E-learning in the Transformation of Education in Digital Society
Scientific Editor Eugenia Smyrnova-Trybulska
"E-learning", 14, Katowice–Cieszyn 2022, pp. 151–162
https://doi.org/10.34916/el.2022.14.11

CREATIVITY AS AN INTERDISCIPLINARY COMPETENCE OF THE INDIVIDUAL AND OF THE ARTIFICIAL INTELLIGENCE

Jolanta Szulc
Institute of Culture Studies / University of Silesia in Katowice
40-007 Katowice, ul. Uniwersytecka 4
jolanta.szulc@us.edu.pl, ORCID 0000-0002-8926-3098

Abstract: *Creativity is a desirable feature of everyone, both in the professional and private spheres, and is increasingly recognised one of the core competences in the 21st century. An individual's creativity can also be enhanced by various forms of artificial intelligence. The aim of the article is to present and examine the common characteristics of human creativity and artificial creativity (Computational, 2022). The study is based on the analysis of the literature on the subject registered in selected databases: ERIC and Web of Science. The article is divided into three parts. The first part discusses the concept and presents current research results on creativity competences. The second part characterises individual creativity and artificial creativity (Computational, 2022) and presents selected examples. In the third part, the competences of an individual are compared with artificial creativity (Computational, 2022). In particular, the following issues are addressed: (1) to what extent man and his creativity become models for the creators of AI solutions and (2) how these solutions can be used in modern education. The results of the research are presented at the end of the article.*

Keywords: creativity, creativity competences, individual creativity, artificial creativity, computational creativity.

INTRODUCTION

In line with the Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962 / EC), developing key competences, both in school education and in the lifelong learning strategy has become one of the top priorities. The issues applicable to all eight key competences include: critical thinking, creativity, initiative, problem solving, risk assessment, decision taking, and constructive management of feelings (Recommendation, 2006). On the other hand, creativity is associated with the cultural and

creatine sectors, created by entities conducting economic activities related to culture and technology and combining artistic activities with entrepreneurship (Regulation (EU) 2021/818). Creativity is understood in a similar way in other European documents, such as:

- Decision (EU) 2021/820 of the European Parliament and of the Council of 20 May 2021 on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (EIT) 2021–2027: Boosting the Innovation Talent and Capacity of Europe and repealing Decision No 1312/2013/EU;
- Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013;
- Regulation (EU) 2021/523 of the European Parliament and of the Council of 24 March 2021 establishing the InvestEU Programme and amending Regulation (EU) 2015/1017.

Creativity in such different ways will be considered in the next chapter.

1. CONCEPT AND RESULTS OF RESEARCH ON CREATIVITY

1.1. Creativity and creativity competences

The concept of creativity, derived from the Latin word creatus, in the common understanding means a mental process that leads to the creation of "something" new, original (Słownik, 2022).

A general description of the concept of creativity is provided in Decision No 1350/2008/EC of the European Parliament and of the Council of 16 December 2008 concerning the European Year of Creativity and Innovation (2009). It reads: "creativity as a personal attribute, and to be harnessed to full advantage it needs to be widely disseminated throughout the population. This requires an approach based on lifelong learning" (Decision No 1350/2008/EC, 2009).

Creativity is also understood as being "a phenomenon whereby something new and valuable is formed. The created item may be intangible (such as an idea, a scientific theory, a musical composition, or a joke) or a physical object (such as an invention, a printed literary work, or a painting)" (Creativity, 2022). Meusburger estimates that there are over a hundred different definitions in the literature, usually developing the context (domain, organization, environment, etc.) that determines the originality and / or appropriateness of the created object and the processes that resulted in it (Meusburger, 2007). For example, we talk about computational creativity, organisational creativity, malevolent creativity (Creativity, 2022).

Competence as an important component of the creative sphere was included in the "Four C" model proposed by Kaufman and Beghetto. This model distinguishes four types of creativity: mini-c ("transformative learning" involving "personally meaningful interpretations of experiences, actions, and insights"), little-c (everyday problem solving and creative expression), Pro-C (exhibited by people who are professionally or vocationally creative though not necessarily eminent) and Big-C

(creativity considered great in the given field) (Kaufman and Beghetto, 2009). Terms taken from this concept are widely used. For example: Kozbelt, Beghetto, and Runco use a little-c/Big-C model to review major theories of creativity (Kozbelt, Beghetto, Runco, 2010). Boden distinguishes between h-creativity (historical) and p-creativity (personal) (Boden, 2004). Robinson (Robinson, 1999) and Craft focus on creativity in the general population, particularly with regard to education, with Craft distinguishing "high" and "little c" creativity and citing Robinson as relating to "high" and "democratic" creativity (Craft, 2001). Csikszentmihalyi defined creativity in terms of those who made significant creative contributions, perhaps changing the field (Csikszentmihalyi, 2013). Simonton analysed career trajectories of outstanding creative people in order to map patterns and predictors of creative productivity (Simonton, 1997; Creativity, 2022).

The concept of creativity competences is related to the concept of creative thinking competence. Creative thinking means „discovering new opportunities and solutions for problems by looking beyond current practices and using innovative thinking" (Creative, 2022). This discovery can be accomplished through activities such as:

- learning when a new approach is required,
- taking over the solution from outside the current work environment,
- modifying the solution from outside the current work environment
- creating a new solution.

In practice, creative thinking competence can be implemented in the form of various activities, which include:

advanced event planning, business writing for impact and influence, creativity and innovation for the workplace, critical thinking and problem solving for effective decision, financial planning for retirement, finding creative solutions to workplace challenges, improving your memory, increasing your self-confidence, life planning for retirement, mindfulness and leadership, practical facilitation skills, strategic thinking, using positive influencing skills in the workplace, writing in plain language (Creative, 2022). Both creativity and creativity competences are the subject of research, the selected results of which will be presented in the next chapter.

1.2. Results of research on creativity and creativity competences

Scientific interest in creativity occurs in many disciplines, primarily in psychology, business and cognitive science. Research on creativity is also developed in education, humanities, technology, engineering, philosophy (especially philosophy of science), theology, sociology, linguistics, art, economics and mathematics. The subject of these studies includes such issues as: the relationship between creativity and general intelligence, personality type, mental and nervous processes, mental health, artificial intelligence. Some of this research concerns fostering creativity through education and training, fostering creativity for the benefit of the national economy, and applying creative resources to improve teaching and learning efficiency (Creativity, 2022). The literature on the subject includes reviews of research on creativity and creativity competences. Detailed information on the literature found is provided in Table 1.

Table 1. Results of searches for search terms, *creativity* and *creativity competences* in ERIC and Web of Science databases (as on 12 September 2022)

Database name	Search term	Number of records found	Including: review article/ reports
ERIC	Creativity (all fields)	22 590	14 928
Web of Science	Creativity (all fields)	79 824	51
ERIC	Creativity competences (all fields)	104	77
Web of Science	Creativity competences (all fields)	2 334	1 957
Total		**104 852**	**17 013**

Source: Own work based on ERIC and the Web of Science databases.

Additionally, Figure 1 and Figure 2 present the percentage analysis of the results of searches for the terms *creativity* and *creativity competences* in the Web of Science database.

Figure 1. Search results for the term *creativity* in the Web of Science database (as on 12 September 2022)

Source: Own work based on the Web of Science database.

Figure 2. Search results for the term *creativity competences* in Web of Science database (status on 12 September 2022)

Source: Own work based on the Web of Science database.

The following research topics were already distinguished in the report from 1966, including 92 publications from 1906–1966: defining creativity, measuring creativity, creativity and intelligence, characteristics of the creative individual, teaching and creativity, and inhibitors of creativity (Hahn, 1968). Works on the topic appear today: unstructured, interactive, or spontaneous motions, including gestures, dance, shifting body postures, physical object-manipulation, drawing, etc. to favourably impact creative performance. As a result of a review of works registered in the PubMed, PsychInfo, Sports Discus and Google Scholar databases, it was found that embodied movement robustly enhanced creativity across nearly all studies (90%), with no studies showing a detrimental effect (Frith, Miller and Loprinzi, 2020).

The second group of reports containing research results concerns creativity competences. A 1997 report found that a common way to teach creative thinking is to use creative problem solving. The stages of problem solving were mentioned, i.e. problem exploration, idea development, implementation and selected activities developing the competence of creative problem solving. The role of attitude, experience and motivation is emphasized. It seems interesting to conclude that creativity training is more a matter of removing internal and external blockages than of learning skills (Henry, 1992).

The research mission was examined in review on the issue of developing teaching competences of novice faculty members. The mission of scientists has changed in recent years. Academics face a strong social demand for graduates to access employment and are increasingly required to possess a range of competences beyond their discipline knowledge. Research is being carried out in the field of developing competences of novice university academics based on the concept of situated competence (Kiffer & Tchibozo, 2013).

Another systematic literature review provided an overview of STEM (science, technology, engineering and mathematics) and STEAM (STEM + Arts) – based empirical educational interventions to determine their potential to develop students' creativity. Publications published in 2010–2020 and registered in the Web of Science and Scopus databases were selected for analysis as part of the review process. Analysis suggests that: (1) the interventions based both on STEM and STEAM have multiple and even contradictory forms, both in theory and in practice; (2) there appears to be a preference among researchers for the Likert-type test to evaluate creativity; and (3) both educational approaches show evidence of positive effects on student creativity (Aguilera and Ortiz-Revilla, 2021).

2. INDIVIDUAL CREATIVITY AND ARTIFICIAL CREATIVITY (COMPUTATIONAL CREATIVITY)

2.1. Individual creativity

Each individual has three components of creativity: knowledge, creative thinking and motivation. Knowledge includes technical knowledge, intellectual qualifications and knowledge of procedures. The ability to think creatively is defined by the ways of approaching problems. On the other hand, motivation is divided into two types: external and internal. External incentives can be cash in the form of bonuses

and promotions. In contrast, internal motivation is driven by individual passion and interest, which has a greater impact on creativity than external motivation (Luecke & Łuczkiewicz, 2005).

What are the qualities of a creative person? Having selected features often enables individuals to generate innovative solutions to their problems. Most often a creative person is characterized by: imagination, openness to experience, inquisitiveness or curiosity, intuition, idea finding, tolerance for ambiguity, independence, innovation (Montgomery, Bull and Baloche, 1993). Creativity is developed through practical activities, which promote features such as: (1) curious – creative people like to learn new things, so their free time may include reading books or watching films on topics of interest to them; (2) playful – people are happy to play with ideas until they find the right one; (3) open-minded – a person with an open mind is willing to listen and try new ideas; (4) flexible – this trait supports their willingness to try out new ideas and experiences; (5) sensitive – increases awareness of the surrounding problems, which may sometimes make people even more concerned with solving them; (6) independent – independent work allows creative people to exercise personal freedom and make their own decisions; (7) risk-taking – creative people are willing to take the risk of trying new ideas; (8) intuitive – people trust themselves to follow their heart instead of feeling constrained by more logical demands; it is a helpful tool for brainstorming and generating ideas; (9) thorough – creative people often put a lot of thought and care into their work, pay attention to details that others seem to be of little importance; (10) ambitious – creative people are often aware of how much effort they put into their work; breakdown of large tasks into smaller, more achievable parts can facilitate the management of complex processes; (11) objective – creative people are often passionate about what they do, but also understand the need to be objective; this often requires constant practice and editing; (12) energetic – creative people are often energetic – this does not mean that they seem hyperactive, but they put a lot of energy into their work (12 Traits, 2022).

The psychology of the development of human creative potential, which is part of the psychology of development, proposes the concept of creative potential and its development. Researching the category of "creative personality potential" requires continuous research of the current and potential characteristics of the examined person. The realization of the creative potential are effective creative activities, initiated by the internal creative activities of the subject and the creative processes taking place in humans on a conscious and unconscious level. Creative potential considered as a category of personality is dominant, multifunctional and passes through various stages of maturity. In this way, it is possible to specify potential creativity on the level of self-reflection, communicative and updated creativity (Wiszniakowa-Zelinskiy, 2016).

The subject of the latest research on individual creativity indicates current research areas. In 2021, 12 publications were registered in the ERIC database (as on 12 September 2022), which were assigned the following subjects, respectively: creativity (10), correlation (5), foreign countries (5), higher education (4), postsecondary education (4) . On the other hand, 541 publications were registered in the Web of Science database in 2022 (status on 12 September 2022), most of which were assigned to such

Web of Science categories as: management (101), psychology multidisciplinary (78), education educational research (60), business (56), psychology experimental (45). Further analysis of the publications assigned to the management category allows us to specify further research areas: business economics, psychology, engineering, information science library science, operations research management science and others. In the group of publications assigned to the management category, there were, inter alia, topics such as: managing creativity in organizations, the relationship between the creativity of members and the creativity of the team, proactive behaviour in the field of information security, the effects of mentor's creativity, the impact of the workplace status on the creativity of employees.

2.2. Artificial creativity (computational creativity)

Computational creativity (also known as artificial computational creativity, mechanical creativity, creative computing or creative computation) is understood as a multidisciplinary enterprise that is at the intersection of the fields of artificial intelligence, cognitive psychology, philosophy and art (Computational, 2022). The purpose of thus understood computational creativity is to model, simulate or create creativity with the use of a computer. The specific goals are:

- constructing a program or computer capable of creativity at the human level;
- better understanding of human creativity and formulation of an algorithmic perspective of creative human behaviour;
- designing programs that can enhance human creativity without necessarily being creative (Jordanous, 2022).

The field of computational creativity deals with theoretical and practical issues in the study of creativity. Theoretical work is carried out on nature and the proper definition of creativity and combined with practical work on the implementation of systems showing creativity, with one thread of work influencing the other. This form of computational creativity is called a media synthesis (Vales, 2019; Computational, 2022). Creative design is about expanding the space of possible projects with new knowledge. This happens as a result of creative design mechanisms such as emergence, analogy, and creative evolution. These mechanisms are also the subject of research on visual perception (Grabska, 2014). The concept of computational creativity also applies to art, mathematical models and engineering projects, and innovative scientific theories. One such theory is that creativity and curiosity are the by-products of a simple computational principle to measure and optimize learning progress. This is the formal theory of Schmidhuber (2006; 2010). If we imagine an agent capable of manipulating its surroundings, and thus its own sensory stimuli, then it can be motivated for continuous, open, active and creative exploration. An agent can use a black box optimization method, such as reinforcement learning, to learn (through conscious trial and error) a sequence of actions that maximize the expected sum of future reward signals. There are external reward signals for achieving externally defined goals, but the goal function to be maximized also includes an additional, inherent term for wow-effect modelling. This non-standard term motivates purely creative agent behaviour even when there are no external targets. Schmidhuber argues that this objective function explains the activities of scientists, artists and comedians. For example, physicists

are motivated to create experiments that lead to observations according to previously unpublished physical laws that allow for better data compression. Composers receive an inherent reward for creating non-arbitrary melodies with unexpected but regular harmonies that produce a wow effect by improving data compression. Likewise, the comedian receives an inherent award for "inventing a novel joke with an unexpected punch line, related to the beginning of the story in an initially unexpected but quickly learnable way that also allows for better compression of the perceived data" (Schmidhuber, 2010).

Computational creativity is a complex phenomenon whose study is further complicated by the plasticity of the language we use to describe it. Therefore, some researchers believe that it is impossible to develop a general theory of creativity (Computational, 2022). However, some generative principles are more general than others, leading to the claim that some computational approaches are "general theories". For example, Stephen Thaler suggests that certain neural network modalities are generative enough and general enough to manifest a high degree of creative ability (Thaler, 2013). Many authors such as Boden (2009), Wiggins (2012) and Ritchie (2001; 2005), have introduced formalisms that help us more accurately define software creativity.

The subject of the latest research on computational creativity indicates current research areas. In the period 1976–2021, 17 publications were registered in the ERIC database (as on 12 September 2022), which were assigned the following subjects, respectively: creativity (12), foreign countries (9), computation (7), computer science education (6), creative thinking (6). On the other hand, 83 publications were registered in the Web of Science database in 2022 (as on 12 September 2022), most of which were assigned to such Web of Science categories as: computer science artificial intelligence (8), computer science information systems (8), education educational research (8), neurosciences (8), mathematical computational biology (7). Further analysis of publications assigned to the category of computer science artificial intelligence management allows to specify further research areas: computer science, engineering, instruments instrumentation, mathematics, operations research management science, robotics. In the group of publications assigned to the computer science management category, there were, inter alia, topics such as: deep learning creativity, creating analogies between human and artificial intelligence as the basis of creativity, the problem of creative writing supported by Large language models (LLMs), automatic game creation using computational processes, algorithmic music generation by harmony recombination with genetic algorithm, CycleGAN algorithm to achieve the sketch recognition process in sketch-based modelling, automate the evaluation of design exams.

In the next chapter, we will look for the similarities and differences in the perception of human and artificial creativity.

3. INDIVIDUAL CREATIVITY VS. ARTIFICIAL CREATIVITY (COMPUTATIONAL CREATIVITY)

When analysing the results of research on creativity, we can ask ourselves the question: to what extent do humans and their creativity become a model for the creators

of AI solutions? In response to these questions, we will present the latest research results concerning selected concepts. They include:

- creative thinking – is one of the characteristics of competences at the human level. It is now believed that speculative ideas about the brain processes involved in creative thinking can be implemented in computational models. Two factors are important for creativity: imagination and selection or filtering. Imagination should be limited by experience, while filtering in the case of creative use of words may be based on semantic and phonological associations. Analysing the brain processes involved in coming up with new words leads to practical algorithms that create many interesting and novel names associated with a set of keywords (Duch, 2006).
- computational thinking competences – assumes the openness of short tasks as an indicator of whether creativity is necessary to successfully solve a task. When designing a task, you can make it more open and thus require more creativity and different competences in the field of computational thinking (Datzko, 2019).
- evaluation as a key element of creativity, both human and artificial – internal evaluation mechanisms drive the creative process and influence the competence of the creative agent. External evaluation works through certainty and requires interaction with users who express both opinions and some subjective quantification of the final work of art. This approach was used in the Psi model, which uses natural language processing techniques to infer satisfaction and emotional impact of the end product obtained by the creative agent (Augello, Infantino, Pilato, Rizzo and Vella, 2015).

Many of these solutions are used in modern education and research. Issues are addressed:

- developing competences of the 21st century through computational thinking and active learning;
- computational thinking perceived as one of the basic conditions for the development of students' problem-solving skills in primary school (including first programming with Ozobots, learning scenarios with robots);
- a methodical approach to teaching STEM skills through educational robotics for school teachers;
- the use of programming tools in teaching and educational materials by teachers of primary and secondary schools;
- virtual environment for creative and team learning;
- learning visual creative programming in the gaming environment;
- implementation and use of learning and collaboration technologies that shape competences in empowerment and creativity;
- designing informatics curriculum for K-12 education.

CONCLUSION

Our statements confirm that creativity as an interdisciplinary competence is attributed to both the individual and artificial intelligence. The analysis of the literature

on the subject allowed us to specify and examine the common characteristics of human creativity and artificial creativity (computational creativity). These are: creative thinking, computational thinking competences, evaluation as a key element of creativity, both human and artificial.

Man and his creativity become a model for the creators of AI solutions, and these solutions can be used in modern education. The subject of research is creativity in the general population, especially with regard to education. Distinctions between "high" and "little c" creativity and "democratic" creativity can be helpful. Moreover, creativity is defined in terms of those people who have made a significant creative contribution, possibly changing the field. Career trajectories of outstanding creative people are drawn up in order to reflect patterns and determinants of creative productivity.

REFERENCES

Aguilera, D. & Ortiz-Revilla, J. (2021). STEM vs. STEAM Education and Student Creativity: A Systematic Literature Review. *Education Sciences*, *11*(7), Article Number 331. https://doi.org/10.3390/educsci11070331.

Augello, A., Infantino, I., Pilato, G., Rizzo, R., & Vella, F. (2015). Creativity evaluation in a cognitive architecture. *Biologically Inspired Cognitive Atchitectures*, *11*, 29–37. https://doi.org/10.1016/j.bica.2014.11.013.

Boden, M.A. (2004). *The Creative Mind: Myths And Mechanisms*. London: Routledge. https://doi.org/10.4324/9780203508527.

Boden, M.A. (2009). Computer models of creativity. *AI Magazine, 30*(3), 23–34. https://doi.org/10.1609/aimag.v30i3.2254.

Computational creativity. In *Wikipedia. The Free Encyclopedia*. Retrieved September 12, 2022 from https://en.wikipedia.org/wiki/Computational_creativity.

Craft, A. (2001). 'Little C' creativity. In A. Craft, B. Jeffrey, & M. Leibling (Eds.). *Creativity in education*. London: Continuum International.

Creative Thinking Competency. In *PCM Training. Performance Management Consultant*. Retrieved September 12, 2022 from https://pmctraining.com/site/develop-your-core-competencies/creative-thinking-competency/.

Creativity. In *Wikipedia. The Free Encyclopedia*. Retrieved September 12, 2022 from https://en.wikipedia.org/wiki/Creativity.

Csíkszentmihályi, M. (2013). *Creativity: Flow and the Psychology of Discovery and Invention*. Harper Perennial.

Datzko, C. (2019). Openness and Creativity in Solving Short Tasks for Learning Computational Thinking. *Constructivist Foudations*, *14*(3), 407–410.

Decision (EU) 2021/820 of the European Parliament and of the Council of 20 May 2021 on the Strategic Innovation Agenda of the European Institute of Innovation and Technology (EIT) 2021–2027: Boosting the Innovation Talent and Capacity of Europe and repealing Decision No 1312/2013/EU. Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021D0820&qid=1662907284808.

Decision No 1350/2008/EC of the European Parliament and of the Council of 16 December 2008 concerning the European Year of Creativity and Innovation (2009) (Text with EEA

relevance). Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008D1350&qid=1663151617120.

Duch, W. (2006). Computational creativity. In *2006 IEEE International Joint Conference on Neural Network Proceedings*, *Vols 1–10* (pp. 435–442). Retrieved September 12, 2022 from http://fizyka.umk.pl/publications/kmk/11-Computational-Creativity.pdf.

Frith, E., Miller, S., & Loprinzi, P.D. (2020). A Review of Experimental Research on Embodied Creativity: Revisiting the Mind-Body Connection. *Journal of Creativity Behaviour, 54*(4), 767–798. https://doi.org/10.1002/jocb.406.

Grabska, E. (2014). The Theoretical Framework for Creative Visual Thinking *Studying Visual and Spatial Reasoning for Design Creativity.* Retrieved September 12, 2022 from https://link.springer.com/chapter/10.1007/978-94-017-9297-43.

Hahn, M. (1968). Minnesota Research Coordinating Unit for Vocational Education, Minneapolis: Review of Research on Creativity. Spons Agency-Office of Education (DHEW).

Henry, J. (1992). Creative Competences. Aspects of Educational and Training Technology Series, *25*, 139–144.

Jordanous, A. (2014). What is Computational Creativity? In *Thecreativitypost*. Retrieved September 12, 2022 from https://www.creativitypost.com/science/what_is_computational_creativity.

Kaufman, J.C. & Beghetto, R.A. (2009). Beyond Big and Little: The Four C Model of Creativity. *Review of General Psychology*, *13*(1), 1–12. https://doi.org/10.1037/a0013688.

Kiffer, S. & Tchibozo, G. (2013). Developing the Teaching Competences of Novice Faculty Members: A Review of International Literature. *Policy Futures in Education*, *11*(3), 277–289. https://doi.org/10.2304/pfie.2013.11.3.277.

Kozbelt, A., Beghetto, R.A., & Runco, M.A. (2010). Theories of Creativity. In J.C. Kaufman, R.J. Sternberg (Eds.). *The Cambridge Handbook of Creativity* (pp. 20–47). Cambridge University Press.

Luecke, R. & Łuczkiewicz, G. (transl.) (2005). Zarządzanie kreatywnością i innowacyjnością. *[Managing creativity and innovation].* Wydawnictwo MT Biznes.

Meusburger, P. (2009). Milieus of Creativity: The Role of Places, Environments and Spatial Contexts. In P. Meusburger, J. Funke, & E. Wunder (Eds.). *Milieus of Creativity: An Interdisciplinary Approach to Spatiality of Creativity*, (pp. 97–153). Cham: Springer.

Montgomery, D., Bull, K.S., & Baloche, L. (1993). Characteristics of the Creative Person: Perceptions of University Teachers in Relation to the Professional Literature. *American Behavioral Scientist*, *37*(1), 68–78. https://doi.org/10.1177/0002764293037001007.

Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962/EC). Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006H0962.

Regulation (EU) 2021/523 of the European Parliament and of the Council of 24 March 2021 establishing the InvestEU Programme and amending Regulation (EU) 2015/1017. Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R0523&qid=1663147833984.

Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regula-

tions (EU) No 1290/2013 and (EU) No 1291/2013. Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0695&qid=1662942787748.

Regulation (EU) 2021/818 of the European Parliament and of the Council of 20 May 2021 establishing the Creative Europe Programme (2021 to 2027) and repealing Regulation (EU) No 1295/2013 (Text with EEA relevance). Retrieved September 12, 2022 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0818&qid=1663147833984.

Ritchie, G. (2001). Assessing Creativity. In *Proceedings of the AISB*. Retrieved September 12, 2022 from https://homepages.abdn.ac.uk/g.ritchie/pages/papers/aisb01.pdf.

Ritchie, G. (2005). Experiments With Assessment of Creative Systems: An Application of Ritchie's Criteria. In *Conference: Second Computational Creativity Workshop, IJCAI2005*. Retrieved September 12, 2022 from https://www.researchgate.net/publication/261511218_Experiments_With_Assessment_of_Creative_Systems_An_Application_of_Ritchie's_Criteria.

Robinson, K. (1999). *All our futures: Creativity, culture, education*. National Advisory Committee on Creative and Cultural Education. eBook, English.

Schmidhuber, J. (2006). Developmental Robotics, Optimal Artificial Curiosity, Creativity, Music, and the Fine Arts. *Connection Science*, *18*(2), 173–187. https://doi.org/10.1080/09540090600768658.

Schmidhuber, J. (2010). Formal Theory of Creativity, Fun, and Intrinsic Motivation (1990–2010). *IEEE Transactions on Autonomous Mental Development*, *2*(3), 230–247. 10.1109/TAMD.2010.2056368.

Schmidhuber, J. (2012). When creative machines overtake man: Jürgen Schmidhuber at TEDxLausanne. Retrieved September 12, 2022 from https://youtu.be/KQ35zNlyG-o.

Simonton, D.K. (1997). Creative Productivity: A Predictive and Explanatory Model of Career Trajectories and Landmarks. *Psychological Review, 104*(1), 66–89. https://doi.org/10.1037/0033-295X.104.1.66.

Słownik Języka Polskiego PWN. *[PWN Polish Language Dictionary]*. Retrieved September 12, 2022 from https://sjp.pwn.pl/szukaj/kreatywność.html.

Thaler, S. (2013). Creativity Machine® Paradigm. In E.G. Carayannis (Eds.). *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship* (pp. 447–456). Springer.

Vales, A. (2019). An introduction to synthetic media and journalism. Retrieved September 12, 2022 from https://medium.com/the-wall-street-journal/an-introduction-to-synthetic-media-and-journalism-cbbd70d915cd (accessed 12 September 2022).

Wiggins, G.A. (2012). The mind's chorus: Creativity before consciousness, Cognitive Computation. Special issue on Computational Creativity, *Intelligence and Autonomy*, *4*, 306–319. https://doi.org/10.1007/s12559-012-9151-6.

Wiszniakowa-Zelinskiy, N. (2016). Psychologia rozwoju kreatywnego potencjału człowieka. [*Psychology of the development of human creative potential*]. Oficyna Wydawnicza AFM.

12 Traits of Creative People: By Indeed Editorial Team. In *Indeed. Carier Guide*. Retrieved September 12, 2022 from https://www.indeed.com/career-advice/finding-a-job/traits-of-creative-people.