitive stylists [6].

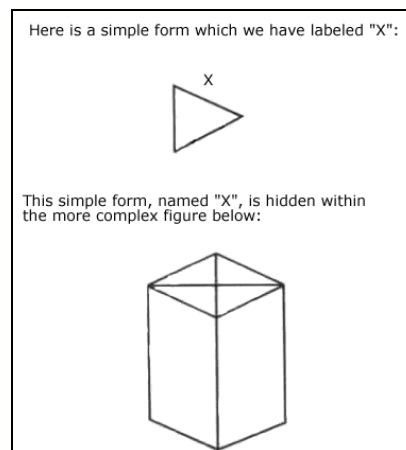


Fig. 1. Sample image from GEFT

The field independent (FI) learners excel at learning tasks such as analytic and mathematical problem solving while field dependent (FD) learners are more likely to excel at learning tasks such as group-oriented and collaborative work situations where individuals need to be sensitive to social cues from others and requires strong interpersonal communication skills [7].

1.3 Online Group Embedded Figure Test (OGEFT)

While the application of the GEFT may open up new frontiers in education, there are several obstacles to overcome. The key problem with paper-based test is all test-takers need to report to a central testing site. Online courses assume students physically located over the entire country or even the world and it is not practical for all participants to report to a central testing site to take GEFT. In addition, all grading and data entry by instructors and test proctors need to be done manually in GEFT.

To overcome these obstacles and improve the scope and usability of the paper-based GEFT, several attempts to create a digital version of GEFT were made. As early as 1984 it was suggested that a computerized version of the GEFT would make much more sense than a one-time used 32-page booklet. Burroway went so far as to test a computerized version of the GEFT (and several other tests using graphic figures) and found it equivalent to the paper and pencil version [8]. In 1987, Melancon and Thompson attempted to get around the difficulties of developing a graphic interface and the difficulties of machine scoring a graphic image by creating a multiple choice FD/I test. Neither of these tests remains available [9]. In 2005, Gannon University developed a more comprehensive online version of the Group Embedded Figures Test (OGEFT) using web technology without losing its original purpose but extending the abilities of the GEFT [10]. OGEFT is a database driven web-based testing, grading, and reporting tool that allows the administration and delivery of the GEFT to a widespread geographic population. Java applet was used for the front-end side development to collect data of students' identification of simple figure over complex figures in GEFT by tracking mouse-clicks. However, Java applet technology has become out-dated now with browser incompatibility and security issues. Moreover, the study on the correlation of the test score between online version and paper version has not been properly conducted yet to show the reliability of online version of GEFT. Auto-grading feature was also missing in OGEFT, which may prevent the tool effectively used in the field minimizing human involvement. To resolve the issues, OGEFT was redeveloped in 2014 using HTML5/jQuery technology with a new auto-grading feature.

2. Methodology and experiment

Three steps were taken for this study: Step 1: Redesign OGEFT, Step 2: Verification of reliability of OGEFT, and Step 3: Conducting the experiment to identify the relationship between OGEFT score and success rate of online course.

In step 1, OGEFT used to use the Java applet technology, which became a source of frustration for many test takers due to JRE issues such as Java start-up performance, Java virtual machine reliability and JRE deployment. In newly developed OGEFT, modern HTML5/jQuery technology replacing Java applet resolved browser incompatibility and security issues. A complex figure on the canvas in HTML5 was used for the subject to draw a simple figure on it interactively. The coordinates of the user drawings are then matched against the coordinates stored in the database for auto-grading.

After the complete renovation of OGEFT in 2014, an experiment was developed to compare the score of paper version GEFT and that of OGEFT. Seventy-five students at the Fairfield University and Columbia University volunteered for this experiment and two examination sessions were given to each person using paper version GEFT and OGEFT. To be fair, a half of the volunteers took paper version GEFT first while the other half took OGEFT. One week later, the person who had taken OGEFT for the first test took the paper version GEFT and other person who had taken the paper version GEFT took OGEFT. Table 1 shows the summary of the average score of OGEFT to the matching score of GEFT.

Table 1. Score comparison between GEFT and OGEFT

Paper based GEFT Score	Avg. OGEFT Score
6	6.8
7	7.5
8	7.6
9	8.8
10	8.9

11	10.2
12	11.5
13	13.1
14	13.5
15	14.2
16	16.1
17	16.9

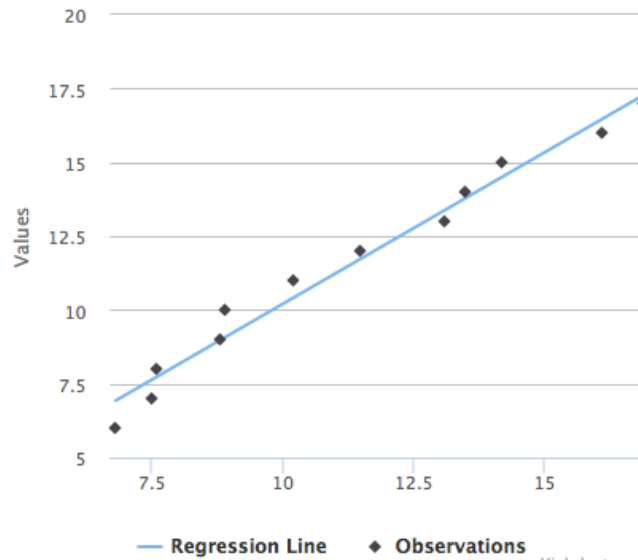


Fig. 2. Linear regression between GEFT and OGEFT score

Fig. 2 shows the simple Linear Regression results with the correlation coefficient (R) of 0.98 and $y = 1.02x - 0.06$ as a line of best fit. This is a highly positive correlation, which means OGEFT is very reliable.

A survey was conducted to 75 students on comfort level of online courses. The average score of students who are comfortable in online course was 12.62 whereas those who feel uncomfortable in online course had an average score of 7.3. Among 75 volunteers, only 32 students actually had previous experience of completing online courses. The average GPA and average grade point on online courses taken were compared with OGEFT as summarized in Table 2.

Table 2. OGEFT score and the performance difference between online courses and regular courses

OGEFT Score	Avg. GPA	Avg. Grade on Online Courses
0 - 11	3.2	2.8
12 - 18	3.5	3.4

Field Independent students (GEFT score between 12 – 18) received much higher grade than Field Dependent students (GEFT score between 0 – 11) on online courses showing a meaningful relationship between the score of GEFT and the success rate of the online course of individual student. More extensive research is needed to a larger population to verify the results to support the idea of using GEFT score to advise students properly before they are taking online course.

3. Conclusion

Although online courses have substantially become popular these days, not everybody is successful in online study. The success rate is closely related to the students' learning styles. Experiments with GEFT as well as usability test survey were carried out for 75 students to examine the correlation of the online test score of a student with her/his GEFT score. Preliminary experimental results show strong relationship between GEFT score and success rate of online course and it can be inferred that the test result of the GEFT could provide valuable information to students. Further a comparative study is



needed to confirm the correlation between GEFT test score of a student with his success rate in online courses.

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