Third Place Impact on Students' Creativity and a Comparison between Measurement Tools: An Experimental and Comparative Study

by

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Abstract

Learning spaces play an important role in the learning process, as the surrounding environment helps to shape human behavior. Specifically, researchers have suggested that, as a social species, humans interacting in open and social spaces improves their behavior and interaction. Moreover, creativity is one quality that might change depending on the learning environment. The social spaces that encourage students to collaborate and interact are called 'third places' (Waxman, 2006; Oldenburg, 1989).

This study hypothesizes that, in an educational setting, students who are exposed to knowledge and are involved in learning in a third place environment will demonstrate more improvement in their creativity levels than those in traditional and high-tech spaces. This is the first study to compare three types of learning spaces in terms of their effect on creativity by trying to measure the differences empirically. In addition, this research will compare the two most common assessment tools, which are Torrance Test for Creative Thinking (TTCT), and Remote Associates Test (RAT); to establish the main differences between them and which is more reliable in measuring creativity, especially in learning spaces.

The participants in this study (N=52) were recruited from two southeastern United States universities, and then divided into three groups: traditional classroom (n=19); high-tech classroom (n=14): and a third place (n=19). Students in all three groups took the pre- and post-tests of two creativity instruments, the Remote Associates Test (RAT), and the Torrance Test for

Creative Thinking - Verbal (TTCT-Verbal). Following the tests, the differences between the groups were analyzed and interpreted.

One-Way ANOVA, Pearson's Correlation, and Paired t-test were the main statistical analysis tools used to identify the differences between all three spaces and compare the two tests. The findings did not support the research hypothesis, as there was a non-significant improvement in creativity levels in the third place, as compared to the traditional or the high-tech classrooms. However, a larger sample size could provide more definitive results. Moreover, a longitudinal study could provide more information by starting with a pre-test at the beginning of the academic semester and continue using the space throughout the semester. Then, at the end of the semester, a post-test could be administered. In addition, fatigue may have had an effect on the results due to the intensity of the TTCT-Verbal test, which required a great deal of writing.

The comparison showed that there was non-significant correlation between the two measurement tools. Also, a paired t-test revealed that there was an improvement between the pre- and post- RAT tests, and a decrease in the levels of creativity in the pre- and post- TTCT-Verbal tests. The difference between the results of the RAT and the TTCT in terms of student scores is suggested to be due to the different nature of the measurement tools.

The results of this study provide major insights which raise the need of studying the many factors that might impact creativity, and researchers should look at the process of creativity improvement as a whole not as one separate factor. Also, it raises the question: when choosing a measurement tool, the researcher should be asking the following question, is this the right population that the tool was intended to measure?

Keywords: Third place; Learning process; Creativity; TTCT; RAT; Collaboration.

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RAT	Remote Associates Test
TTCT	Torrance Test for Creative Thinking
CAQ	Creative Achievement Questionnaire

CHAPTER 1: THE IMPACT OF INCORPORATING THIRD PLACE IN THE EDUCATIONAL PROCESS ON STUDENTS' CREATIVITY: AN EXPERIMENTAL STUDY

Introduction

As humans, most of us spend the majority of our lifetimes in interior spaces. One of the most important spaces that we inhabit, at least in our earlier years, is the educational space. Being in a classroom or a design studio may influence individual performance or ways of thinking in a number of ways.

Many studies have shown that space influences user behavior. Therefore, space can be understood to have an impact on creativity. Examples that relate to this premise include Google and Facebook, companies that provide their staff with very sophisticated, open, flexible, and relaxing spaces in which to work. According to Gargiulo (2011), the flexibility and availability of different types of spaces at the Google offices increase their employees' innovativeness and productivity.

As a profession, interior design is essentially about shaping the spaces in which people live, work, and learn. The design studio is a space in which architecture and interior design students spend the majority of their time during their learning journey, where they explore new skills and methods of design and working with or without their professors' supervision (Lueth, 2008). The skills that students acquire in the design studio space will shape their future career, which will depend heavily on those skills. According to Ledewitz (1985), one such skill is learning a new language, the language of architecture and design. It is in this same space that students learn how to visualize and present their design ideas and concepts, a necessary part of developing their architectural and design skills (Ledewitz, 1985). By developing those skills, the

student will come to understand the importance of functionality, aesthetics, the design process, analysis, and the evaluation of space and design, which in turn will shape their future design concepts.

Most existing research relating to the impact of the interior environment on human behavior has focused on workspace productivity. For instance, Cohen (1990) discussed designing for productivity in relation to the economic, industrial and sociotechnical contexts of the workspace. However, he did not provide a specific method to study those spaces.

A study by Hameed and Amjad (2009) derermined that the design of workspaces impacts on employee productivity. Specifically, their study found that lighting in the workspace was the factor that most affects employee productivity. Also, the importance of the surrounding environment and its impact on creativity was discribed as follows: "Had Beethoven been born on a deserted island, he might have done terrific bird imitations, but it is unlikely he ever would have composed the Ninth Symphony" (Lemons, 2011, p758).

Problem Statement

The existing research on the 'third place' primarily explores the relationship between third places and healing spaces, healthcare facilities, and assisted living facilities (Zavotka & Teaford, 1997; Campbell, 2015). Researchers have argued that the concept of the third place can enhance the quality of social engagement in healthcare facilities, as the healing process would be improved in such facilities that have third places in them (Campbell, 2014).

Building upon the demonstrated impact of the third place in the healthcare environment, the researcher is taking this concept of the impact of the third place into the educational environment, specifically to the study of third place's effect on creativity. The impact and significance of the design studio environment on students' creativity in interior design programs

are addressed in this study. However, little research has been done on the topic of creativity in the interior design studio space, and in students' learning and educational journey. This gap in the literature indicates the need for further studies of the relationships between the design studio environment and the creativity of interior design students. Consequently, this study will examine the concept of the third place to establish whether it has any impact on students' performance in design projects.

There are two main variables in this study. The independent variable is the learning space, which can be broken down into three categories: traditional studio, high-tech space, and third place. The dependent variable is creativity. Figure 1 visually represents the research model and the relationship between these variables.

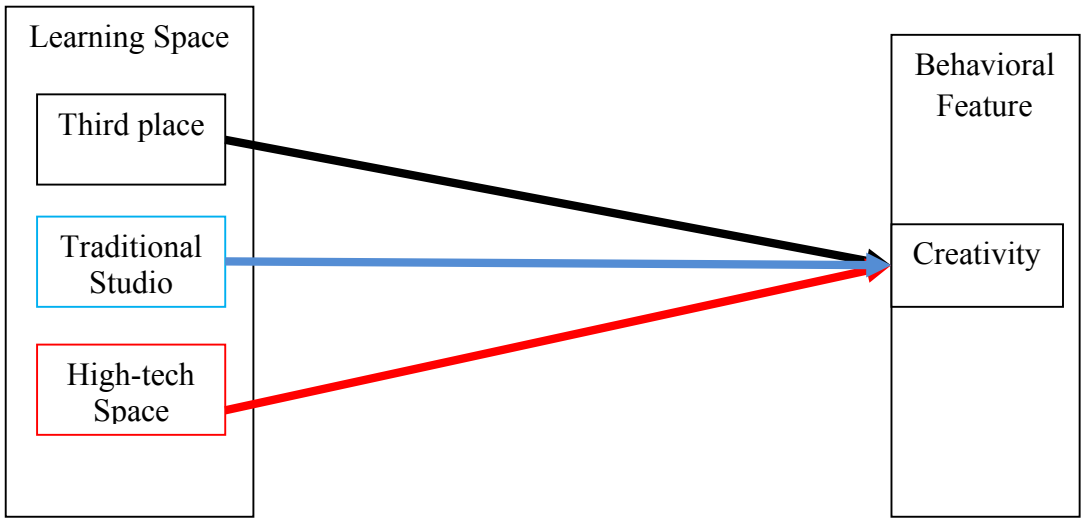

Figure 1: *Research Model.*

The significance of the study is that it enriches the existing literature on the impact of third place on creativity. In addition, further insights are provided on the impact of the learning space on students' creativity, which might lead to an improvement in the approach taken to the interior design of learning spaces, and to an understanding of what other factors might affect

students' creativity. Furthermore, this study highlights certain other factors that might impact creativity, not just the space and time range impact of creativity improvement.

Moreover, this study will be promoting the importance of creativity learning space, not only in design, but also, any other major. This study will also be beneficial to the teachers and education providers in adapting new strategies to employ creativity learning spaces and environment. By understanding the factors that impact students' creativity; students will be benefited by the new approaches that are being implemented to enhance their creativity such as the collaboration using the learning space.

Literature Review

The aim of this study is to predict the impact of the studio environment and the presence of the third place in the educational process on student creativity. Previous work had discussed and examined the impact of the office space on workers' productivity; however, little research has yet been published regarding the design studio environment and the third place, and most of the existing research has been on providing third places in the educational setting to improve collaboration between students (Pennington, 2016). Likewise, at this time, though there is an increasing interest in the improvement of creativity in our society (De Backer, Lombaerts, De Mette, Buffel & Elias, 2012), since there is a limited research about creativity enhancement through space in in the educational sitting. De Backer *et al.*'s (2012) study found that the stimulation of artistic creativity in schools is irregular and not consistent. Therefore, in order to facilitate a better understanding of these relationships and concepts, it is necessary to study, in detail, the previous work on creativity and the effect of the learning environment on behavioral outcomes, including creativity, which will be discussed in the following section.

Productivity

Hameed and Amjad (2009) describe productivity as a measurement process that helps an organization or institution to assess its workers' or students' outputs and services. Moreover, Leaman and Bordass (1999) describe productivity as the ability to enhance the output of work by refining the quality and quantity of the product or services provided. Most institutions that rely on their members' productivity for success will continually look for new methods of improving and enhancing productivity; an example of such institutions include schools, hospitals, and commercial companies (Pope, 1996).

The importance of productivity lies in the many effects that it has on the economy; indeed, enhanced productivity can improve the quality and standards of life (Sullivan, 2012). Since the improvement of productivity will affect quality of life, then the adaptation of multiple strategies for improving the higher education environment in order to improve productivity is a critical issue and one that requires greater scholarly attention (Sullivan, 2012)**.**

Creativity

Most definitions of creativity suggest that creativity is the ability to provide and generate different novel, special, and functional solutions to a presented problem (Cubukcu & Eksioglu, 2009). There are many advantages to fostering creativity, leading to an increasing awareness of creativity's critical role in improving societies (Eunice, & Zélia, 2016). As stated by Hatamleh (2015), to create a society of knowledge, it is important to improve educational systems so that they foster and motivate creativity. Elnokaly, Elseragy, and Alsaadani (2008) emphasize the importance of the design studio in shaping students' problem-solving abilities, which are linked to their creativity. This definition closely describes and defines creativity as it will be presented in this study.

Several studies on creativity have shown that it is one of the most important factors in innovation and national growth, and in bringing about community benefit (Knox, 2017; Songkram, 2017). However, there are many and varying definitions of creativity, and researchers have yet to agree upon a methodology for defining, controlling, and improving it (Rush, 1999).

Ozkar (1999, p.11) accurately describes the creative space as, "an open system that is assumed to be forever-unfinished and unexpected. The unknown path of the future, continually redefined at any moment, is due to a particular accumulation in the past that evolves at every present moment". Livingston (2010) further claims that the application of creativity and creative thinking in a way that improves people's lives means that it becomes a force for good and can exert a significant positive influence on the community.

In addition, Clarke and Cripps (2012) define creativity as, "a transformative process of knowing, thinking and doing that embodies elements such as risk taking, envisaging, engaging, persisting, observing, experimenting, attending to relationships, taking a benign attitude to error and critically reflecting" (2012: p. 114).

In the field of design, the design process is a critical stage as it shapes the outcome, the product that is designed. However, the creative outcome is not a specific or singular solution; it usually takes the form of different proposals and outcomes that need evaluation and assessment before making a final decision (Kudrowitz, 2010). Improving creativity could help to integrate relationships across different disciplines that will shape and enhance the future of society. This improvement will come first from incorporating creativity within and through the learning environment (Potter, 2010).

Furthermore, for a product or project to be creative, it should have characteristics such as novelty and usefulness; without these features, a product can be original, but not creative

(Greenberg, 2008). In terms of the measurement of individual creativity, there are many aspects to be studied, such as fluency, flexibility, elaboration, and originality, which can be observed and measured through inventories, behavioral tests, divergent thinking tests, word-building tests, interpretation of inkblots, and drawing (Greenberg, 2008).

Rush (1999) argued that creativity is not only genetic, or something that individuals are born with, but that environmental factors also affect creativity. Although the focus on creativity in education has been described and developed in the literature, the research on creative classrooms or learning spaces is still at an early stage (Rush, 1999).

In addition, creativity is not restricted to the level of individuals. A study by Potter (2010) showed that most people are able to be creative, where 89.66% of participants demonstrated a degree of creativity, and 98.6% of participants were able to grow and improve their measured creativity. Investigations of creativity have not only focused on individuals; recently, there has been more of a focus on measuring creative behavior and processes in the performance of each participant. However, there is a gap in the literature in terms of the creative process at a group level (Hennessey & Amabile, 2010).

In a review of the literature on creativity, Trnova (2014) identified several features that have a high impact on the development of creativity, such as a suitable environment, the personality traits of the teacher, family-related factors, school administration, life experiences, education, motivation, hard work, and group work. The present research is concerned with the group work factor, focusing on having a diverse range of students, their willingness to help and recognize other groups of students, brainstorming, and collaboration (Trnova, 2014). Pifarré, Martí, and Cujba (2015) state that interaction with other people through high-quality dialogue will also lead to the emergence of creativity.

According to Bratteteig and Wagner (2012), collaboration and social interaction play an important role in fostering creativity. While most existing research relates creativity to individuals, there are other viewpoints, such as that socio-cultural and collaboration activity also have a critical impact on individual creativity (Bratteteig & Wagner, 2012).

In the learning environment, students will be exposed to basic knowledge through lectures or lessons with the teacher that will initiate a critical thinking process (Lunenburg, 2011). According to Clarke and Cripps (2012), in traditional lectures or classes, the teaching method treats students as co-learners, and this teaching method gives a clear understanding of students' view on the problem, which will help foster students' creativity in the collaborative environment of the design studio.

This highlights the importance of creating an educational environment that promotes collaboration and social interaction between the teacher and students, and facilitates the acquisition and exploration of knowledge, which will enhance students' cognitive skills (Jia, 2010). Therefore, in the educational process, it is important to create a collaborative environment in order to improve the knowledge that students gain during their lectures.

When involving the students in the learning and creativity-enhancement process, the role as a teacher changes from a discussion initiator and introducer to a helper, aiding students in their journey of exploration (Jia, 2010). In this role, teachers are more like designers of the learning environment, and guides for students' creativity, exploration, and learning (Jia, 2010).

Previous research studies have shown that the physical and social environment has a significant impact on peoples' creative performance (Hennessey & Amabile, 2010). However, most such research has been carried out in organizational work environments, which Hennessey

and Amabile (2010) have assumed can be transferred to the educational environment. From these findings, it can be hypothesized that the learning environment influences students' creativity.

This study asserts that any creative student should also be productive at the same time. This integration between productivity and creativity will improve the engagement between the students and the professional environment, and thus prepare students for their future careers. To this end, this research will investigate different learning spaces in order to determine whether one type of space is better able to encourage and improve students' creativity throughout their educational experience.

Third Place

According to Oldenburg (1989), the 'third place' is a place in which individuals meet, and is an environment that is separate from both work and residential spaces. There are many types of spaces that have these basic characteristics, such as public parks and coffee shops (Gennain, 2001). Third places are further characterized by their open and comfortable environments, which provide a space for socializing and having conversations with other people sharing the space (Memarovic, Fels, Anacleto, Calderon, Gobbo & Carroll, 2014). These types of spaces help to foster and characterize, and thus make city life more friendly and less stressful (Memarovic, *et al*., 2014).

As a term, the third place is typically used to refer to public spaces and environments to encourage people to get together and socialize (Memarovic *et al.,* 2014). Furthermore, third place gives people a chance to build new relationships, connections, and have new experiences that cannot be found at work or home (Gennain, 2001). In addition, having a third place within a structure gives people a chance to build new relationships, connections, and have new experiences that cannot be found at work or home (Gennain, 2001).

The third place exists in the larger discipline of interior design, as well as in specific sub-disciplines. The concept of the third place is usually employed to create social spaces within healthcare spaces for aging adults in retirement communities, and the social space actually is a third place by its nature. This application of the concept of third place in healthcare facilities and retirement communities arises from the notion that there is a connection between health and wellness improvement and the facilitation of social interactions in healing spaces (Zavotka & Teaford, 1997; Campbell, 2015). In addition, the findings of Zavotka and Teaford, (1997) and Campbell (2015), suggest that it is important to pay attention to the quality of the third place or the social space because the design of the third or social space is significant in defining third places to be homelike (Campbell, 2015).

Campbell (2015) insisted on paying more attention to the interior environment of the social space, as it will have an influence on the healing process. This attention should be paid in the form of carefully choosing the design elements of a space in terms of aesthetics and function, which will have a strong relationship with the users' likability of a space. Those design elements, when properly considered, will support and create a more supportive social space (Cohen, 1990).

A further study on the third place has been carried out by Moore (2012) in the area of landscape architecture, more specifically in mall spaces. The research analyzed the third place of the landscape in the Riccarton Mall in a Christchurch, New Zealand suburb to identify the common elements that make third places successful and socially effective, in order to understand the types of modifications needed in the landscape of these spaces (Moore, 2012).

Moore (2012) identified a number of different aspects that the third place in the mall provides; for instance, the third place that provided a social infrastructure connected to the building design gave people a feeling of ownership of the space, making it more comfortable for

them to interact in the space. This interaction provided a diverse and active environment for socializing, adding a new function to the mall spaces, making it more than just a space for shopping. Moore's (2012) findings also support the statement that the third place relates to the usage of public spaces as environments for people to socialize in (Memarovic *et al*., 2014).

In the mall setting, the third place also provided an activity space that motivated people to interact more with each other in a comfortable and free manner (Moore, 2012). The social space, which was diverse and active, created a stable environment that enabled people to meet by creating a general meeting space within the landscape of the mall. Similarly, Memarovic *et al*. (2014) related the concept of a third place to the concept of public, specifically how people come together and become active and social because of the existence of these diverse public places.

The social space in the landscape within the mall building is also connected to the interior space within the mall as a part of the social space (Moore, 2012). Moore (2012) states that these interior spaces within the landscape of the mall create a successful third place in the building, which provides new qualities such as scale, legibility, interior permeability, safety, activities, and hybridity.

Moreover, discussing Third Place Theory, Yi-Fu Tuan (1979) states that people experience space differently, and have different feelings about it depending on the possibilities and limitations of their senses, and that perceptions of space arise from various qualities. He suggested that when we study and analyze space from a humanistic perspective, we are studying people's feelings, ideas, and experiences; that people perceive the world, places, and spaces through feelings and sensations (Tuan, 1979).

Another study related to the concept of the third place was conducted in a coffee shop environment, and concluded that designers, when creating a space, should pay attention to the

community-gathering space in the building, which can improve communication between the users of the space (Waxman, 2006). The same study also showed that different factors characterize the social space, such as the opportunity to linger, feelings of ownership, ability to territorialize, trust and respect, anonymity, productivity, an opportunity to socialize, and support (Waxman, 2006).

In addition, Waxman (2006) pointed out that to add more dynamic characteristics to a coffee shop to make it an ideal third place, the following are important: cleanliness, aroma, adequate lighting, comfortable furniture, and a view to the outside. Nevertheless, the lack of existing research and literature on the principles of designing social and third places meant that the focus of the research was the attachment to the place (Zavotka & Teaford, 1997; Waxman, 2006).

Another area of research regarding the concept of the third place which is more directed toward the social space discusses the design of public libraries (Sufara, Talibb & Hambalic, 2012). The researchers here argue that libraries are closely linked to education, even in the digital age where learners can find most learning materials online. Hence, libraries provide a space where individuals can come together and socialize, offering a chance for interaction, which can be a satisfying experience. Learners attached to these spaces can explore collaborative learning opportunities (Sufara *et al*., 2012).

The findings of previous studies of the third place are valuable to this research, as they can provide an idea about the direction of planning and design of third places for education. For example, according to Moore (2012), these spaces should provide legibility, interior permeability, safety, activities, and hybridity. In addition, Waxman (2006) argued that people

will be social and interact more if space has some of the following qualities: cleanliness, aroma, adequate lighting, comfortable furniture, and a view to the outside.

Learning Spaces

Learning spaces play a critical role in the educational and learning process. Providers of education seek to create educational and learning spaces that support and improve the learning process, and help to achieve high-end learning outcomes at each learning stage (Oblinger, 2006).

There are two main types of learning spaces: traditional classrooms, and adjustable classrooms. The traditional classroom consists of chairs and tables that are directed toward the instructional area, which includes either a whiteboard or a chalkboard. On the other hand, the remodeled adjustable classroom has bigger tables, and each table has multiple chairs to accommodate more than one student, and students are not facing the instructor all of the time. The adjustable classroom is used to enhance the spirit of group and team work among students (Oblinger, 2006).

Traditional classrooms are changing based on variety of reasons including the experience of designing alternative learning spaces to create more effective learning spaces. Researchers and designers are trying to create more effective learning spaces by making them more dynamic and easier to change, instead of creating spaces that are set up for one-way learning- the teacher to student-, which decreases the opportunities for interaction between the students (Leonard, 2007; Topçu, 2013).

In this research, the concept of using a high-tech classroom, such as a design or computer lab, will be studied as one alternative to the traditional classroom, to determine whether there is any improvement in the students' performance regarding creativity.

Gislason (2010) argued that creating non-traditional learning environments, such as open-plan spaces, will lead to more effective school organization and programs. The findings of Gislason's (2010) study shows that having an open-plan learning space instead of a traditional learning space supports educational outcomes, and Gislason argues that giving learners more freedom in the learning space will impact positively on their motivation, which in turn will lead to more creativity and innovation.

In an attempt to create a new and different learning environment other than the traditional one, Park and Choi (2014) found that students reported that the active and collaborative learning space, i.e., defined as the active learning classroom, is more influential and inspirational. They also observed a greater level of collaborative thinking and idea sharing in the active learning space, which enriched the educational experience (Park & Choi, 2014; Crook & Mitchell, 2012). In addition, Turner, Welch, and Reynolds (2013) argue that more attention should be paid to the concept of collaborative learning through creating flexible learning spaces. Such spaces encourage formal and informal interaction between the teacher and the students, reinforcing the statement that the design of learning space influences students' learning behaviors.

Topçu (2013) found that when students and faculty members have the chance to control and make changes to the learning environment based on their preferences, and do not have to remain in a set format that cannot be changed, i.e, the traditional classroom, this will have a positive impact on the students' performance and learning process. Furthermore, Sagan (2007) suggests that to achieve a student-centered learning experience, social spaces must exist that push learners to have emotional, social, psychological, and diverse interactions. Such diverse interaction is harder when learners are restricted in the traditional learning space, where their view is positioned such that they can only observe the teacher.

The design studio is an essential space for many educational disciplines, including architecture, interior design, industrial design, graphic design, and fine art. In these disciplines, students spend most of their academic life in design studios that are usually provided by their university or institution (Lueth, 2008).

The main reason for having a design studio is to provide a space to house the specific furniture and supplies that are needed to complete the variety of projects that students will work on throughout their higher education. Another reason for having the design studio is to enable students to practice teamwork and collaboration, in order emulate and prepare them for professional practice (Ledewitz, 1985). As a learning space with this kind of environment, the design studio can be related to the concept of the third place, which enhances the social behaviors of the users of the space (Pennington, 2016).

Research Hypotheses

H_1: Students in a third place will show a statistically significant higher creativity response than students in traditional and high-tech studio spaces.

Research Methods

This research utilized a quantitative research approach. The data were collected from different architecture and interior design classes at different levels (freshmen, sophomore, junior, and senior) from two southeastern United States universities.

The research used two different tools to evaluate and assess students' creativity, Torrance Tests of Creative Thinking (TTCT) and Remote Associates Test (RAT). Both tests had a pre- and post-test which were analyzed to help understand the difference in participants' creativity levels after interacting within each space. The collected data were analyzed through various

statistical analysis methods to determine whether there was a significant difference in students' creativity in the three distinct spaces.

Participants

The sample for this research was design students in two southeastern U.S. universities. After obtaining institutional review board approval, the participants were recruited by posting announcements regarding the study. The announcement was printed on 8.5" by 11" paper with the following statement: "get a free creativity assessment and a $5 Starbucks gift card, reserve your seat now for more info," and posted in the classrooms and hallways of both departments. Also, course instructors were emailed with information about the study and asked to share it with their students.

In total, 52 students decided to participate in this study, three participants were male, and 49 were females; 49 students were design majors, and 1 student was a music major. There were two graduate students, and the rest were undergraduate students; 15 students came from University one, and 37 from University two. More information regarding the demographics of the participants will be presented in the results section. All participants were thanked for their participation with a gift card.

Assessing Creativity

The Torrance Tests of Creative Thinking (TTCT)-Verbal test (see Appendix 1) was used in each of the three different spaces to assess students' creativity levels in the three spaces. TTCT-Verbal had a pre and a post-test. This tool has been verified in terms of its validity and reliability, as indicated in the findings of Kim (2006). Also, TTCT is widely used to evaluate students' creativity, not only with gifted students, but also for discovering and encouraging everyday creativity in general (Kim, 2006; Hersen, 2004). Additionally, Kaufman, and

Lichtenberger (2011) state that TTCT test is highly recommended as a creativity assessment, as it has two forms that incorporate both verbal and figural tests. In this study, the TTCT-Verbal version was used to be consistent with the other measurement tool, RAT, which is a textual creativity assessment tool. Kim (2006) discussed the validity and reliability of TTCT and indicated that reliability coefficients of TTCT ranged from 0.50 to 0.93. This variation of the reliability coefficients was found to be due to the motivational conditions, and the complexity of creative thinking.

Also, the TTCT has been widely used in creativity assessment research (Almeida, Prieto, Ferrando, Oliveira, & Ferrándiz, 2008; Kim, 2006). Furthermore, the TTCT has been translated into over 35 languages, which indicates its global applicability for further cross-cultural research in creativity assessment (Aslan, & Puccio, 2006; Kim, 2006).

The Remote Associates Test (RAT), with its pre and posttests (see Appendices 2 and 3), is a measurement scale for creativity as thinking in a general manner, without restricting the measurement to a specific field (Chermahini, Hickendorff & Hommel, 2012). This scale was developed by Sarnoff Mednick in 1967, and correlates cognitive abilities with the creative thinking process, such as divergent thinking (Kudrowitz, 2010).

The RAT is about creating relationships and associations between a combination of words or ideas to create new ones. Individuals taking the test are presented with three different words, and are asked to identify the connection between those words, and come up with a fourth word that is connected to the first combination (Kudrowitz, 2010). There was a pre- and post-RAT test, as well as for the TTCT-Verbal.

RAT test is a widely used assessment tool for creativity in multiple disciplines such as psychology and neuroscience (Klein, & Badia, 2015). Also, the RAT test has been translated to

different languages such as Dutch, and its reliability coefficient is 0.85; this shows a global applicability of this measurement tool (Akbari, Hickendorff, & Hommel, 2012).

Two creativity assessment tools were used to study the agreement and association between the two measurement tools. Also, having two measurement tools helps to study the differences between a tool that measures general creative thinking (TTCT), and a tool that measures divergent thinking (RAT). Understanding these differences might lead to greater insights into creativity, and thus to an improved and more comprehensive measurement of creativity.

Another measurement of students' creativity that was used to enhance the validity and reliability of this study is the Creative Achievement Questionnaire (CAQ) (see Appendix 3). This questionnaire is a self-report scale of the participants' creative achievements across ten sectors of creativity (Carson, Peterson & Higgins, 2005). The domains are visual arts, music, dance, architectural design, creative writing, humor, invention, scientific discovery, theater and film, and culinary arts (Carson, Peterson & Higgins, 2005). This test was used to determine creativity levels for each participant. It was used to assign students with similar creativity levels to all three spaces, i.e., there were a similar number of participants in each space that had low, medium and high creativity levels based on the CAQ scores. Therefore, the CAQ was used to ensure that there were no outliers or group of participants in one space that were more creative by nature than the other students in that space.

The Hawthorne Effect and Social Desirability Bias Avoidance

To avoid the Hawthorne effect and social desirability bias, which may affect participants' responses, the traditional learning space served as a control group, as advised by Coombs and Smith (2003). Another unintended means of avoiding those effects was that the

participants could not intentionally change their level of creativity. Furthermore, the participants were told that the results of the TTCT tests, RAT tests, and CAQ were entirely anonymous.

Research Setup

The study was carried out in three spaces: a traditional design studio, a high-tech studio, and a third place. The spaces were located in the interior design facilities at both universities. The setup consisted of two traditional studios, two high-tech classrooms, and two third places, with one of each type of space in each university.

The square footage of the traditional studios was approximately 750 to 850 square feet for each. Both studios were well lit with artificial lighting provided by fluorescent lighting fixtures; the light was equally distributed throughout the space. Also, both spaces had similar natural lighting, as both studios had four medium sized windows. The furniture in both rooms consisted of the following: drafting tables with a parallel bar on each table, chairs, white boards, and, one of the studios had a sink and lockers for students' use. Please refer to Figure 2, which illustrates the traditional space.

Figure 2: *Traditional studio.*

The high-tech classrooms were approximately 400 to 600 square feet each. One of the classrooms had windows, but the blinds were lowered to make both of the high-tech spaces consistent, since the other high-tech classroom did not have any windows. The high-tech classrooms used artificial fluorescent lighting, and were well-lit. The lighting fixtures in both spaces were easy to control and dim. Furniture in the high-tech classrooms consisted of the following: computer tables, chairs, computers, projection systems, printers, and whiteboards. Figure 3 represents the high-tech spaces.

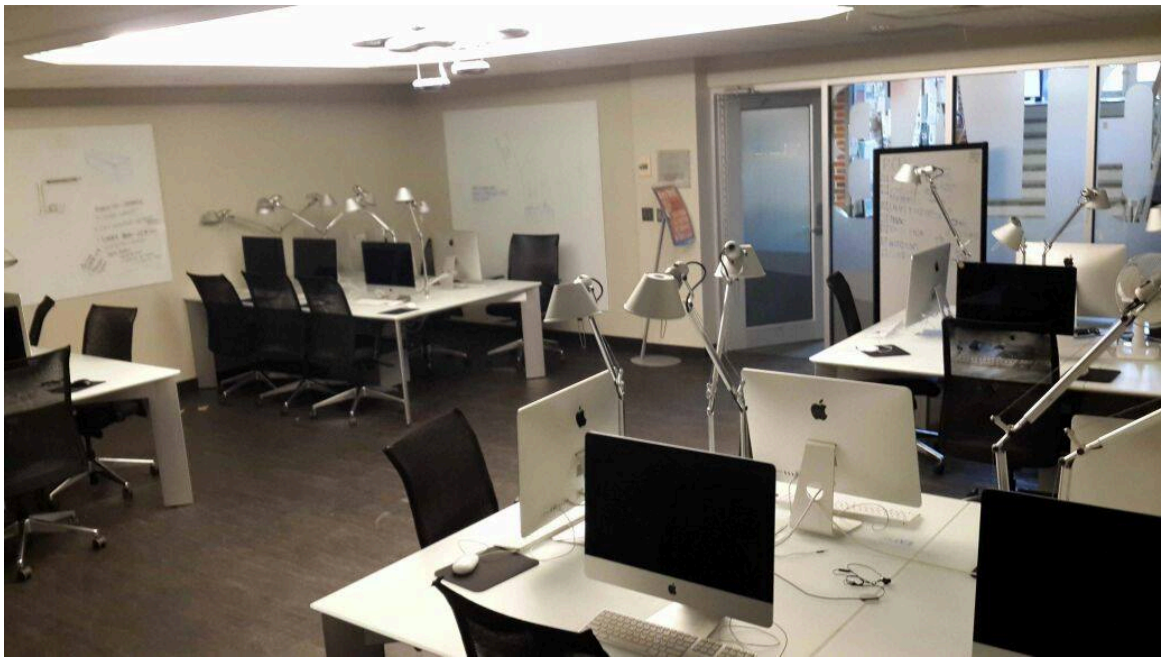

Figure 3: *High-tech studio.*

The third places were more varied in size. One was approximately 450 square feet, and the second one was approximately 800 square feet. Both spaces were well lit with artificial fluorescent lighting fixtures. The light was distributed equally throughout the space and could be easily controlled and dimmed based on the preferences of users. Both spaces also had some natural lighting; however, there was a difference in the size of the windows, due to the size difference between the spaces. The furniture in both rooms consisted of the following: different types of tables, such as individual tables and discussion and group tables, chairs of different types, such as benches and individual chairs of varied heights, whiteboards, televisions, technology stations, and, one of the spaces had a separate break-out room for smaller groups. Figures 4 and 5 show the third places.

Figure 04: Third place.

Figure 05: Third place.

The students were given two tests to measure creativity: TTCT-Verbal, and RAT. First, in order to divide the groups equally, the students took the CAQ questionnaire, which gave the researcher an idea of how to divide the students into three groups and avoid outliers. This was accomplished based on each participant's score on the CAQ. Each student was given a number before taking the CAQ questionnaire, and they entered this number into their questionnaire so that the researcher could divide the students into groups without identifying student names. Environmental and temporal features, such as time, temperature, and lighting of the three spaces were controlled during the testing to reduce confounding variables. Figure 06 provides a visual overview of the research steps, from the recruitment of the participants to data analysis.

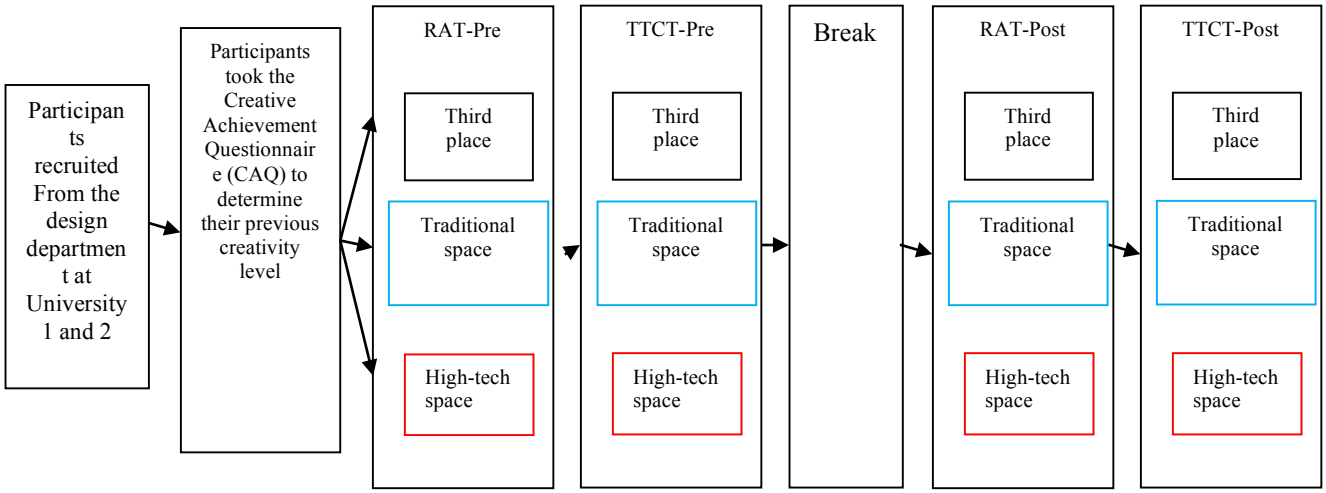

Figure 06: *Research Procedure.*

Data Analysis and Results

This section will present the data analysis and results of the study. A total of 52 participants participated in the study from a target sample of 77 students who showed their interest in participating the study, representing a 67.5% response rate for the study. The participant test results were analyzed using SPSS software. This section will focus solely on presenting the data collected in a meaningful way, in order to facilitate the discussion.

Demographic Results

There were 52 students who decided to participate in this study. Among participants, three participants were male, and 49 were female; 51 students were design majors, and just one student was a music major. There were two graduate students; the rest were undergraduate students; 15 students came from University one, and 37 came from University two. The participants' education levels were as follows: freshmen (8), sophomores (16), juniors (24), seniors (2), and graduates (2).

The age range of the participants was as follows: 18-20 (35), 21-25 (15), one participant was 35, and one participant was 63. The ethnicities of the participants were as follows: African American (5), Caucasian (43), Asian (2), and Hispanic (2). The number of participants allocated to each space was as follows: traditional studio (19), high-tech classroom (14), and third place (19). The distribution of the students across the spaces was based on their CAQ survey scores.

Table 1

Descriptive statistics results.

Demographics

		Frequency	*Percent*	*Cumulative Percent*
Class	Freshman	8	15.4	15.4
	Sophomore	16	30.8	46.2
	Junior	24	46.2	92.3
	Senior	2	3.8	96.2
	Grad	2	3.8	100.0
	Total	52	100.0	
Gender	Female	49	94.2	94.2
	Male	3	5.8	100.0
	Total	52	100.0	
Age	18	6	11.5	11.5
	19	12	23.1	34.6

	20	17	32.7	67.3
	21	12	23.1	90.4
	22	3	5.8	96.2
	35	1	1.9	98.1
	63	1	1.9	100.0
	Total	52	100.0	
Ethnicity	African American/Black	5	9.6	9.6
	Caucasian/White	43	82.7	92.3
	Asian American/Asian	2	3.8	96.2
	Hispanic/Latino	2	3.8	100.0
	Total	52	100.0	
Space	Traditional	19	36.5	36.5
	High-tech	14	26.9	63.5
	Third place	19	36.5	100.0
	Total	52	100.0	

Data Analysis

The RAT pre- and post- tests were graded by the researcher. Each participant received a score from 0-10 based on his/her test results. The pre- and post- TTCT-Verbal tests were graded by a specialized and accredited center for creative assessment.

One-Way ANOVA was applied to the pre- and post- measurement tools to gain insight as to whether there was any improvement in the students' performance in one specific space over the other spaces. An Alpha level of .05 was used to determine statistical significance in the differences between the three spaces. The scores for both of the measurement tools were normalized to a score between 0 and 1 to get more meaningful means, since the RAT test scores range from 0-10, and the scores for the TTCT-Verbal have no specific range.

For the RAT test, each participant was given one score ranging from 0-10 based on their test results. For the TTCT-Verbal test, each participant received three different scores, for the following areas: fluency, originality, and flexibility. The three parts of the TTCT-Verbal test represent the range of creativity that the test measures, and there is no limit to how high the scores can be.

Mean Differences between the Three Spaces

The means of each test were computed and compared based on the space. The results of the means comparison were as follows. Traditional space: RAT: Pre-test mean (.8947), Post-test mean (4.5789); TTCT Fluency: Pre-test mean (84.74), Post-test mean (73.47); TTCT Originality: Pre-test mean (63.74), Post-test mean (57.95); TTCT Flexibility: Pre-test mean (47.42), Post-test mean (39.42). High-tech space: RAT: Pre-test mean (.2143), Post-test mean (2.5000); TTCT Fluency: Pre-test mean (97.79), Post-test mean (79.14); TTCT Originality: Pre-test mean (73.14), Post-test mean (62.43); TTCT Flexibility: Pre-test mean (45.79), Post-test mean (40.14). Third place: RAT: Pre-test mean (.5789), Post-test mean (3.6316); TTCT Fluency: Pre-test mean (84.05), Post-test mean (62.53); TTCT Originality: Pre-test mean (60.47), Post-test mean (45.37); TTCT Flexibility: Pre-test mean (43.53), Post-test mean (37.37). These results are also presented in Tables 2 and 3.

Table 2

Descriptive results for pre-tests

Report Pre-Test

Space		*RAT_A*	*Fluency_A*	*Originality_A*	*Flexibility_A*
Traditional	Mean	.8947	84.74	63.74	47.42
	N	19	19	19	19
	Std. Deviation	1.24252	30.329	22.588	11.515
	Variance	1.544	919.871	510.205	132.591
High-tech	Mean	.2143	97.79	73.14	45.79
	N	14	14	14	14
	Std. Deviation	.42582	39.602	35.021	11.335
	Variance	.181	1568.335	1226.440	128.489
Third place	Mean	.5789	84.05	60.47	43.53
	N	19	19	19	19
	Std. Deviation	.69248	20.277	17.880	8.120
	Variance	.480	411.164	319.708	65.930
Total	Mean	.5962	88.00	65.08	45.56
	N	52	52	52	52
	Std. Deviation	.91308	30.093	25.139	10.279
	Variance	.834	905.608	631.955	105.663

Table 3

Descriptive results for post-tests

Report Post-Test

Space		*RAT_B*	*Fluency_B*	*Originality_B*	*Flexibility_B*
Traditional	Mean	4.5789	73.47	57.95	39.42
	N	19	19	19	19
	Std. Deviation	3.23721	26.730	22.977	7.755
	Variance	10.480	714.485	527.942	60.146
High-tech	Mean	2.5000	79.14	62.43	40.14
	N	14	14	14	14
	Std. Deviation	1.40055	29.357	28.180	9.281
	Variance	1.962	861.824	794.110	86.132
Third place	Mean	3.6316	62.53	45.37	37.37
	N	19	19	19	19
	Std. Deviation	2.62912	26.018	21.117	8.939
	Variance	6.912	676.930	445.912	79.912
Total	Mean	3.6731	71.00	54.56	38.87
	N	52	52	52	52
	Std. Deviation	2.70599	27.532	24.472	8.531
	Variance	7.322	758.000	598.879	72.785

Differences between TTCT-Verbal and RAT

A paired t-test was run on the traditional space sample (n=19) to determine whether there was a statistically significant difference between the pre- and post- RAT and the pre- and post-TTCT-Verbal. There was a statistically significant increase in the RAT test scores and a decrease in the TTCT-Verbal fluency and flexibility, and a non-significant decrease for originality. The

results of the test were as follows: RAT: t (18) = -5.927, p = .000. Fluency: t (18) = 3.217, p = .005. Originality: t (18) = 1.937, p = 0.0685. Flexibility: t (18) = 2.819, p = .011. (See Tables 4 and 5).

Table 4

Descriptive results for Pre-Post RAT and TTCT-Verbal in the Traditional Space

Paired Samples Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	TTCT Fluency_A	84.74	19	30.329	6.958
	Fluency_B	73.47	19	26.730	6.132
Pair 2	TTCT Originality _A	63.74	19	22.588	5.182
	Originality _B	57.95	19	22.977	5.271
Pair 3	TTCT Flexibility	47.42	19	11.515	2.642
	Flexibility _B	39.42	19	7.755	1.779
Pair 4	RAT_A	.8947	19	1.24252	.28505
	RAT_B	4.5789	19	3.23721	.74267

Table 5

t-test results for RAT and TTCT-Verbal in the Traditional Space

		Mean	*Std. Deviation*	*Lower*	*Upper*	*t*	*df*	*Sig. (2-tailed)*
Pair 1	TTCT Fluency_A Fluency_B	11.263	15.260	3.908	18.618	3.217	18	.005
Pair 2	TTCT Originality _A Originality _B	5.789	13.024	-.488	12.067	1.938	18	.069

Pair 3	TTCT Flexibility_A Flexibility_B	8.000	12.369	2.038	13.962	2.819	18	.011
Pair 4	RAT_A - RAT_B	-3.68421	2.70909	-4.98995	-2.37847	-5.928	18	.000

Then, a paired t-test was run on the high-tech space sample (n=14) to determine whether there was a statistically significant difference between the RAT and TTCT-Verbal Pre-Post. A statistically significant increase of the RAT test scores and a statistically significant decrease in the TTCT-Verbal fluency, flexibility, and originality scores was found. The results of the test were as follows: RAT: t (13) = 6.450, p = .000. TTCT Fluency: t (13) = 4.168, p = .001. TTCT Originality: t (13) =3.114, p = 0.008. TTCT Flexibility: t (13) = 2.983, p = .011. (See Tables 6 and 7).

Table 6

Descriptive results for Pre-Post RAT and TTCT-Verbal in the High-tech Space

Paired Samples Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	TTCT Fluency_A	97.79	14	39.602	10.584
	Fluency_B	79.14	14	29.357	7.846
Pair 2	TTCT Originality_A	73.14	14	35.021	9.360
	Originality_B	62.43	14	28.180	7.531
Pair 3	TTCT Flexibility	45.79	14	11.335	3.029
	Flexibility_B	40.14	14	9.281	2.480

Pair 4	RAT_A	.2143	14	.42582	.11380
	RAT_B	2.5000	14	1.40055	.37431

Table 7
t-test results for RAT and TTCT-Verbal in the High-tech Space

Paired Samples Test

		Paired Differences					*t*	*df*	*Sig. (2-tailed)*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference* *Lower*	*Upper*			
Pair 1	TTCT Fluency_A - Fluency_B	18.643	16.736	4.473	8.980	28.306	4.168	13	.001
Pair 2	TTCT Originality_A - Originality_B	10.714	12.875	3.441	3.281	18.148	3.114	13	.008
Pair 3	TTCT Flexibility - Flexibility_B	5.643	7.078	1.892	1.556	9.729	2.983	13	.011
Pair 4	RAT_A - RAT_B	-2.2857	1.32599	.35438	-3.05132	-1.52011	-6.450	13	.000

Finally, a paired t-test was run on the third place sample (n= 19) to determine whether there was a statistically significant difference between the RAT and TTCT-Verbal Pre-Post means. A statistically significant increase in the RAT test scores and a statistically significant decrease in the TTCT-Verbal fluency, flexibility, and originality scores was found. The results of

the test were: RAT: t (18) = -6.125, p = .000. TTCT Fluency: t (18) = 5.418, p = .000. TTCT Originality: t (18) =4.258, p = 0.001. TTCT Flexibility: t (18) = 4.030, p = .001. (See Tables 8 and 9)

Table 8

Descriptive results for Pre-Post RAT and TTCT-Verbal in the Third Place

Paired Samples Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	Fluency_A	84.05	19	20.277	4.652
	Fluency_B	62.53	19	26.018	5.969
Pair 2	Originality_A	60.47	19	17.880	4.102
	Originality_B	45.37	19	21.117	4.844
Pair 3	Flexibility_A	43.53	19	8.120	1.863
	Flexibility_B	37.37	19	8.939	2.051
Pair 4	RAT_A	.5789	19	.69248	.15887
	RAT_B	3.6316	19	2.62912	.60316

Table 9

t-test results for RAT and TTCT-Verbal in the Third Place

Paired Samples Test

		Paired Differences					*t*	*df*	*Sig. (2-tailed)*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference* *Lower*	*Upper*			
Pair 1	TTCT Fluency_A - Fluency_B	21.526	17.318	3.973	13.179	29.874	5.418	18	.000

Pair 2	TTCT Originality_A - Originality_B	15.105	15.463	3.547	7.652	22.558	4.258	18	.000
Pair 3	TTCT Flexibility - Flexibility_B	6.158	6.661	1.528	2.948	9.368	4.030	18	.001
Pair 4	RAT_A - RAT_B	-3.05263	2.17239	.49838	-4.09969	-2.00557	-6.125	18	.000

Creativity Levels in the Third Place compared to the Traditional Space

It was hypothesized that the third place would show the highest creativity levels compared to the traditional and high-tech spaces. To test this prediction, a series of One-Way ANOVAs were computed. The results of the One-Way ANOVA on the participants' creativity scores revealed that there was no statistically significant difference between any of the groups' means. Therefore, post-hoc tests were not computed. The One Way ANOVA results were as follows: TTCT Fluency_A: $F(2,49) = 1.016$, $p = .370$. TTCT Fluency_B: $F(2,49) = 1.628$, $p = .207$. TTCT Originality_A: $F(2,49) = 1.069$, $p = .351$. TTCT Originality_B: $F(2,49) = 2.366$, $p = .104$. TTCT Flexibility_A: $F(2,49) = .678$, $p = .512$. TTCT Flexibility_B: $F(2,49) = .480$, $p = .622$. RAT_A: $F(2,49) = 2.364$, $p = .105$. RAT_A: $F(2,49) = 2.525$, $p = .090$. The results are also presented in Table 10.

Table 10
One-Way ANOVA results for RAT and TTCT-Verbal differences between the three spaces.

ANOVA

		Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
RAT_A	Between Groups	3.741	2	1.871	2.364	.105
	Within Groups	38.778	49	.791		
	Total	42.519	51			
RAT_B	Between Groups	34.890	2	17.445	2.525	.090
	Within Groups	338.553	49	6.909		
	Total	373.442	51			
TTCT - Fluency_A	Between Groups	1839.011	2	919.506	1.016	.370
	Within Groups	44346.989	49	905.041		
	Total	46186.000	51			
TTCT - Fluency_B	Between Groups	2408.812	2	1204.406	1.628	.207
	Within Groups	36249.188	49	739.779		
	Total	38658.000	51			
TTCT - Originality_A	Between Groups	1347.557	2	673.778	1.069	.351
	Within Groups	30882.135	49	630.248		
	Total	32229.692	51			
TTCT - Originality_B	Between Groups	2690.030	2	1345.015	2.366	.104
	Within Groups	27852.797	49	568.424		
	Total	30542.827	51			

TTCT - Flexibility_A	Between Groups	145.101	2	72.551	.678	.512
	Within Groups	5243.726	49	107.015		
	Total	5388.827	51			
TTCT - Flexibility_B	Between Groups	71.291	2	35.645	.480	.622
	Within Groups	3640.767	49	74.301		
	Total	3712.058	51			

Discussion, Conclusions, Limitations, and Further Recommendations

The present study predicted that third places would show higher creativity levels compared to traditional and high-tech spaces. However, the hypothesis was not supported, and there were no significant differences in creativity levels between the three spaces. The creativity levels of the students who were occupying the third places did not seem to be positively affected by the space. This latter finding suggests that there was no positive effect of the third place on creativity levels in this study.

The research hypothesis was as follows:

H_1: Students in the third place will have a statistically significant higher creativity response than students in traditional and high-tech studio spaces.

The results have revealed that there is no statistically significant difference in creativity levels between the third place, high-tech space, and traditional space. These results constitute evidence that contradicts the existing research findings, which suggest that a third place has a positive impact on human behavior and ways of thinking (Campbell, 2015; Campbell, 2014; Waxman, 2006).

The previous research findings regarding the positive impact of third place on human behavior were not confirmed in this study (Campbell, 2015; Campbell, 2014; Waxman, 2006). Instead, this research found no statistically significant difference in the creativity levels between the third place, high-tech space, and traditional space. This finding indicates that the third place had no positive impact on the students' creativity levels in this study, compared to the high-tech and traditional spaces. This contrary finding may be due to the short time spent in the third place by the students. A potential explanation could be that only spending three hours in a space is not sufficient to have a significant impact on students' creativity.

Another explanation for the contradiction between the results of this research and those of previous studies is that other factors might have significantly impacted the creativity enhancement, such as creativity training being implemented in the courses throughout the education curriculum in the design programs and an increased focused on the creative problem-solving process in the design projects (Kvashny, 1982). Also, the findings of Demir (2005) suggest that brainstorming sessions will positively impact university students' creative performance in long-term projects. Furthermore, other factors might also impact creativity, such as the instructor's teaching philosophy, which will shape his/her way of delivering information to students. These factors might have a stronger impact on creativity, but there were not assessed in this study.

Also, it should be noted that, since both measurement tools were validated and reliable, and the sample was randomized; it seems as if other factors may have also impacted the results. For example, the main problem with the results may be the time range of the study, and the amount of time the participants spent in the third place.

As the previous literature suggests that the interior environment will change human behavior over time, there are no specific numbers suggested as to the length of time needed to change human behavior (Sufara *et al*., 2012). The researcher suggests that the main limitation of the present study was probably time. In total, the participants spent three hours in the space; this was the same for all three spaces. In light of the results of this study, the researcher would argue that the participants need to spend more time in the spaces prior to the analysis. For instance, this could be over a full academic semester, which ranges from 14 to 16 weeks.

In addition, it is the researcher's view that the length of the tests was another factor that affected the results of the study, as based upon reports from the study participants, by the end of the sessions they were fatigued, due to the fact that all of the tests were done with pencil and paper. There were four main tests used in the study, two RAT and two TTCT-Verbal. Each RAT test was comprised of 10 questions, and each TTCT-Verbal test consisted of five activities. All of the TTCT-Verbal tests involved intensive writing, which may have caused the participants to become tired, especially after the first session, since they spent approximately an hour and a half on an intensive writing task.

As can be seen from the different results of different studies of creativity and third place, there is no clear conclusion about the impact of third place on creativity. More research needs to be done in this area, taking into account the limitations of the present study, and the factors that impact creativity presented in the previous literature, in order to provide more inclusive conclusions and findings, which will help shape new learning environments.

The results of this research suggest that students' creativity was not impacted by their being in a third place. Furthermore, the participants' scores in TTCT-Verbal pre-tests were higher than in the post-test scores, which indicates that in fact there was a negative impact on

their creativity levels during the course of the study. The researcher attributes these results to the intensive nature of the TTCT-Verbal test. Again, the primary explanation for this trend is fatigue due to the large amount of writing required by the tests, especially the TTCT-Verbal test. Another factor was that the number of participants in this study was low; if there had been more participants, there may have been different trends in the results and a greater opportunity for significant differences to be seen.

The paired t-test also revealed that there was a positive significant change in each space between the pre-tests and post-tests. While the post- RAT test results were significantly higher in all three spaces than were the pre- RAT test results, that was not true for the TTCT-Verbal test. The post- TTCT-Verbal test results were significantly lower than the pre- TTCT-Verbal test results, except for originality in the traditional space, where the differences were non-significant. These results indicate a difference between the two measurement scales, which are supposed to measure the same variable, i.e., creativity.

One explanation for the significant difference between the two measurement tools is due to the differences in complexity and structure of each tool. The RAT is simpler, shorter and does not require as much writing or effort to complete the task. By contrast, the TTCT-Verbal is lengthier and more sophisticated and involves a lot of writing.

These differences are related to the earlier suggestion that fatigue had a significant impact on the results of the tests. The last test the students took was the post- TTCT-Verbal test and the participants were fatigued at the end of the session. That fatigue may have led to the significant change in the TTCT-Verbal scores and the conflict between those and the RAT test scores.

Returning to the idea of time pressure, the fact that the participants had to finish four creativity assessment tests in approximately three hours may also have impacted their

performance, and increased the pressure on them. This would be consistent with Amabile *et al*.'s (2002) findings that when people are time pressured they tend to focus more on producing and finishing the task than on reflecting and going through the creative thinking process. This limitation of the time frame of the study is an important variable that needs to be further studied in order to understand the relationship of time to the other aspects of the work and learning environment in their effect on creativity (Amabile, 2012; Amabile *et al*., 2002).

The results of this study are not consistent with the previous qualitative research that suggests that human behavior, and students' creativity, will improve and evolve through collaboration and socialization, which is the basis of the concept of third place (Waxman, 2006; Hameed & Amjad, 2009; Sufara *et al.,* 2012; Hyayy, 2014; Memarovic *et al.,* 2014). However, these findings must be considered in light of limitations including time constraints and a small sample size: (N = 52), (19) in the traditional space, (14) in the high-tech space, and (19) in the third place. In addition, the sample was drawn from only two departments, and was quite homogeneous, being made up of predominantly females (n = 49, 94.2%) and Caucasians (n= 43, 82.7%).

The small sample size is one limitation that might have affected the results of the study. Having a larger sample would provide more data, more insight, and thus more informative results. The low participation rate might be due to the relativity long time that the study consumed, from the perspective of a student. Informal conversations with some participants after the study revealed that many of them had complaints regarding the length of the session. Some indicated that many of their peers had been interested in participating in the study but declined when they found out that it was three hours long. This limitation can be overcome by offering

more incentives and rewards to participants, and trying to reduce the amount of time that the study requires from the participants.

Furthermore, to increase the number of participants, the number of institutions involved in the study could be increased. By doing so, the study could expand on a regional or national scale, which could provide more meaningful results and thus greater insights regarding the differences in the effect of space on creativity across different institutions, regions, or states.

Also, some of the factors that may have impacted participants' performance were external factors. First, all of the participants except one were enrolled in a design program. Being design students means that the participants were under a lot of pressure to finish their classwork projects and assignments. Since most design students have at least one or more studio class per semester, it is reasonable to assume that they are under significant pressure. To compound this, since the nature of their projects requires a lot of creative thinking, and this might have affected their performance if they were overwhelmed or tired due to their workload, which may have affected the way they perceived the tests. Factors such as time pressure and the mental states of the participants right before participating in the study were not assessed in the previous research of the impact of third place on human behavior. Therefore, these factors might have affected the participants' performance in all three spaces.

Another external factor potentially affecting the study results is the familiarity with the space, since many of the students had been using the studios in which the study took place. This familiarity was mostly related to the traditional studio, where many of the students had studied and worked. In order to overcome this limitation, further testing should take place in a space where the participants have not previously had classes. Also, comparing spaces that the

participants are familiar with and other spaces that the participants are not familiar with might yield some interesting findings.

Whilst there is little literature on the impact of space familiarity on human behavior or ways of thinking, a study by Erten and Razı (2009) does show that cultural familiarity with a reading task can facilitate and improve comprehension and understanding. Therefore, the results obtained by Erten and Razı (2009) regarding cultural familiarity can potentially be correlated with familiarity with space and its impact on human behavior and creativity. The effect of familiarity with the space may be present in this study, as shown by the higher creativity levels in the traditional space than in the third place.

Further research in this area is suggested due to the lack of literature investigating the impact of a third place on creativity. A larger sample size could provide more definitive results. Moreover, a longitudinal study beginning at the start of the academic semester, where a pre-test is conducted, the space continues to be used throughout the semester, and a post-test is administered at the end of the semester, would also be beneficial

Further investigation into the impact of the third place will provide helpful information in terms of the design of learning environments and the development of educational policies. Also, using different measurement tools can provide more insights in terms of measuring creativity, and provide insight as to how the results might differ significantly between the different measurement tools.

The results of this study have major implications for the study of the third place and its impact on human behavior and ways of thinking, as the results did not support the previous research findings in terms of the impact of the third place on creativity. The results of this research provide further insights into the many factors that might impact on creativity, and

suggest that the process of creativity improvement should be looked at as a whole, rather than concentrating on separate factors. Another implication of this study is that the space type did not significantly impact creativity levels over a short-term period, suggesting that the time range factor should be taken into account in future studies of the impact of space on creativity.

Furthermore, these results raise more questions about the impact of physical environment on creativity. Is it an isolated factor or is it a range of factors that work together to enhance creativity? This is an important question to be asked since one can see that there is a shift in creating active learning spaces within schools as part of their new and renovated buildings, and further research is needed to gain insights if those active learning spaces are any different than the traditional learning spaces in their impact on creativity. These insights would be highly important to education providers since they are always looking for new strategies to improve the educational process and experience (Oblinger, 2006).

CHAPTER 2: ASSESSING CREATIVITY WITH TWO MEASUREMENT TOOLS: TTCT-VERBAL VERSUS RAT: A COMPARATIVE STUDY

Introduction

Several studies on creativity have shown that it is one of the most important factors in innovation and national growth, and bringing about community benefit (Knox, 2017; Songkram, 2017). However, there are many and varying definitions of creativity, and researchers have yet to agree upon a methodology for defining, controlling, and improving it (Rush, 1999). Livingston (2010) claimed that the application of creativity and creative thinking in a way that improves people's lives means that it can be a force for good and a great influence on the community. In order to understand creativity and creative thinking, especially in a learning situation, it is important to understand the process of assessing creativity. However, despite the unknowable and flexible nature of creativity, many researchers have tried to create tools to assess creativity, and to compare these tools in terms of creativity assessment methods (Benedek, Nordtvedt, Jauk, Koschmieder, Pretsch, Krammer, & Neubauer, 2016; Lu, & Luh, 2012).

Two of the most common tests used to assess creativity are the Remote Associates Test (RAT), and the Torrance Tests of Creative Thinking (TTCT) (Oman, Tumer, Wood, & Seepersad, 2013; Kaufman, Plucker & Russell, 2012). The RAT is more focused on the assessment of the general creativity of an individual or group. On the other hand, the TTCT test divides creativity into classifications and categories, namely fluency, flexibility, and originality.

Both tests measure different aspects of creativity, such as cognition and communication, problem-solving, and association and communication. These three factors are considered to be important in assessing creativity (Fields & Bisschoff, 2014), with the three factors represented in different ways in the two tests. RAT gives a general score that represents the general level of

creativity (Smith, Huber & Vul, 2013). The TTCT-Verbal breaks the score down into three separate scores, for fluency, originality, and flexibility, with this information, TTCT-Verbal is able to provide greater insight and information about creativity levels (Kim, 2006). This research seeks to establish whether there is any correlation and/or similarities between the results of the RAT and the TTCT-Verbal.

Problem Statement

Assessing creativity is one of the topics that is being widely studied in the research area of giftedness (Kaufman, Plucker & Russell, 2012)**.** Due to the importance of gaining an in-depth understanding of the most common creativity assessment tools, this research aims to identify which tool is more comprehensive and thus represents a better assessment of creativity, and the level of agreement between the two tools, TTCT-Verbal and RAT. This aim will be achieved by comparing the RAT and the TTCT tools based on students' scores for both tools, which will help to establish the main differences and agreements between the two, and identify which provides more insightful information about the creativity of individuals or groups.

The significance of this study is that it could provide information regarding the agreement between two of the most widely used creativity assessment tools, TTCT-Verbal and RAT. Furthermore, gaining a knowledge of the association levels between the two tools will help future researchers to develop a more comprehensive and inclusive creativity assessment tool, one which might fill the gaps in the TTCT-Verbal and RAT assessments if there are indeed any.

Literature Review

The background section of this research will define creativity, and explain the relevant assessment methods and tools. According to Barbot, Besançon and Lubart (2011), the tools and

methods of creativity assessment have developed alongside research into creativity and the process of understanding the concept of creativity.

Creativity has many definitions and interpretations, depending on how the researcher approaches creativity. In this research, the definition of creativity that will be used relates to the broader spectrum, i.e., "a transformative process of knowing, thinking and doing that embodies elements such as risk-taking, envisaging, engaging, persisting, observing, experimenting, attending to relationships, taking a benign attitude to error, and critically reflecting" (Clarke & Cripps, 2012: 114).

According to this definition, creativity is not related to any single type of thinking or creating. Rather, it is about innovation, observation, and experimenting; and, in order for those skills to be maintained, an appropriate environment must be developed. Gaining an understanding of the measurement of creativity might help in gaining the knowledge that is needed to create the proper environment to enhance creativity, across its wide spectrum and multiple components (Oman, Tumer, Wood, & Seepersad, 2013).

Shawareb describes the different aspects of creativity as follows:

> *"Creative thinking is a novel way of seeing or doing things characterized by four thinking processes: fluency, flexibility, originality and elaboration. Fluency is described as generating many ideas, while flexibility occurs when a person easily shifts his or her perspective about a topic being considered. Originality has been explained as conceiving of new ideas or solutions whereas elaboration is the ability to build on other ideas. When faced with challenges, a creative person is curious, optimistic, able to suspend judgment, and comfortable with imagination. He also tends to seek problems, enjoy challenges, see problems as opportunities*

and as interesting, view problems as emotionally acceptable, challenge assumptions, refuse to give up easily, and persevere" (2011, p 214).

Upon examining the wide range of creativity assessment tools available, it can be observed that those tools can be categorized based on one component or a specific type of creativity that they relate to (Barbot *et al*., 2011). According to Gomez (2007), who also references the work of Donald N. Mackinnon (2005) at the Institute of Personality Assessment and Research Laboratory (IPAR), Berkeley, California, there are three main types of creativity. The first type is artistic creativity, which is a behavior or a way of thinking that represents the individual's inner needs and motivations. The second type is scientific and technological creativity, which is about solving problems and thinking of new and innovative solutions; this type of creativity represents the creator's personality and views. Finally, the third type is hybrid creativity, which is a combination of creative problem-solving and an artistic and innovative representation of the inner self.

In terms of categorizing the wide range of creativity assessment tools, Houtz and Krug (1995) specify the following categories: tests, self-report inventories, personality preference inventories, and environmental indices. However, all of these assessment tools rely on human judgment at some point (Lu, & Luh, 2012). Therefore, a comparison between these assessment tools is an important area to study and explore.

Remote Associate Tests (RAT)

One of the most common measurement tools that are used to measure associative thinking and creative ideas is Mednick and Mednick's Remote Associates Test (RAT) (Barbot *et al.,* 2011). The RAT test is primarily an activity that involves generating a word to connect three different words or concepts (Acar & Runco, 2014). This tool was developed by Sarnoff Mednick

in 1967, and correlates cognitive abilities with the creative thinking process, such as divergent thinking (Kudrowitz, 2010). Individuals taking the test read three different words, and are given time to think of a word that connects the three given words (Kudrowitz, 2010). This tool is mainly used to measure convergent thinking (Acar & Runco, 2014).

As a measurement tool, the RAT helps to study problem-solving abilities, by providing problems that are designed to have a unique best solution (Smith, Huber & Vul, 2013). Also, Mednick (1962) found that the RAT results correlated with real-world problem-solving abilities and creativity, which will help in making informed decisions regarding individual differences in terms of creativity levels.

For this research, the RAT test was the first tool used in this study to measure creativity, followed by the TTCT, and a comparison was done between the results yielded by the two tools. Using the results, the researcher was trying to understand whether there was any consistency and association between the scores for the two tests, and whether they correlated with each other.

Torrance Tests of Creative Thinking (TTCT)

The main focus of the TTCT is creative potential, and on this basis the TTCT test was constructed. It was developed in such a way that it would provide insight into what factors can improve and nurture creativity (Kaufman *et al*., 2012). There are two types of test, the TTCT-Verbal, and the TTCT-Figural. The TTCT-Verbal has two parts, A and B, with five activities in each: ask-and-guess, product improvement, unusual uses, unusual questions, and just suppose (Shawareb, 2011). The TTCT-Figural has two forms, A and B, and each form has five activities: picture construction, picture completion, and repeated figures of lines or circles (Shawareb, 2011).

In this research, the TTCT-Verbal was used, in order to be consistent with the other tool used (RAT). The TTCT has been verified in terms of its validity and reliability, and it has been used and verified by evaluating students' creativity not only with gifted students, but also in the process of finding and motivating everyday creative thinking and creative lifestyles (Kim, 2006; Hersen, 2004). Additionally, Kaufman, and Lichtenberger (2011) and Houtz and Krug (1995) confirm that the TTCT is one of the best-known tests of creativity and it features both verbal and figural tests.

Research hypotheses

This research aims to reveal new insights in the field of creativity assessment by comparing the two main measurement tools. Therefore, it is hypothesized that both measurement tools will show correlation and association between their scores. The hypothesis of this research is presented below:

- H_1: The results of students' creativity levels will show a positive correlation and association between the TTCT-Verbal and RAT (e.g., if RAT shows improvement, TTCT-Verbal will also show improvement).

Research Methods

The research followed an experimental quantitative method. The following section will describe the participants, tools and materials, and procedures involved in this study.

Participants

The sample for this research was design students in two southeastern U.S. universities. After obtaining institutional review board approval, the participants were recruited by posting announcements regarding the study. The announcement was printed on 8.5" by 11" paper with the following statement: "get a free creativity assessment and a $5 Starbucks gift card, reserve

your seat now for more info," and posted in the classrooms and hallways of both departments. Also, course instructors were emailed with information about the study and asked to share it with their students.

Measurement Tool

The tools used in this research are creativity assessment tools. The first tool was the pre- and post-test versions of the RAT test, A and B. The second tool is the pre- and post- TTCT-Verbal, with two forms, A and B. In the time between completing the two test forms, participants were engaged in two tasks; first, discussion questions, and second, creating a balanced abstract with three pieces of paper with different shapes. The students were provided with the tests, paper, and pencils required for the experiment. The discussion questions and balance abstract outcomes were not analyzed, since they are not considered to be creativity assessment tools, there were only used to provide a thinking break.

The third measurement used in this research was the Creative Achievement Questionnaire (CAQ). This questionnaire is made up of a self-report scale relating to participants' creative achievement across ten sectors of creativity (Carson, et al., 2005). The ten domains are visual arts, music, dance, architectural design, creative writing, humor, invention, scientific discovery, theater and film, and culinary arts (Carson, et al, 2005). Based on the CAQ results, the students were divided into three groups, with an equal distribution of students across the groups, in terms of their previous creative achievements. The CAQ results were not analyzed furthure since not all the participants who completed it participated in the study.

Each RAT test was comprised of ten questions. In addition, the TTCT featured five activities on each form. The participants were given 15 minutes to complete each RAT form, and approximately 50 minutes to complete each TTCT form.

Examples of the RAT test that was created by Mednick (1962) are provided in Appendix (1).

The following is a description of the TTCT-Verbal activities:

- Ask-and-Guess: the participant is asked to look at a picture at the beginning of the test booklet, and to complete three sub-tasks:

    - Asking: the participant asks as many questions as possible about the picture; for example, a participant might ask, "what is the elf looking for?" And "why is he alone?"
    - Guessing Causes: the participant lists possible causes for the pictured action; for example, a participant might write, "the elf is trying to find out who he really is."
    - Guessing Consequences: the participant lists possible consequences of the pictured action; for example, a participant might write, "The elf falls into the water."
    - Product Improvement: the participant is asked to make changes to improve a toy; for example, a participant might write, "Make it fluffier."
    - Unusual Uses: the participant is asked to think of as many different uses for an ordinary item as possible; for example, a participant might write, "a spaceship," or "small house."
    - Just Suppose: the participant is asked to "just suppose" an improbable situation has happened, then list the possible ramifications. For example, a participant might write, "a lot of people would choose to be in heaven," or "Tarzan, is that you?"

All the measurements used in the study have been confirmed to be valid and reliable by multiple researchers (Mednick, 1962; Carson *et al*., 2005; Shawareb, 2011).

Procedures

This research compared two tools used to measure creativity and creative thinking, namely the RAT and the TTCT-Verbal. The participants were asked to complete the two tests so that their scores on the two tests could be compared, in an attempt to understand what the two tools reveal.

The study setting was controlled. The research took place in three classrooms at two universities in the southeastern part of the United States of America. Flyers describing the research and inviting participation were posted in the design department hallways and classrooms. Also, the research information was sent to students via email by faculty in each department.

The students who were interested in participating in the study sent an email to the researcher to obtain a link to the CAQ survey which the students completed prior to the study. On the day of the study. The researcher met the participants and divided them into three groups. Each group was sent to a classroom, and a ten-minute instruction section took place.

The sequence of the study was as follows:

- Ten-minute introduction and briefing about the study.
- Pencils were handed out.
- RAT A tests were handed out and the participants had 15 minutes to complete the form.
- TTCT A tests were handed out, followed by instruction on how to fill it out and a description of each activity, as well as the time limits for each task. The whole TTCT A test process took approximately 50 minutes to finish the TTCT-Verbal A.
- Then, students were given a break.
- Discussion questions were given to the students, with a 10-minute time limit.

- A 10-minute exercise was distributed to the students as a break from the intensive thinking required for the tests.
- RAT B tests were handed out, and the participants had 15 minutes to complete the form.
- TTCT B tests were handed out, followed by instruction on how to fill it out and a description of each activity, as well as the time limits for each task. The whole TTCT B test process took approximately 50 minutes.
- At the end of the study session, the participants were thanked, and left the classrooms.

Data Analysis and Results

This section presents the data analysis and results derived from the comparison of the two measurement tools. A total of 52 participants took part in the study from a targeted sample of 77, which represents a 67.5% response rate. The results were analyzed using SPSS software. The main focus of this section will be to present the gathered data in a meaningful way, in order to provide insight into the relationship between the two measurement tools: TTCT-Verbal and RAT.

Demographics

A total of 52 students participated in the study, 49 females and just three males. Of these, 51 students were design majors, and one student was a music major. There were two graduate students, and the rest were undergraduate students; 15 students came from University one, and 37 were from University two. The participants' education levels were as follows: freshmen (8), sophomores (16), juniors (24), seniors (2), and graduates (2).

The age range of the participants was as follows: 18-20 (35), 21-25 (15, one participant was 35, and one participant was 63. The ethnicities of the participants were as follows: African American (5), Caucasian (43), Asian (2), and Hispanic (2). In terms of the type of teaching

space, the number of participants allocated to each was as follows: traditional studio (19), high-tech classroom (14), and third place (19). The distribution of the students across the different spaces was based on their CAQ survey scores. CAQ scores were divided into three categories, low, medium, and high creativity; each space had an equal number of participants from each category. See Figure 11 below.

Table 11

Descriptive statistics results

Demographics

		Frequency	*Percent*	*Cumulative Percent*
Class	Freshman	8	15.4	15.4
	Sophomore	16	30.8	46.2
	Junior	24	46.2	92.3
	Senior	2	3.8	96.2
	Grad	2	3.8	100.0
	Total	52	100.0	
Gender	Female	49	94.2	94.2
	Male	3	5.8	100.0
	Total	52	100.0	
Age	18	6	11.5	11.5
	19	12	23.1	34.6
	20	17	32.7	67.3
	21	12	23.1	90.4
	22	3	5.8	96.2
	35	1	1.9	98.1
	63	1	1.9	100.0
	Total	52	100.0	
Ethnicity	African American/Black	5	9.6	9.6
	Caucasian/White	43	82.7	92.3
	Asian American/Asian	2	3.8	96.2

	Hispanic/Latino	2	3.8	100.0
	Total	52	100.0	
Space	Traditional	19	36.5	36.5
	High-tech	14	26.9	63.5
	Third place	19	36.5	100.0
	Total	52	100.0	

Data Analysis

The RAT tests were graded by the researcher. Each participant received a score between 1 and 10 based on their test results. The TTCT-Verbal tests were graded by a creative assessment specialized and accredited center in Earth City, Missouri

One-Way ANOVA was applied to the pre- and post- measurement tools, TTCT-Verbal and RAT. The scores for both of the measurement tools, TTCT-Verbal and RAT, were normalized to a score between 0 and 1 to get more meaningful means, since the RAT test scores range from 1 to 10, and the scores for the TTCT-Verbal had no specific range.

For the RAT test, each participant was given one score ranging from 0-10 based on their test results. For the TTCT-Verbal test, each participant received three different scores, for the following areas: fluency, originality, and flexibility. The three parts of the TTCT-Verbal test represent the range of creativity that the test measures, and there is no limit to how high the scores can be.

The study was carried out in three spaces: a traditional design studio, a high-tech studio, and a third place. The spaces were located in the interior design facilities at both universities. The setup consisted of two traditional studios, two high-tech classrooms, and two third places, one of each type of space in each university. However, there was no significant difference in creativity

levels between the three spaces. Therefore, they were all analyzed as one space; this will be explained later on in the article.

Different Creativity Levels between the Three Spaces

There was no statistical difference between the three spaces, as determined by One-Way ANOVA; the results were as follows: TTCT Fluency_A: F (2,49) =1.016, p= .370, TTCT Fluency_B: F (2,49) = 1.628, p= .207. TTCT Originality_A: F (2,49) = 1.069, p= .351, TTCT Originality_B: F (2,49) = 2.366, p= .104. TTCT Flexibility_A: F (2,49) = .678, p= .512, TTCT Flexibility_B: F (2,49) = .480, p= .622. RAT_A: F (2,49) = 2.364, p= .105, RAT_A: F (2,49) = 2.525, p= .090. Therefore, due to the non-significant results of the test, the Tukey post-hoc test also showed non-significant differences between the three spaces based on both pre- and post-tests of TTCT and RAT. The results are also presented in Table (12 and 13). These results led to the decision to analyze the data as one group, not based on the space.

Table 12
One-Way ANOVA results for all three spaces

ANOVA

		Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
RAT_A	Between Groups	3.741	2	1.871	2.364	.105
	Within Groups	38.778	49	.791		
	Total	42.519	51			
RAT_B	Between Groups	34.890	2	17.445	2.525	.090
	Within Groups	338.553	49	6.909		
	Total	373.442	51			
Fluency_A	Between Groups	1839.011	2	919.506	1.016	.370
	Within Groups	44346.989	49	905.041		

	Total	46186.000	51			
Fluency_B	Between Groups	2408.812	2	1204.406	1.628	.207
	Within Groups	36249.188	49	739.779		
	Total	38658.000	51			
Originality_A	Between Groups	1347.557	2	673.778	1.069	.351
	Within Groups	30882.135	49	630.248		
	Total	32229.692	51			
Originality_B	Between Groups	2690.030	2	1345.015	2.366	.104
	Within Groups	27852.797	49	568.424		
	Total	30542.827	51			
Flexibility_A	Between Groups	145.101	2	72.551	.678	.512
	Within Groups	5243.726	49	107.015		
	Total	5388.827	51			
Flexibility_B	Between Groups	71.291	2	35.645	.480	.622
	Within Groups	3640.767	49	74.301		
	Total	3712.058	51			

Table 13
Post-hoc tests results for all three spaces

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Space	(J) Space	*Mean Difference (I-J)*	*Std. Error*	*Sig.*
RAT_A	Traditional	High_tech	.68045	.31334	.086
		Third_Space	.31579	.28863	.522
	High_tech	Traditional	-.68045	.31334	.086
		Third_Space	-.36466	.31334	.480
	Third_Space	Traditional	-.31579	.28863	.522

		High_tech	.36466	.31334	.480
RAT_B	Traditional	High_tech	2.07895	.92583	.074
		Third_Space	.94737	.85281	.512
	High_tech	Traditional	-2.07895	.92583	.074
		Third_Space	-1.13158	.92583	.446
	Third_Space	Traditional	-.94737	.85281	.512
		High_tech	1.13158	.92583	.446
TTCT Fluency_A	Traditional	High_tech	-13.049	10.596	.441
		Third_Space	.684	9.761	.997
	High_tech	Traditional	13.049	10.596	.441
		Third_Space	13.733	10.596	.404
	Third_Space	Traditional	-.684	9.761	.997
		High_tech	-13.733	10.596	.404
TTCT Fluency_B	Traditional	High_tech	-5.669	9.580	.825
		Third_Space	10.947	8.824	.435
	High_tech	Traditional	5.669	9.580	.825
		Third_Space	16.617	9.580	.203
	Third_Space	Traditional	-10.947	8.824	.435
		High_tech	-16.617	9.580	.203
TTCT Originality_ A	Traditional	High_tech	-9.406	8.842	.541
		Third_Space	3.263	8.145	.915
	High_tech	Traditional	9.406	8.842	.541
		Third_Space	12.669	8.842	.332
	Third_Space	Traditional	-3.263	8.145	.915
		High_tech	-12.669	8.842	.332
TTCT Originality_B	Traditional	High_tech	-4.481	8.398	.855
		Third_Space	12.579	7.735	.244
	High_tech	Traditional	4.481	8.398	.855
		Third_Space	17.060	8.398	.115
	Third_Space	Traditional	-12.579	7.735	.244
		High_tech	-17.060	8.398	.115
TTCT Flexibility	Traditional	High_tech	1.635	3.644	.895
		Third_Space	3.895	3.356	.482
	High_tech	Traditional	-1.635	3.644	.895
		Third_Space	2.259	3.644	.810
	Third_Space	Traditional	-3.895	3.356	.482
		High_tech	-2.259	3.644	.810
TTCT	Traditional	High_tech	-.722	3.036	.969

Flexibility_B		Third_Space	2.053	2.797	.745
	High_tech	Traditional	.722	3.036	.969
		Third_Space	2.774	3.036	.634
	Third_Space	Traditional	-2.053	2.797	.745
		High_tech	-2.774	3.036	.634

The results of the One-Way ANOVA indicated that there was no significant difference in creativity between the three spaces for both tests TTCT-Verbal and RAT. Therefore, a Pearson's Correlation test was conducted on all of the participants' scores altogether.

Pearson's Correlation was applied to the pre- and post- measurement tools to establish whether there were a correlation and association between TTCT-Verbal and RAT. An Alpha level of .05 was used to determine any statistical significance in the differences between the two measurement tools. It was hypothesized that the students' creativity level results would show a positive correlation and association between the TTCT-Verbal and RAT. A series of Pearson's Correlation tests were computed using SPSS to test this prediction.

Association between TTCT-Verbal and RAT

A Pearson's Correlation test was applied to the pre-tests and post-tests individually. The Pearson's Correlation was computed in order to determine whether there was any correlation and association between the TTCT-Verbal factors, namely fluency, originality, and flexibility, and the RAT test scores. The results revealed that none of the correlations and associations were statistically significant. The correlations and associations were as follows: RAT_A and TTCT Fluency_A ($r = .133$, $n = 52$, $p = .346$). RAT_A and TTCT Originality_A ($r = .135$, $n = 52$, $p = .338$). RAT_A and TTCT Flexibility_A ($r = .083$, $n = 52$, $p = .559$). RAT_B and TTCT Fluency_B ($r = .076$, $n = 52$, $p = .591$). RAT_B and TTCT Originality_B ($r = .063$, $n = 52$, $p =$

.656). RAT_B and TTCT Flexibility_B (r = .085, n = 52, p = .551). See Tables 14 through 17 below.

Table 14
Descriptive statistics for all three spaces, pre-test

Descriptive Statistics

	Mean	*Std. Deviation*	*N*
RAT_A	.5962	.91308	52
Fluency_A	88.00	30.093	52
Originality_A	65.08	25.139	52
Flexibility_A	45.56	10.279	52

Table 15
Pearson's Correlation Results for RAT and TTCT-Verbal, pre-test

Correlations

		RAT_A	*Fluency_A*	*Originality_A*	*Flexibility_A*
RAT_A	Pearson's Correlation	1	.133	.135	.083
	Sig. (2-tailed)		.346	.338	.559
	N	52	52	52	52

**. Correlation is significant at the level of 0.01 (2-tailed).

Table 16
Descriptive statistics for all three spaces, post-test

Descriptive Statistics

	Mean	*Std. Deviation*	*N*
RAT_B	3.6731	2.70599	52
Fluency_B	71.00	27.532	52
Originality_B	54.56	24.472	52
Flexibility_B	38.87	8.531	52

Table 17
Pearson's Correlation Results for RAT and TTCT-Verbal, post-test

Correlations

		RAT_B	*Fluency_B*	*Originality_B*	*Flexibility_B*
RAT_B	Pearson's Correlation	1	.076	.063	.085
	Sig. (2-tailed)		.591	.656	.551
	N	52	52	52	52

**. Correlation is significant at the level of 0.01 (2-tailed).

After conducting a correlation analysis, a paired t-test was also carried out to calculate the mean change in the two measurement tools between the pre- and post-tests.

Pre-Post Test Results

A paired t-test was run on the sample (N=52) to determine whether there was a statistically significant difference between the means of the Pre-Post RAT and TTCT-Verbal. A statistically significant increase in the RAT test scores, and a decrease in the TTCT-Verbal fluency, flexibility, and originality was found. The results of the test were as follows: RAT: t (52) = -9.909, p = .000. TTCT Fluency: t (51) = 7.325, p = .000. TTCT Originality: t (51) =5.328, p = 0.000. TTCT Flexibility: t (51) = 5.282, p = .000. See Tables 18 and 19 below.

Table 18
Paired sample statistics for RAT and TTCT-Verbal.

Paired Sample Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
Pair 1	RAT_A	.5962	52	.91308	.12662
	RAT_B	3.6731	52	2.70599	.37525
Pair 2	TTCT Fluency_A	88.00	52	30.093	4.173
	Fluency_B	71.00	52	27.532	3.818
Pair 3	TTCT Originality _A	65.08	52	25.139	3.486
	Originality _B	54.56	52	24.472	3.394
Pair 4	TTCT Flexibility _A	45.56	52	10.279	1.425
	Flexibility _B	38.87	52	8.531	1.183

Table 19
Paired sample t-test for RAT and TTCT-Verbal.

Paired Sample Test

		Paired Differences					*t*	*df*	*Sig. (2-tailed)*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference* *Lower*	*Upper*			
Pair 1	RAT_A - RAT_B	-3.07692	2.23910	.31051	-3.70029	-2.45355	-9.909	51	.000
Pair 2	TTCT Fluency_A - Fluency_B	17.000	16.736	2.321	12.341	21.659	7.325	51	.000
Pair 3	TTCT Originality_A - Originality_B	10.519	14.237	1.974	6.556	14.483	5.328	51	.000
Pair 4	TTCT Flexibility_A - Flexibility_B	6.692	9.136	1.267	4.149	9.236	5.282	51	.000

Discussion, Conclusions, Limitations, and Further Recommendations

The present study predicted that both measurement tools would be correlated and associated, since they measure the same variable. The hypothesis is presented below:

- H_1: The results for students' creativity levels will show a positive correlation and association between the TTCT-Verbal and RAT (e.g., if RAT shows improvement, TTCT-Verbal will also show improvement).

This hypothesis aims towards obtaining an understanding of the subjectivity of the assessment process of creativity, and represents an attempt to add to the existing body of literature to improve the understanding of creativity assessment tools. The results of this study led to the rejection of the hypothesis, as there was a non-significant correlation between the results of the two measurement tools. Also, in terms of the trend in the results for both tools, TTCT-Verbal and RAT, there were conflicting results, where the results showed that there was an improvement in the pre- and post-tests of the RAT. On the other hand, the TTCT-Verbal results showed a decrease in creativity levels between the pre- and post-tests.

Returning to the correlation results, there was a non-statistically significant correlation between the RAT and the TTCT-Verbal tests. The results of the correlation test were consistent with previous research, where there was no correlation or association between the two tests in terms of students' performance in an educational setting (Zeng, Proctor & Solvency, 2011). This result provides some insight into how each measurement tool is different from the other. Even if they measure the same variable, there will still be variance in the results. This non-significance of the correlation might be due to the different nature of each measurement tool, where RAT measures divergent and convergent thinking in general, while TTCT-Verbal only measures creative potential based on three main spectrums: fluency, originality, and flexibility (Lemons, 2011).

The variance between the creativity level scores of the two measurement tools can be explained in many ways. First, the level of detail within each test is very different; RAT is a very simple test compared to TTCT-Verbal. Whereas the level of detail in the TTCT-Verbal test is very high, where it measures three main factors of creativity: fluency, originality, and flexibility. However, the RAT test main focus is on problem-solving and association relationships and it is

less detailed than TTCT-Verbal. This difference in the focus of each test might be one of the reasons for the variance in the results.

Furthermore, what is interesting when looking at the correlation tests results, is that even though all of the results were non-significant, all of the relationships were positive. This suggests that all, or most, creativity factors are connected in some way to complete the overall spectrum of creativity. Furthermore, understanding those relationships, even if they are non-significant in this small scale study, can perhaps contribute to the development of creativity assessment, and to the development of a new comprehensive measurement tool that covers all, or most, creativity factors.

On the other hand, looking at the paired *t-test* results, there was a conflict in the results between the pre- and post- measurements, where there was a significant improvement in the RAT test results, but there was a decrease in creativity levels according to the TTCT-Verbal results. Looking at these different results, the researcher would suggest that this is due to the nature and intensity of each tool, where the RAT test is simpler and shorter compared to the TTCT-Verbal, which involves a lot of writing and takes more time to complete.

This suggests that fatigue might have had an impact on participants' performance. Where each of the RAT tests takes around 15 minutes to complete, each of the TTCT-Verbal test takes approximately 50 minutes to complete. This might have caused the participants to become fatigued, especially when they came to the post-test for the TTCT-Verbal, which was an hour and 25 minutes after the initial start of the study.

In light of the results presented here, two main limitations to the study can be identified. First, the low number of participants (N= 52), and the fact that the sample was drawn from only two departments, made up of predominantly females (n = 49, 94.2%) and Caucasians (n= 43,

82.7%). Second, the length of the study which was three hours was short; the time limitation of the study might have affected the results. For future research, it would be suggested to make a study over the length of the semester, where the participants take the pre- tests, and keep using the space during the semester, and by the end of the semester, they would take the post- tests.

Finally, based on the results of this research, it is recommended that future research tests creativity should use multiple measurement tools. Specifically, the RAT and TTCT tests should be used together when assessing creativity, and the agreement between the two tools should be measured. This might provide insight into the factors that might affect general creativity (from the RAT) and obtain more specific data relating to the three main creativity spectrums (from the TTCT-Verbal).

Further research comparing creativity assessment tools might help develop the understanding of the gaps between the different assessment tools, which will help researchers to develop new and improved assessment tools for creativity. Also, a larger sample size could provide more meaningful results. Moreover, as mentioned earlier, the length of the study should also be considered; specifically, more time should be spent on the comparison between measurement tools, in order to produce more meaningful results and insights.

The implications of this study are relevant to researchers seeking to measure creativity. The findings of this research indicate that two tools for measuring creativity, TTCT-Verbal and RAT, show different levels of creativity, which suggests that researchers need to take this into consideration when trying to measure creativity. Also, when choosing a measurement tool, the researcher should ask the following questions: what population is the tool intended to measure? were both tools, TTCT-Verbal and RAT, should be used on students in general, and not design students in specific.

The results of this study are limited to the population studied and it is hard to generalize the conclusions to other populations. However, many questions can be raised for additional research on the agreement between creativity assessment measurement tools, and the possibilities of creativity a more comprehensive creativity assessment tool that can help in creating more generalizable and inclusive conclusions.

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Appendix 1

Appendix 1: Torrance Tests of Creative Thinking

Table 1. Description of the Torrance Tests of Creative Thinking (TTCT): Verbal

Name of Test and Subtests	*Description*	*Rationale*	*Creative Factors*
Activity 1 *Ask and Guess*	This activity requires the person to ask questions based on drawings on a page.	The *Asking* activity reveals a person's ability to sense what a person is unable to discern by looking at a picture and to ask questions to fill in gaps in knowledge. Curiosity is the indispensable element of inquiry and scientific creativity.	• Fluency—relevant responses • Flexibility—different categories/shifts in thinking • Originality—uncommon, original responses
Activities 2/3 *Guessing Causes* and *Guessing Consequences*	These activities require the person to make guesses about causes and consequences of happenings related to a drawing.	The *Guessing Causes* and *Guessing Consequences* activities are designed to reveal a person's ability to formulate cause and effect.	
Activity 4 *Product Improvement Activity*	The person thinks of as many ways as possible to change a toy animal to make it more fun to play with.	This activity taps the person's ability to develop and play with ideas.	• Fluency • Flexibility • Originality
Activity 5 *Unusual Uses Activities*	The person devises as many uses as possible for objects, such as tin cans or cardboard.	This activity tests a person's ability to think originally.	• Fluency • Flexibility • Originality
Activity 6 *Just Suppose Activity*	The person predicts possible outcomes and consequences of an improbable situation.	This activity is a test for the ability to "play with" ideas and consequences, and often is an indication of degree of imagination.	• Fluency • Flexibility • Originality

Appendix 2

Form-A

Name:_____ Email:_____

Room:_____

Remote Associates Test

Each of the ten problems below consists of three "clue" words. For each problem, please think of a forth word that relates to each of the other three "clue" words. Write you response on the line alongside each problem.

Example:

Elephant–Lapse–Vivid *Answer:* Memory

---

1. Bass–Complex–Sleep _____
2. Chamber–Staff–Box _____
3. Desert–Ice–Spell _____
4. Base–Show–Dance _____
5. Inch–Deal–Peg _____
6. Soap–Shoe–Tissue _____
7. Blood–Music–Cheese _____
8. Skunk–Kings–Boiled _____
9. Jump–Kill–Bliss _____
10. Shopping–Washer–Picture _____

Appendix 3

Form-B

Name:_____ Email:_____

Room:_____

Remote Associates Test

Each of the ten problems below consists of three "clue" words. For each problem, please think of a forth word that relates to each of the other three "clue" words. Write you response on the line alongside each problem.

Example:

Elephant–Lapse–Vivid *Answer:* Memory

---

1. Athletes–Web–Rabbit _____
2. Shelf–Read–End _____
3. Sea–Home–Stomach _____
4. Car–Swimming–Cue _____
5. Board–Magic–Death _____
6. Walker–Main–Sweeper _____
7. Cookies–Sixteen–Heart _____
8. Chocolate–Fortune–Tin _____
9. Lounge–Hour–Drink _____
10. Keel–Show–Row _____

Appendix 4
Creative Achievement Questionnaire

1. Place a check mark beside the areas in which you feel you have more talent, ability, or training than the average person.

__ Visual arts (painting, sculpture)

__ Music

__ Dance

__ Individual sports (tennis, golf)

__ Team sports

__ Architectural design

__ Entrepreneurial ventures

__ Creative writing

__ Humor

__ Inventions

__ Scientific inquiry

__ Theater and film

__ Culinary arts

2. Place a check mark beside sentences that apply to you. Next to sentences with an asterisk (*), write the number of times this sentence applies to you.

A. Visual Arts (painting, sculpture)

__ 0. I have no training or recognized talent in this area. (Skip to Music).

__1. I have taken lessons in this area.

__2. People have commented on my talent in this area.

__3. I have won a prize or prizes at a juried art show.

__4. I have had a showing of my work in a gallery.

__5. I have sold a piece of my work.

__6. My work has been critiqued in local publications.

*__7. My work has been critiqued in national publications.

B. Music

__0. I have no training or recognized talent in this area (Skip to Dance).

__1. I play one or more musical instruments proficiently.

__2. I have played with a recognized orchestra or band.

__3. I have composed an original piece of music.

__4. My musical talent has been critiqued in a local publication.

__5. My composition has been recorded.

__6. Recordings of my composition have been sold publicly.

*__7. My compositions have been critiqued in a national publication.

C. Dance

__0. I have no training or recognized talent in this area (Skip to Architecture)

__1. I have danced with a recognized dance company.

__2. I have choreographed an original dance number.

__3. My choreography has been performed publicly.

__4. My dance abilities have been critiqued in a local publication.

__5. I have choreographed dance professionally.

__6. My choreography has been recognized by a local publication.

*__7. My choreography has been recognized by a national publication.

D. Architectural Design

__0. I do not have training or recognized talent in this area (Skip to Writing).

__1. I have designed an original structure.

__2. A structure designed by me has been constructed.

__3. I have sold an original architectural design.

__4. A structure that I have designed and sold has been built professionally.

__5. My architectural design has won an award or awards.

__ 6. My architectural design has been recognized in a local publication.

*__7. My architectural design has been recognized in a national publication.

E. Creative Writing

__0. I do not have training or recognized talent in this area (Skip to Humor).

__1. I have written an original short work (poem or short story).

__2. My work has won an award or prize.

__3. I have written an original long work (epic, novel, or play).

__4. I have sold my work to a publisher.

__5. My work has been printed and sold publicly.

__6. My work has been reviewed in local publications.

*__7. My work has been reviewed in national publications.

F. Humor

__0. I do not have recognized talent in this area (Skip to Inventions).

__1. People have often commented on my original sense of humor.

__2. I have created jokes that are now regularly repeated by others.

__3. I have written jokes for other people.

__ 4. I have written a joke or cartoon that has been published.

__5. I have worked as a professional comedian.

__6. I have worked as a professional comedy writer.

__7. My humor has been recognized in a national publication.

G. Inventions

__0. I do not have recognized talent in this area.

__1. I regularly find novel uses for household objects.

__2. I have sketched out an invention and worked on its design flaws.

__3. I have created original software for a computer.

__4. I have built a prototype of one of my designed inventions.

__5. I have sold one of my inventions to people I know.

*__6. I have received a patent for one of my inventions.

*__7. I have sold one of my inventions to a manufacturing firm.

H. Scientific Discovery

__0. I do not have training or recognized ability in this field (Skip to Theater

__1. I often think about ways that scientific problems could be solved.

__2. I have won a prize at a science fair or other local competition.

__3. I have received a scholarship based on my work in science or medicine.

__4. I have been author or coauthor of a study published in a scientific journal.

*__5. I have won a national prize in the field of science or medicine.

*__6. I have received a grant to pursue my work in science or medicine.

__7. My work has been cited by other scientists in national publications.

I. Theater and Film

__0. I do not have training or recognized ability in this field.

__1. I have performed in theater or film.

__2. My acting abilities have been recognized in a local publication.

__3. I have directed or produced a theater or film production.

__4. I have won an award or prize for acting in theater or film.

__5. I have been paid to act in theater or film.

__6. I have been paid to direct a theater or film production.

*__7. My theatrical work has been recognized in a national publication.

J. Culinary Arts

__0. I do not have training or experience in this field.

__1. I often experiment with recipes.

__2. My recipes have been published in a local cookbook.

__3. My recipes have been used in restaurants or other public venues.

__4. I have been asked to prepare food for celebrities or dignitaries.

__5. My recipes have won a prize or award.

__6. I have received a degree in culinary arts.

*__7. My recipes have been published nationally.

K. Please list other creative achievements not mentioned above.