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Creativity in Computer Science and Fiction Writing

Abstract

This paper seeks to find the difference in the creative mindset between the computer scientist and the fiction writer. This research explores how much freedom and creativity are employed in each field. It also explains how domains in each field can be helpful or harmful to one another, whether computer scientists can enter flow, and how creativity is employed when building aircraft. However, which field is more useful and beneficial to the world? While writing has more freedom of expression and imagination, computer science is more based on logic and mathematics. To answer this question, various sources were used to learn about the creative process in fiction writing and computer science, the psychological benefits of writing, the use of mathematics in computer science, and creativity in aircraft design. Research shows that both fields have freedom when it comes to creativity, but fiction writers have more freedom because they have no boundaries and computer scientists need to pay closer attention to details. Despite the differences between the two fields, they both go through the same creative process. Even though creativity may not be used very often in technological fields, one should not assume that it is not used at all.

The fields of computer science and fiction writing are commonly used in today's society, and there is an important relationship between reading and writing and working with technology. These are two opposite fields; computer science is based more on knowledge in technology, logic, and mathematics while fiction is more based on imagination. However, both of these fields use creativity. This leads to the question- what are the differences in the creative mindset between the computer scientist and the fiction writer? By using terms from Kaufman's reading such as domain, flow, the cognitive creative process, and the componential model of creativity, they will help differ the two fields and discover the thought and creative process for both. The term domain, which is a preexisting area of expertise, will be used to define one's specialty in computer science or fiction writing. The term flow, which is a state of mind where one is flooded with ideas and deeply concentrated in his/her work (as cited in Kaufman 36), will be used to determine whether individuals with a domain in computer science can experience this altered

state of mind. The cognitive creative process, created by Wallas, uses the five stages: preparation, incubation, intimation, illumination, and verification to explain how one thinks creatively. In the preparation stage, one begins work on a problem. Incubation is where one can work on other tasks while his/her mind continues to think about the problem from the preparation stage. In the intimation stage, one realizes he/she is about to have a breakthrough. Hence, illumination is when one gets insight. Finally, verification is where one tests, develops, and uses his/her ideas (as cited in Kaufman 38). The cognitive creative process supports this paper because it is used and applied to computer science and fiction writing. When discovering this process for both domains, one can see the differences between the two. The componential model of creativity, proposed by Amabile, states that domain-relevant skills, creativity-relevant skills, and task motivation are needed for creativity to occur. Domain-relevant skills consist of knowledge, technical skills, and specialized talent. Creativity-relevant skills consist of personal factors that are associated with creativity, such as self-discipline and risk-taking. Task motivation is simply being motivated toward the task at hand (as cited in Kaufman 43). By applying the componential model of creativity to both domains, it shows how each one is creative. As a result, the cognitive creative process and the componential model of creativity help identify the differences between the two creative mindsets. Since these are two opposite fields, it can be difficult to find connections between the two in order to apply them to one another and create contrasts. Also, there is a controversy between the two: computer scientists help solve problems by using programs, and writing can improve one's psychological being and enable self expression. That being said, which domain is more beneficial to the world? Both fiction writers and computer scientists have freedom to explore ideas when it comes to creativity because they go through the same cognitive creative process from preparation to verification. However, fiction

writers have more freedom because they have no boundaries when using imagination to create ideas, while computer scientists are more restricted because they need to think logically and work within the constraints of the programs they are designing.

Just like fiction writers, computer scientists also have freedom when it comes to creativity. In the article "Creativity as a Pathway to Computer Science" Ralf Romeike and Maria Knobelsdorf say, "At this point the computer is seen as a creative tool...it supports the user in gaining relevant knowledge; provides the basis for exploration and experimentation, offers immediate feedback; and allows disseminating the results to others" (289). The authors are saying that a computer helps one be creative because it helps him/her gain knowledge, and it allows the user to explore and experiment for ideas. Additionally, Ralf Romeike and Maria Knobelsdorf report, "Programming influences students' image of CS [Computer Science]. Therefore, we found product (artifact) orientation as the most-frequently mentioned creativity characteristic of CS" (289). Programming is obviously an important part of computer science. Although it may be difficult and tricky to do at times, creativity is still used because computer scientists are able to create programs according to their wishes, and explore different ways to get them to work. In addition, creativity is also used when designing the graphics and functions of computer games. For example- in the currently popular game Angry Birds, the scientist needs to figure out all the possible actions a user can make and how to get the game to respond accordingly. On the whole, it has been proven that computer scientists indeed have freedom and creativity and are not always restricted. On the other hand, some may say that computer science is always restricted because a lot of mathematics is used. In the article "Mathematics and Computer Science: Exploring a Symbiotic Relationship", Ralph Bravaco and Shai Simonson state "Fractal geometry, chaos, and iterative algorithms are all major players...each of these

mathematical topics is virtually impossible to explore without computers and computer science" (308). This quote supports the claim that computer science is restricted because complicated math is used. When working with it, one cannot be creative because there are only specific ways to solve the problems. Meanwhile, Charlotte L. Doyle, a generalist in psychology with special interests in the creative process, says "...the creative process in fiction writing is a voyage of discovery but differs from most other arts and sciences in one of its major modes of thought-narrative improvisation, a nonreflective mode that typically involves stances in a fictionworld from viewpoints different from one's own" (29). In other words, fiction writers have the freedom to explore, but the creative process involved differs from other arts and sciences. In narrative improvisation, one enters a 'fictionworld', which is a world where characters and events unfold as they appear in the author's imaginative experience and words (Doyle 31). This quote confirms that fiction writers have freedom when it comes to creativity because narrative improvisation allows one to explore and discover new ideas via the fictionworld.

   In addition, McCormack says, "But writing itself is one of the great, free human activities. There is scope for imagination, and elation, and discovery, in writing. For the person who follows with trust and forgiveness what occurs to him, the world remains always ready and deep, an inexhaustible environment, with the combined vividness of an actuality and flexibility of a dream. Working back and forth between experience and thought, writers have more than space and time can offer. They have the unexpected realm of human vision" (qtd. in Bateman 33). Paraphrased, McCormack discusses more benefits of writing: how one is able to incorporate individuality, elation, and discovery into his/her writing. It is also clarified that the world serves as an inspirational environment in which writers have endless possibilities to vividly describe experiences in their writing. Therefore, this quote further supports the statement that writers have

a lot of freedom and are not restricted to boundaries. Amabile's componential model of creativity applies here because creativity-relevant skills are certainly being used when writing. This is also relevant to Wallas's term cognitive creative process because writers go through the incubation, intimation, illumination, and verification stages; their minds are still thinking about what else to write, and the world enables one to have a breakthrough and get insight. Additionally, using imagination and discovery are part of insight. Lastly, writers are able to test and use their ideas in unlimited ways. To summarize, Kaufman's borrowed term "cognitive creative process" applies to both fiction writers and computer scientists because they both go through the preparation, incubation, intimation, illumination, and verification stages. However, the verification stage may be done slightly different only because writers and scientists do not test, develop, and use their ideas the same way. In Amabile's componential model of creativity, both computer scientists and fiction writers use domain-relevant skills. In computer science, knowledge and technical skills are needed when creating a program and the scientist needs to know his way around all the technological features in order to get the program to work. Meanwhile, writers use domain-relevant skills such as knowledge of grammar rules and story frameworks in order to ensure their stories are organized and written in proper English. Michael Petracca, a professor at University of California, says "It's impossible to write a "how-to" book for fiction writing as one would write a recipe book for the rural cuisine of southern France or a repair manual for Volkswagon engines, because writing has no strict, inviolable rules and structures" (3). This quote is supporting the statement that fiction writing has freedom and no restrictions. Aside from grammar rules, writers have no strict rules to follow as opposed to computer scientists. Furthermore, both domains use creativity-relevant skills as well; writers can take risks with their stories and computer scientists can also take risks when trying to get a program to work.

Although these may be two different fields, it is quite surprising to discover that they both go through the same creative process.

Computer scientists are able to experience the state of flow. Maria Knobelsdorf and Ralf Romeike, the authors of "Creativity as a Pathway to Computer Science", state "...Creativity-related factors: namely how a creative person feels when programming- were revealed to be the most persuasive drivers for engaging in the projects. The following creativity-related factors were identified: usage, intellectual stimulation, reputation, identification with the group, learning, and altruism" (287). Simply put, the way one feels when programming can enable him/her to do the work. Creativity-related factors that can occur when one is motivated towards the task are also named. Thus, this quote confirms that computer scientists can enter flow because the way one feels gets one to engage in the work, and this can eventually lead to flow. When relating this to Kaufman, all the creativity-related factors mentioned fall under the creativity-relevant skills in Amabile's componential model of creativity. The way one feels when programming also applies to Amabile's theory because it is a task motivation variable that triggers creativity to occur. Therefore, this provides more evidence that computer science uses creativity and is not always restricted. On the other hand, if one is having a difficult time programming, it may prevent him/her from entering flow. Ralph Bravaco and Shai Simonson say "When a problem is intractable, the theorists go on to another problem, and the engineer sharpens his pencil. Students need to tweak and experiment with techniques to make sure their programs can cope with a theoretically intractable problem" (309). In other words- when a problem is too hard to solve, computer science students have to move onto the next one. In order for the programs to work, the students need to tweak and experiment with the techniques. Although flow may help one experiment with ideas, tweaking with techniques can prevent flow

because one needs to work slowly and carefully in order to prevent making a mistake. In flow, one freely expresses what he/she is thinking without worrying about making mistakes. Thus, when a problem is too hard to solve, it can also prevent flow because one is unable to figure it out and he/she ends up giving up. So in this case, flow was not able to help the individual come up with a solution.

Similarly, fiction writers are also able to enter the state of flow. Susan Perry, a social psychologist with expertise in creativity, says "The length of time you write may be hard for you to define, since you may consider yourself 'writing' even when you are not putting words down. Some writers live in a parallel world of their own imagining, always in a mild flow around their characters' lives. 'It's all part of the process,' as Carol Muske explains: 'While I'm making coffee or making toast, I'm writing. I write sometimes on envelopes, on telephone message pads...I've never thought of flow as a separate thing" (146). This explains the state of flow for some fiction writers; they live in their own world filled with imagination and the characters they created. Also, some writers may mentally be in flow even when they are not writing. In any case, flow is an important part of writing because it helps the writer visualize and come up with ideas. However, not every writer experiences it the same way. One may be in a deeper state while another individual may be in the state for a longer period of time; it depends on the person. Nevertheless, flow is a part of the incubation, intimation, and illumination stages in Wallas's cognitive creative process because one can work on other tasks while still thinking of the problem, have a breakthrough, and get insight. When applying Amabile's componential model of creativity, creativity-relevant skills and task motivation are a part of flow. In summation, both computer scientists and fiction writers are able to enter the state of flow when being fully focused on a task.

Both domains can be helpful or harmful to one another. In the article "Need an Expert? Ask a Computer" Mary Ellen Phillips and Carol E. Brown say, "When a user queries a typical expert system, it responds with its own questions that prompt the user to reframe the question or simply dig deeper" (91). This means that when using a computer program, it influences the user to think deeper in order to receive an answer from it. For instance, if one is searching for an answer as to why he hasn't been feeling well lately, the program will ask the user to be more specific about his condition in order to provide a helpful answer. This can be helpful to a fiction writer because it helps one think of ways to rephrase questions or sentences. Consequently, it can enable creativity because one has to come up with various ways to rephrase their thoughts and writing. Therefore, this can be useful when writing a fiction story. Additionally, this proves that computer programs enable creativity by getting one to think. To create such a program, computer scientists use creativity to make the program complex as opposed to restricted. Instead of having the program say either 'yes', 'no', or not respond at all, the scientists have made it user-friendly. This does require logic for both the user and the scientist because the scientist needs to program the responses to the user's input. The user needs to use logic, in addition to creativity, in order to get the program to provide an answer. Unquestionably, this presents more evidence that computer science can encourage creativity.

On the other hand, a domain in computer science can likewise be harmful to fiction writers. Patricia Greenfield, a UCLA professor of psychology, reports "...most visual media are real-time media that do not allow time for reflection, analysis, or imagination- those do not get developed by real-time media such as television or video games. Technology is not a panacea in education, because of the skills that are being lost" (2). In other words, Greenfield is saying that visual media is not very beneficial when it comes to education because one does not use

reflection, analysis, or imagination. In computer science, visual media is used often because everything is done on a computer instead of paper. As a result this can prevent one from being creative because he/she is not using the skills mentioned above. Additionally, this can make it more difficult to write a fiction story because one's skills in critical thinking and analysis have declined due to the lack of the use of these skills. Meanwhile, Joanna F. Wing, Nicola S., and Brian Byrne state, "Writing about any meaningful aspect of life may promote cognitive processing, encouraging the examination, understanding, and assimilation of emotions that might otherwise be left unscrutinized" (1292) (Pennebaker, 2002; para. 1). To paraphrase, writing about a certain event in one's life can empower cognitive processing and deep assessment in one's emotions. The examination and understanding of one's emotions enables self-discipline and gives one better knowledge of how he/she is feeling, which is using the domain and creativity-relevant skills from Amabile's componental model of creativity. This information further supports the statement that fiction writers have no boundaries because in order to express one's emotions, one can write whatever he/she wants. Writing about events in one's life can also help the writer identify a seed incident, which is an event or character that provides a starting point in a fiction writer's story. Although the earlier quote addresses emotions, the actions used to assess these emotions can be useful in computer science. Cognitive processing is useful in computer science because one needs to think logically, analyze, and identify what work needs to be done. It can help one create a successful program, and if a problem occurs, one will be able to identify it. Kaufman's borrowed term "cognitive creative process" can be applied here because all of this assessment can be considered as insight. Overall, a domain in computer science can help fiction writers think deeper, while a domain in fiction writing can help a computer scientist by enabling

cognitive processing. This is important because it proves that skills used in one domain can be useful in an opposite domain.

When building aircraft, creativity can be employed. In the article "Build your own Airplane" David J. Bak says, "The procedure is straight-forward and explained--with the aid of simple drawings, parts inventories, and check-off list--in the corresponding instruction manual" (76). This quote explains the general procedure followed when building an airplane. It shows that building aircraft does have specific rules and instructions to follow, and there is no creativity involved. Wallas's cognitive creative process does not apply here because there is no creative thought occurring; one is given all the instruction and illustrations. Thus, there is no need for one to come up with any ideas. However, a plane must go through a trial test in order to demonstrate it is functioning properly. Although this is done for safety purposes, it can be relatable to the verification stage in the cognitive creative process because one is testing out the performance of a certain aircraft model to see if the design allows the aircraft to operate as anticipated. In Amabile's componential model of creativity, knowledge and technical skills, which are domain-relevant skills, are used; in order to understand and follow directions given, one should have some knowledge and familiarity with the procedure. In addition, one would not succeed in building a plane without any technical skills. Creativity-relevant skills do not apply because creativity cannot be used when one has to strictly follow the instruction manual.

Although many people might say that there is no creativity involved when building airplanes, others may argue the opposite. In the article "Aircraft design innovation: creating an environment for creativity" a man named Burt Rutan says "We do not spend much money on creating an environment for creativity. Much of what people do, called design, is really better called analysis. So aircraft design is something different...You need to be able to visualize the

flow over an airplane and just what it needs to do" (171). In essence Rutan is saying that not much is being done to encourage creativity because there is no creative environment. However, aircraft designers need to be able to visualize. Visualizing can be compared to imagination, which is a creativity factor. Even if one is not in a creativity-encouraged environment, creativity is being used when designing because every possible path and flow of the plane needs to be visualized in order to make sure the airplane will function properly with its design. Wallas's cognitive creative process applies here because aircraft designers work on the problem, get insight, and test, develop, and use their ideas. Amabile's componential model of creativity also applies because both domain and creativity-relevant skills are being used. The domain-relevant skills used are knowledge and technical skills, and the creativity-relevant skill used is visualization. Therefore, it has been verified that there is a way to use creativity in fields where one needs to pay attention to details and think more logically.

Overall, both fiction writers and computer scientists have freedom to explore ideas when it comes to creativity because they go through the same cognitive creative process from preparation to verification. This research confirms that both domains use creativity and require freedom for developing new ideas. Yet, fiction writers have more freedom because they are able to create stories using ideas fresh out of their minds while computer scientists need to generate ideas that will be compatible with the functions of their programs. It was originally believed that there was no creativity involved in computer science. However, this research has proven otherwise by explaining that computers enable one to be creative by allowing exploration and experimentation to occur. As a result this allows one to come up with numerous ideas. By applying the framework of the cognitive creative process, which explains how one thinks creatively by using the preparation, incubation, intimation, illumination, and verification stages,

it helped explain how computer scientists and fiction writers can be creative and enter flow. When being creative, both domains go through the same stages from preparation to verification. However, the verification stage differs between the two because writers and scientists do not test and use their ideas the same way. Furthermore, both domains similarly incorporate intimation and illumination stages because it is where one gets insight. Lastly, both domains need to enter flow, the fully-focused state of mind, because it helps one feel motivated to finish his work. Another important feature of the framework that computer scientists and fiction writers use- the componential model of creativity-states domain-relevant skills, creativity-relevant skills, and task motivation are needed to make a creative product. On the other hand, it was determined that the cognitive creative process and componential model of creativity were not supported when discussing how computer science can be restricted, because the purpose was to counter creativity. Therefore, neither of the terms could be used. In any case it is obvious that fiction writing utilizes creativity in imagination and the 'fictionworld', but one should not assume that creativity is not used in the technological fields. Even if one is working with numbers instead of words or logic instead of imagination, creativity is being used one way or another to create new ideas; it gets one to think outside the box and explore possibilities. Therefore, this should encourage individuals with a strength in creativity to not feel intimidated and give technological fields a chance, because they can be as fun and creative as writing and artistic fields.

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