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A STUDY ON CURRICULUM DEVELOPMENT TO PROPOSE A NEW DESIGN EDUCATION MODEL: FOCUSED ON USING THE CREATIVE THINKING STYLE INDEX(CTSI) TO ENHANCE COLLABORATIVE CREATIVITY.

Kyungwon Kim^{*a}, Juyoung Chang^a

a Dongseo University, College of Design, Republic of Korea

* kkw770@gdsu.dongseo.ac.kr

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ABSTRACT | This study introduces a pedagogical approach in design education, using the Creative Thinking Style Index (CTSI) to foster collaborative creativity among students. It responds to educational changes driven by rapid technological and cultural shifts, emphasizing the need for collaborative and self-directed learning, especially for Generation Z students influenced by digital personalization trends.

The research highlights the growing importance of creativity in education, driven by the democratization of creative work through digital platforms. It highlights the personalized learning preferences of Generation Z and the urgent need for education systems to promote more collaborative learning methods. The study identifies a gap in current design education in Asia, particularly in South Korea, where students are not adequately prepared to meet the collaborative and creative demands of today's world.

The aim of the study is to propose a new model of design education that focuses on self-directed and collaborative relationships and enhances creative skills through the CTSI. This involves a comprehensive analysis of creative thinking styles and the experimental implementation of a curriculum that promotes collaborative learning. The methodology includes a sequential literature review and the practical application of the CTSI in curriculum development to enhance collaborative creativity and problem solving. Findings indicate that the CTSI effectively enhances students' creative thinking styles and fosters a more collaborative learning environment. The CTSI-integrated curriculum was shown to improve students' ability to work together creatively to solve complex problems. The study highlights the importance of mutual understanding and shared perspectives in the collaborative creative process facilitated by the CTSI.

The research concludes that the innovative educational model using the CTSI can significantly contribute to the advancement of design education by preparing students with the necessary skills for collaborative and creative problem solving. The model addresses the challenges of personalized learning trends and equips students for future collaborative work environments. It is expected that future research will build on this educational model and continue to demonstrate the value of using CTSI at the undergraduate level through more sophisticated and quantitative experiments.

1. Introduction

1.1 Research Background

Today, rapid economic and cultural changes and the emergence of new technologies and media have led to a surge of interest in the meaning and possibilities of creativity, especially with the popularization of various digital tools and platforms that allow individuals to share their creations and ideas with the world. The democratization of creative work has led to a new valuation of the professional skills of creatives such as artists and designers, and this shift has contributed to increased awareness and interest in fostering creativity in education. This study was motivated by the question: “How can learners' collaborative creativity be fostered in the context of this paradigm shift?”

People have different thinking frameworks and orientations depending on their cultural backgrounds, and people from different cultures are constantly socialized to develop certain habits of mind from the moment they are born. However, as the world becomes more globally and locally connected than ever before, human thinking habits are gradually shifting toward a more individualized and diverse society. This is particularly true in higher education. The pandemic has led to a transition from a more personalized digital environment to a society that encourages individualization more than ever before, regardless of generation. In particular, the collaborative methods that today's learners, who have grown up with competitive relationships, are exposed to in higher education have proven to be a major hindrance to spontaneous creativity.

The current design education system (at least in Asia, including South Korea) does not prepare students to respond sensitively to these challenges. Especially in Korean culture, the concept of hierarchy plays an important role in structuring society and influences various aspects of life, including the educational environment. This hierarchical perspective often emphasizes vertical relationships, such as those between teachers and students, rather than horizontal relationships, such as those among students. For example, in a typical classroom in some Asian countries, the teacher is often seen as the ultimate authority and primary source of knowledge. This perception stems from cultural values that respect age, experience, and position. Students are generally expected to listen, absorb information, and not openly challenge the teacher's authority. This dynamic can sometimes lead to classrooms where student-to-student interaction is minimal because the focus is primarily on the vertical teacher-student relationship.

There are two main reasons for this. The first is the increasingly personalized nature of learners. This is not just a problem for the current generation of students, known as Generation Z. The societal shift that has occurred since the pandemic, which has dramatically increased our reliance on personal devices, is perhaps the biggest culprit. But for digital natives, this societal trend has created a culture that is even more deeply and intensely personalized than before. This trend is particularly strong among young people in South Korea, who consume more digital content than any other country.

The second cause is that society and culture are shifting to a situation that requires more collaboration and consultation than ever before. However, in Asian cultures, where there is a relatively high sense of hierarchy within groups, there is less awareness of horizontal relationships. In addition, learners who have learned through more intense competition than ever before have a deficit in learning about cooperation and consultation. In such an environment, the concept of group work or peer-to-peer learning may not be as emphasized or valued as in Western educational settings, where horizontal relationships are often encouraged to foster a more collaborative and interactive learning experience.

1.2 Aims and Methodology

The aim of this research is to propose a 'new' model of undergraduate education in which learners can form self-directed collaborative relationships and discover and enhance the creative skills central to design

learning through complementary relationships rather than individual skills. In other words, the "new design education model" referred to in this study is a shift from education for knowledge transfer and solution training to education for self-generation of knowledge and solutions.

While many design programs still maintain siloed perspectives and inefficient mechanisms for tacit knowledge transfer, the ability to develop creative solutions to complex problems has become increasingly important, and design industry employers are beginning to recognize this need (Davis, M., & Dubberly, H., 2023). At this point, it is necessary to discuss what insights design education has to offer and what its ultimate direction should be, which can be explored through new approaches to fostering collaborative creativity among learners.

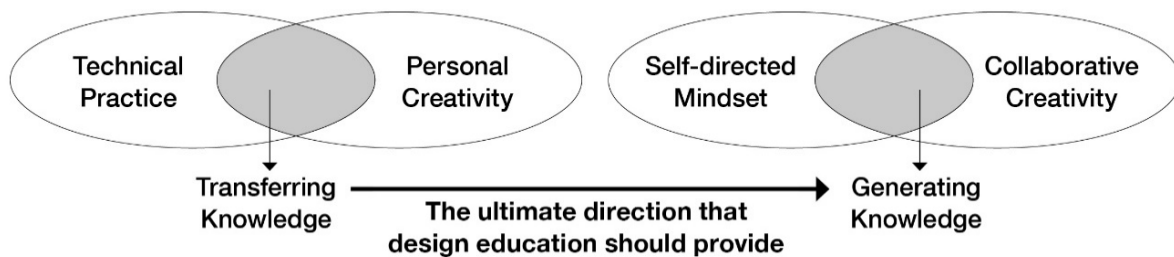


Figure 1. The relationship between two key factors for self-generating knowledge.

The focus of this study is to promote collaborative creativity for complex problem solving by helping learners develop a clear awareness of their own creative thinking styles and maximize their collaborative and self-directed skills. Through the Design and Creative Ideation class, which the authors developed and ran as a regular course at their school from 2017-2022, they found that design majors (at the undergraduate level and practical course in university education) were reluctant to collaborate. The course was a cross-curricular project that aimed to teach creativity through the extension of design concepts. This pedagogical experiment allowed us to discover the importance of encouraging collaborative creativity in higher education for both creatives and non-creatives, including designers. It also convinced us of the need for a new educational model in our time, where learning is accompanied by self-direction and the ability to generate knowledge and solutions on one's own.

This led to the development of an index of "creative thinking style" to identify the ingrained creative tendencies and mindsets of individual learners. As an extension of this research, this study aims to examine whether the CTSI (Creative Thinking Style Index) can be used as a tool that can be applied to the undergraduate level of educational models. The main research method is a sequential literature analysis method that analyzes key data from previous research and synthesizes commonalities. Based on the results of exploring the theory and phenomenon, this study proposes an educational model by deriving a curriculum structure that applies the CTSI.

2. Theoretical Background

2.1 Implications of 'Discovery Learning Theory' for Design Education

Jerome S. Bruner's Discovery Learning Theory, outlined in his influential work "The Process of Education" (1961), proposes a model of learning that emphasizes active engagement, exploration, and discovery. The theory is based on constructivist principles, which suggest that learners actively construct their own understanding of the world through interactions with their environment. However, in design education, which requires learning to balance logic and sensation, there is a risk that learners' self-expressive activities can lead to a somewhat subjective bias. For this reason, in today's complex environment, we can expect a

greater synergy between active and collaborative approaches to design problem solving and the expression of creativity. Ultimately, discovery learning theory has positive and empirical implications for design education, allowing learners to construct their own knowledge and develop critical thinking skills.

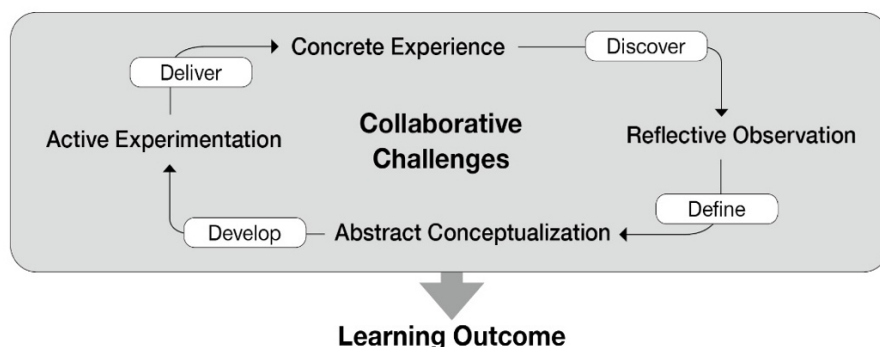


Figure 2. Design training course reimagined based on Bruner's discovery learning theory

These concepts are important in design education for fostering collaborative creativity because they empower students to take an interactive role in their learning, develop critical thinking skills, and cultivate a deeper understanding of design principles and practices. Students develop collaborative creativity through group exploration and problem-solving activities and gain confidence in their ability to experiment with different ideas and solutions to co-create design innovations and creative outcomes.

2.2 Group Dynamics for Fostering Collaborative Creativity

Creativity is a multifaceted phenomenon that is essential for innovation and problem solving in various domains. While creativity has often been perceived as an individual endeavor, the concept of collaborative creativity emphasizes the collective generation of ideas and solutions through group interaction. The implications of collaborative creativity extend to the pedagogy of art and design. In education, collaborative creativity promotes active learning and critical thinking and prepares students for real-world challenges (Sawyer, 2006). Group projects, peer collaboration, and interdisciplinary initiatives foster creative skills essential for success in the knowledge economy. Collaborative creativity is explained by several mechanisms.

1. **Diverse perspectives:** Collaborative groups include individuals with different backgrounds, skills, and cognitive styles, increasing the breadth of ideas generated (Paulus & Nijstad, 2003). Diversity stimulates divergent thinking, allowing for the exploration of unconventional solutions.
2. **Social interaction:** Interaction within groups facilitates the exchange and integration of ideas and stimulates creativity through dialogue, debate, and feedback (Sawyer, 2007). Social interactions trigger cognitive processes such as perspective taking and idea elaboration, enriching the creative process.
3. **Synergy and emergence:** Collaborative environments enable synergistic interactions in which ideas converge, evolve, and combine to produce emergent outcomes that transcend individual contributions (Sawyer, 2012). This emergent creativity results from the dynamic interplay of ideas within the group.

2.3 Personalization Tendencies of Gen Z College Students and the Impact on Collaborative Learning

Generation Z, often referred to as Gen Z, comprises individuals born between the mid-1990s and the early 2010s. This cohort has matured in an era of rapid technological advancement and increased access to

personalized digital content, which has shaped their individualization tendencies. These tendencies have significant implications for their approaches to learning and problem solving in college settings. Notable research, such as Twenge (2017), highlights how Gen Z's upbringing in a digital environment inundated with personalized technology cultivates a preference for autonomy and self-directed learning. This inclination potentially diminishes their propensity for collaborative problem solving, as personalized content encourages a focus on individual preferences and experiences.

The influence of social media and prevailing educational paradigms further accentuate the trend toward personalization among Gen Z college students. The notion of “personalization” as used in this paper refers to tendencies among learners in a general socio-cultural sense, and it could be recombined and suggested in meaningful ways depending on the online platform or pedagogy. However, Boyd’s (2014) analysis illustrates how social media platforms allow Gen Z individuals to create and curate their online personas, fostering a culture of individualism and self-centeredness. This digital self-curation may hinder collaborative efforts, especially in problem-solving scenarios that require collective thinking and collaboration. Furthermore, the traditional education system's emphasis on individual achievement, as discussed by Twenge and Campbell (2018), reinforces the notion of solitary success over collaborative efforts, potentially undermining the perceived value of teamwork in the learning process.

The trend toward personalization manifests itself in a variety of ways, with implications for collaboration among Gen Z students. Roberts and Foehr (2008) suggest that Gen Z's preference for personalized learning experiences may lead to a preference for solitary work, hindering the cultivation of essential collaborative problem-solving skills. Uhls (2019) notes that the generation's reliance on digital communication may hinder the development of important interpersonal skills, which are critical for effective collaboration. Additionally, Hershfield et al. (2018) discuss how Gen Z’s online image consciousness and fear of failure may foster risk aversion, potentially stifling innovation and creative problem solving in group settings. Furthermore, Sullivan (2014) notes the potential pitfalls of over-reliance on technology, which could undermine the effectiveness of face-to-face collaboration and brainstorming, which are critical to collective problem solving.

3. Structuring Curriculum for Enhancing Collaborative Creativity Using CTSI

3.1 About CTSI (Creative Thinking Style Index)

The CTSI is an approach to finding a better understanding of creative competencies that focuses on creative mindsets, analyzes how creative mindset types are classified, and systematizes semantic categories, rather than assessing individual creativity. Creativity, which is presented as one of the core competencies in design education, has been measured by various assessment methods in the design of competency and skill-based curricula. However, it is not easy to diagnose the creativity of individual learners and apply it to education. In particular, different terminologies and concepts such as creativity, creative work, creative competence, and creativity seem to cloud the context of creativity research in the field of design. In addition, most creativity research has focused on assessing individual creativity skills. Since the basis for assessing creativity is based on the result of the creation of an output obtained through a limited process, it is inevitable that the criteria for creativity are variable and depend on many variables such as environmental factors, the purpose of the activity, and the learned state. In this context, the CTSI critically discussed the limitation that most of the studies related to creativity developed in various previous studies focused on the evaluation of individual competence, and reorganized the characteristics of creative thinking from cognitive factors to affective (non-cognitive) factors, determining the characteristics of creative personality and deriving the main keywords.

First, the key findings on the relationship between creativity and mindset are as follows. As a cognitive factor, creative thinking can be defined as a “purposeful mental activity” that starts from the recognition of a problem that cannot be solved in a conventional way and is not just an expression of imagination, but “something new”. At the same time, it requires an “active attitude” to solve a problem or perform a task in order to sustain it. The degree to which creative thinking skills can be expressed depends on how the inherent mindset is enforced. For example, ideation techniques such as the double diamond, brainstorming, and mind mapping used in the design thinking method represented by Design Thinking are tools for discovering the possibilities of incomplete ideas and promoting activities that connect the inner and outer logic. Therefore, the creative mindset presupposes an attitude that lies on top of an individual’s ideas and must meet the premise of an activity or method that enforces a way of thinking or a tendency to think.

Second, in the relationship between creativity and personality, the keywords are as follows: In the field of psychoanalysis, creativity is defined as an inner experience or personality centered on affective (non-cognitive) factors. The theoretical background of the relationship between creativity and personality has been proposed in various ways, but the most commonly cited theory is the five-factor theory of personality (Goldberg, 1992; Hofstee, de Raad, & Goldberg, 1992). In particular, de Young's (2006, 2015) cybernetic Big Five distinguishes five categories of personality based on two important hierarchical factors: plasticity and stability. Plasticity includes extraversion and openness to experience, which refers to a person's tendency to be social, active, and conversational. Openness to experience refers to how open a person is to new ideas, experiences, cultures, etc. People with high Openness tend to be curious about new ideas and creative, while those with low Openness prefer traditional and stable things and may be more resistant to change. Sub-keywords that can be derived from the plasticity category include outgoing, collaborative, open, and receptive. Stability, on the other hand, includes Neuroticism, Agreeableness, and Conscientiousness. Neuroticism is a personality trait that refers to an individual's emotional stability, which can make them more likely to react to everyday stressful situations or more sensitive to negative events. Agreeableness describes how a person interacts with others. People who are high in agreeableness tend to be cooperative and avoid conflict in their relationships with others, usually through respect and empathy. Conscientiousness is related to responsibility and diligence, and refers to people’s tendency to achieve goals, make plans, and do things thoroughly. Sub-keywords that can be derived from the Stability category include internal, solitary, closed, and conservative.

Taken together, creative personalities fall into a typology based on two non-cognitive factors: an individual's beliefs and attitudes, each of which dictates the corresponding conceptual categories of dependency and independence, growth mindset and fixed mindset. Creative mindset, on the other hand, is based on the cognitive factor of the form and direction of thinking, which dictates the corresponding conceptual categories of lateral thinking and vertical thinking, as well as narrative thinking and paradigmatic thinking. Based on the corresponding words in each conceptual category in this relational network, we were able to organize the tendency of each type of creative thinking according to its characteristics.

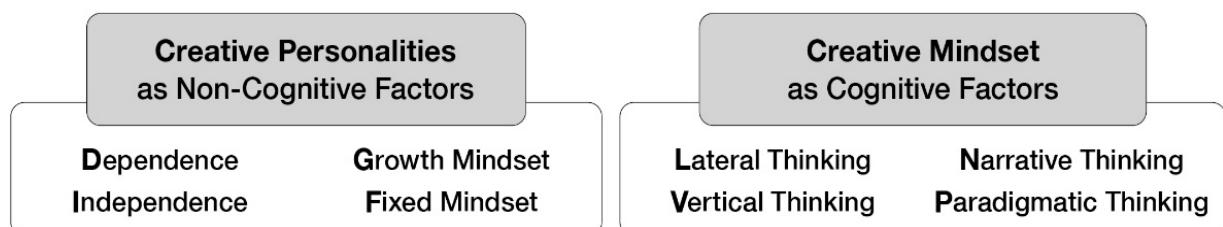


Figure 3. The Eight Factors of the CTSI.

3.2 Reframing the CTSI as Adaptation-Innovation Theory

Kirton's theory suggests that both adapters and innovators play essential roles in the creative process. Adapters contribute by refining and optimizing existing solutions, while innovators drive innovation and change through their willingness to explore new ideas and challenge the status quo. By recognizing and leveraging the strengths of both types of creative thinkers, teams and organizations can effectively address complex challenges and achieve creative results.

Adapters are individuals who prefer to work within existing frameworks and systems. They excel at making incremental changes, improving existing methods, and following established procedures. Adapters are pragmatic problem solvers who value stability, efficiency, and practicality. They tend to prefer familiar approaches and rely on proven methods to achieve their goals. Innovators, on the other hand, are individuals who prefer to challenge existing norms and explore new possibilities. They thrive in unstructured environments and are comfortable with ambiguity and uncertainty. Innovators are creative thinkers who generate new ideas, explore alternative solutions, and push the boundaries of conventional thinking. They value originality, experimentation, and unconventional approaches to problem solving.

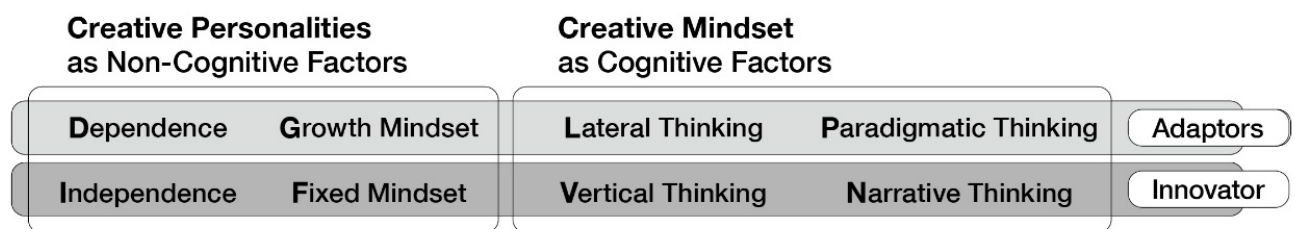


Figure 4. Reframing CTSI Factors into two categories.

The study on CTSI provides the 16 types of creative thinking styles by categorizing them into cognitive and non-cognitive factors. Cognitive factors are related to the individual's thought processes and can be divided into:

- Lateral thinking: Associated with creative idea generation, not focused on a single solution.
- Vertical thinking: Focused on finding the single best solution to a problem.
- Narrative thinking: Involves describing situations or problems in detailed and rich terms.
- Paradigmatic thinking: Relies on established norms and models to understand or solve problems.

On the other hand, non-cognitive factors are related to personal characteristics, attitudes, and motivations, which can be divided into:

- Dependence: Relying on external inputs and guidance.
- Independence: Focuses on self-direction and initiative.
- Growth Mindset: Believes in the ability to develop and grow skills and intelligence over time.
- Fixed Mindset: Believes that skills and intelligence are static and unchangeable.

The typology presented by CTSI can be compared and paired with the results of various psychological tests such as MBTI, TCI, etc., because it is based on psychological theory and derives the key factors necessary for creativity. Each of the 16 styles identified by the CTSI consisted of four pairs of corresponding keywords, each of which could be reorganized into categories of Innovators and Adaptors. Based on this, it is believed that teams can be organized according to the degree of individual creative mindset style to increase the efficiency of the collaborative creativity process.

For example, a dependent personality is used to getting energy from the outside world, while an independent personality tends to get their energy needs from within. In terms of how they think, those with a growth mindset tend to favor purpose and direction in their perceptions, while those with a fixed mindset tend to favor clear purpose and direction. On the other hand, people with a high preference for lateral thinking tend to be idealistic and rely on possibilities and meaning, while people with a high preference for vertical thinking tend to be realistic and grounded in experience. It can be said that narrative thinkers prefer to make judgments contextually and comprehensively, while paradigmatic thinkers prefer to make judgments based on logic and analysis. These interpretations, combined with the 16 types of creative thinking styles, provide a nuanced understanding of how individuals approach creativity and can be particularly useful in educational settings to tailor instructional methods and more effectively foster creativity in students.

3.3 Curriculum Structuring with CTSI

Building an academic curriculum requires careful planning and organization to ensure that students acquire the necessary knowledge, skills, and competencies in a logical and coherent manner. In the following four steps, which are fundamental to curriculum planning, learners will organize themselves into teams based on the CTSI and gain a clear sense of their own and their teammates' creative tendencies.

1. Learning goals and objectives state what learners should know, understand, and be able to do by the end of the entire course. They should be specific, measurable, attainable, relevant, and time-bound (SMART), and understanding learners through the CTSI has the advantage of clarifying goals and achievable roles in collaboration, not only for the instructor but also for the learners themselves.
2. Content sequencing is the determination of the order in which content is presented to learners after learning objectives have been identified. Starting with basic concepts and skills and moving to more complex topics, the logical progression of ideas and concepts is considered, ensuring that each concept builds on the previous one. Based on the CTSI, each learner recognizes his or her own creative tendencies, so there is no need to determine roles in the research and analysis phase as in the past, and there can be tacit agreement on each role naturally.
3. The curriculum, which organizes the content into units or modules, can also be determined by the learners themselves. When the curriculum is divided into units or modules based on thematic or conceptual groupings, each unit focuses on a specific topic or set of related topics, and activities such as Ideation and Conceptualization can be used to guide teams in scoping their projects. In this activity, teams can be divided into innovative and adaptive groups and encouraged to play to their strengths to achieve results. Organizing teams for collaborative creativity by dividing them into innovative and adaptive groups can create synergies that leverage the strengths of each group to achieve optimal results. The division of group composition for collaborative creativity is ultimately a refinement of the process of learners recognizing their strengths and pursuing their perspective roles.

Table 1. Comparing the concepts of Innovative Groups and Adaptive Groups.

	Innovative Groups	Adaptive Groups
Core Description	Innovative groups are characterized by their ability to generate novel ideas and explore unconventional solutions to problems.	Adaptive groups focus on refining and implementing ideas effectively.
Theoretical background	According to Amabile's Componential Theory of Creativity (Amabile, 1983), innovation is fueled by creativity, and innovative groups excel at generating creative ideas through divergent thinking and experimentation.	They excel at problem-solving within constraints and optimizing processes for efficiency and effectiveness. This aligns with the concept of adaptive management, which emphasizes learning, flexibility, and responsiveness to change (Holling, 1978).

4. In the process of developing learning activities and assessments, a variety of learning activities and assessments will be designed to engage students and measure their progress. At this stage, learner initiative and creative synergy can be at their highest. The two groups that have been active in each of the previous phases will be able to consult with each other to drive the final outcome. Synergies resulting from the interaction of the two groups include:
 - **Complementary strengths:** By combining innovative and adaptive groups, organizations can leverage the complementary strengths of creativity and practicality. This synergy enables the generation of bold ideas and their effective implementation.
 - **Dynamic Collaboration:** The interaction between innovative and adaptive groups fosters dynamic collaboration and cross-pollination of ideas. This collaboration creates opportunities for creative solutions to be refined and put into practice.
 - **Resilience and Agility:** The combination of innovative and adaptive approaches increases organizational resilience and agility. Innovative groups drive change and adaptability, while adaptive groups provide stability and continuity during transitions.
 - **Feedback Loop:** Adaptive groups provide valuable feedback to innovative groups, helping to refine and scale promising ideas. In turn, innovative groups inspire adaptive groups with new possibilities and stretch goals.

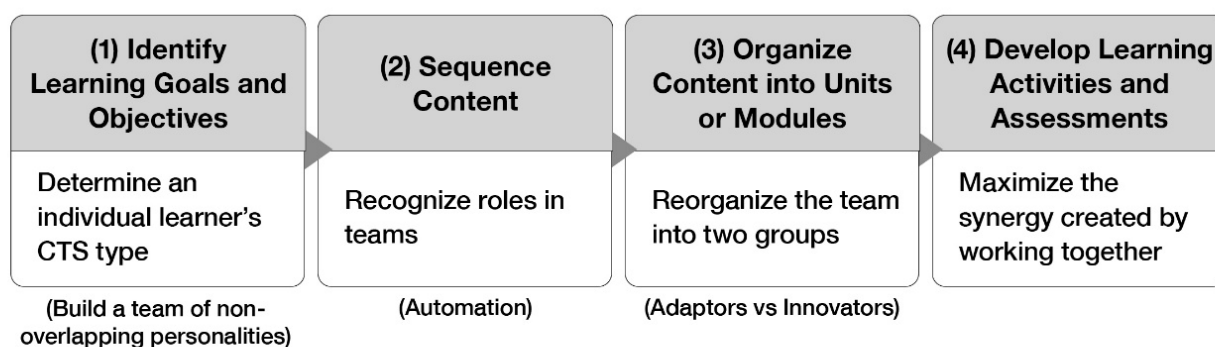


Figure 5. Utilizing CTSI across curriculum phases.

To summarize, engaged learners are aware of their own creative tendencies, which naturally consists of role awareness. Furthermore, organizing teams for collaborative creativity by dividing them into innovation and adaptation groups can optimize the innovation process and create synergies that drive organizational

success. This approach can leverage the strengths of each group while fostering collaboration, resilience, and agility in the face of complex challenges, and most importantly, all of these activities can be voluntary and the learning content can be learner-driven.

3.4 Proposing the New Design Education Model to Promote Collaborative Creativity

In the collaborative process of a design project, the meanings that individuals attach to objects may be different, and integrating them requires mutual understanding among actors. Forming and maintaining mutual understanding is essential because it is at the heart of intersubjectivity, and the goal of collaborative creativity is the formation and integration of knowledge (Kleinsmann & Valkenburg, 2008). CTSI helps to visibly form a congruent meta-perspective between oneself and others. This is because, as emphasized by Corti & Gillespie (2016), the meta-perspective contributes to achieving common ground in the context of the interaction, rather than just what the parties agree on.

The step-by-step learning of the design process, coupled with a structured training curriculum, facilitates the spontaneous interaction of participants that is necessary for collaborative creativity to flourish. As in any social activity, the development of mutual understanding is an important factor in the collaborative process. The design education model that is needed in this era is one in which the subjectivity of the creative process is mutually agreed upon and aimed at reaching the optimal conclusion, not the best outcome.

4. Conclusion and Avenues for Future Research

The design industry of the future will not be a simple process of problem solving, which is why design education is emphasizing collaboration and convergence more than ever before, redefining the concept of design education. Creativity is more valuable when the thought processes of many people are combined than when one person thinks alone. However, in design education of Korea, creativity has been focused on individual competencies, which has hindered the ability of students to work in teams and accomplish tasks through collaborative relationships. The CTSI promotes collaborative synergy among learners through self-assessment, was useful as a basis for the new educational model proposed in this study. In the new design education model, it is necessary to propose specific measures for structuring and phasing the curriculum before providing topic-oriented learning, because collaboration in the design learning process is possible when a group has a common purpose, and synergy within a group can be strengthened by the consensus or disagreement of participants, and higher learner-learner synergy can be expected when learners understand their own thinking tendencies.

This study is significant in that it provides a new direction for design education based on a comparison of theories and authors' previous research on creative thinking style. However, it should be acknowledged that this paper is based on qualitative interpretation and is still subject to much debate. In the future, the challenge will be to provide an education that enables students to actively think and form their own personalities by breaking away from the existing knowledge education in the regular college classroom. The authors are working to apply CTSI in the classroom based on this educational model and will continue to prove the value of using CTSI in the undergraduate level through more sophisticated and quantitative experiments in the future.

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About the Authors:

Kyungwon Kim is a professor of the Digital Media Design major at Dongseo University. He is a graphic designer and design curator who has been working on typography, editorial, and identity design projects in various media over the past ten years. His research focuses on experimental screen media and graphic design education.

Prof. Juyoung Chang is the Dean at Dongseo University's School of Design and the Director of the Asia Design Center for Future. Her research focus is on design within Korean and Asian cultural contexts, enhancing understanding of cultural diversity in design.

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