User Experience of Creativity Support Tools – A Literature Review in a Management Context

Timon Sengewald[1] and Angela Roth[1]

[1] Friedrich-Alexander University Erlangen-Nürnberg (FAU), Chair of Information Systems - Innovation & Value Creation, Nuremberg, Germany
timon.sengewald@fau.de, angela.roth@fau.de

Abstract. Creativity Support Tools or Creativity Support Systems are a well-studied subject in the research of computer science and information systems. Whether the User Experience of Creativity Support Tools or Creativity Support Systems has been likewise sufficiently researched, shall be examined. A systematic literature search was conducted to investigate the current state of scientific literature. This review provides a brief overview of open and superfluous research areas in the field of User Experience for the development of Creativity Support Tools for business or management purposes. A total of 19 papers were selected and coded, sorted to concepts and assigned to the various phases of the creative process. The results of the analysis have shown that there is a need for further research in this field.

Keywords: creativity support tools, creativity support systems, user experience

1 Introduction

1.1 The Relevance of User Experience of Creativity Support Tools

The study of creativity in computer science - or at least in the community of the Association for Computing Machinery (ACM) - probably began around 1990 and has split into several research directions [1]. Digital tools, in particular, play an important role in most creative processes. Especially such tools which support creativity. This type of tools is known as Creativity Support Tools, for which there is still a need for further research [2]. The term first appeared when [3] began to show structured ways in which software can support the creative process. [4] identified already eighteen years ago, the research on Creativity Support Tools as one of the great challenges in Human-Computer Interaction (HCI) research. Today, there is still no consensus definition for Creativity Support Tools [2], but it can be generally said that it is a tool that "runs on one or more digital systems, encompasses one or more creativity-focused features, and is employed to positively influence users of varying expertise in one or more distinct phases of the creative process" [2]. Accordingly, the target group of such tools is widely scattered across different industries and application areas [5]. A similar type of software program or system to which this type of tool is attributable was also investigated very early in the Information Systems (IS) community [e. g. 6-8]. These so-called Creativity Support Systems generally refer to tools that support

15th International Conference on Wirtschaftsinformatik,
March 08-11, 2020, Potsdam, Germany

https://doi.org/10.30844/wi_2020_r14-sengewald

creativity [7], but research in the early stages was more concerned with how to support creativity in Decision Support Systems e. g. [7-8]. These two terms are used synonymously in the following. In summary, it can be said that there are different names for this kind of tools, but they are an important research area in both the HCI [1], [5] and IS research. A current systematic literature review by [2] on the present state of Creativity Support Tools shows that research usually only addresses a specific domain and user level (such as novel or expert). User experience (UX) research addresses these issues as it traditionally focuses on the inner state of the user, the characteristics of the designed system and the context within the interaction between the user and tool [9]. A positive UX can also increase users' creativity, e.g., by helping to generate more or more original ideas [10]. However, by performing a search on Scopus with the keywords "Creativity Support Tool" AND "User Experience" (5 June 2019) only twelve hits were generated, which are only partly related to the searched question. Especially if one wants to take a look at the impact of UX on Creativity Support Tools in a business or management context, research on this specific question does not seem to provide many answers at the moment. However, as [11] point out in their literature research, the use of creativity-supporting software in companies could make a positive contribution to innovation problems such as idea generation or problem-solving. However, the question arises as to what scientific findings are already at hand for this purpose.

1.2 Objective and Structure of the Study

For the reasons given above, this paper, aims to identify which UX patterns have already been studied in the scientific literature to develop tools to support creativity that helps users generate more ideas in a business or management context. In particular, (1) *which UX patterns lead to a positive UX*, (2) *and which lead to a negative UX*. Furthermore, (3) *for which phases in the creative process patterns exist for tools in a business context, especially for generating or evaluating business ideas (*4) *which gaps in knowledge exist and where there are matching concepts* (5) *which key directions for future research are to be investigated.* A systematic literature review was chosen to answer these questions.

As vom Brocke et al. [12] called for more methodological rigour in literature reviews, this paper attempts to answer this request by documenting in detail the process of searching, identifying and selecting relevant literature in the methodology section. This is followed by a scientrometric and content-based analysis of the selected papers. Subsequently succeeded by a discussion of the results, the contribution to the knowledge base in the field of information systems, the identified research gaps, the implications and limitations of this work and finally a short summary.

https://doi.org/10.30844/wi_2020_r14-sengewald

2 Theoretical Background

The view on Creativity Support Tools and the defined basic understanding, presented here, should serve as a basis to better understand the search for subtopics, the coding process, and the classification.

A creative process is generally defined in literature as the "individual exploration and transformation of conceptual spaces to generate ideas" [13]. Various models have been developed in research to map such a process [13]. In 2000, Shneiderman [3] introduced a framework, called Genex, for building user interfaces to increase creativity that can be applied to Creativity Support Tools. The Genex framework was chosen because it has created the basis for the design of user interfaces of Creativity Support Tools and is still relevant in today's research e. g. [2], [11], [15], [16]. The framework is based on three perspectives on creativity, which are called Inspirationalist, Structuralist, and Situationalist. The *inspiring model* assumes that the existing way of thinking or perception must be broken through to generate new ideas. Software, for this purpose, should support the free association by using textual or graphical instructions. The second perspective of the *Structuralists* focuses on learning from previous work and analysing and evaluating possible solutions. Libraries and so-called what-if tools are beneficial for this group. *Situationalists* consult with colleagues, friends, or mentors to support the creative process. For them, the possibility of advice is the decisive advantage. These three perspectives can also complement each other for some users [3].

Based on these three perspectives of use, Shneiderman [3] defines four phases, which are not linear but can also run in an iteration, and eight activities to support creativity. An overview of these phases and activities can be seen in Figure 1. The phase Collect can be defined as learning from previous work. The phase Relate termed in general consultation with a third party. The phase Create includes all activities related to a comparison of possible solutions. The fourth phase Donate includes all activities for making results again available to others [3].

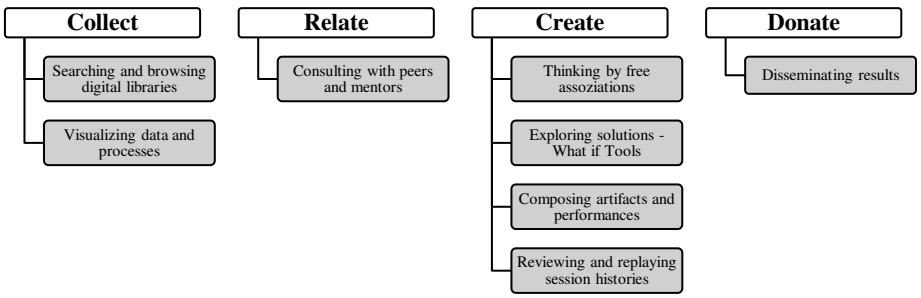

Figure 1. Genex framework and primary activities [2]

During these four phases, the user should be supported with at least the following eight activities. For the collection phase, the software should include support for searching and browsing digital libraries and visualization support for data and

https://doi.org/10.30844/wi_2020_r14-sengewald

processes. The phase Relate should at least enable the user to have a consultation with a third party. The phase Create should encourage to think through free associations, to identify possible solutions, and enable comparison, to allow composing of artefacts, and give the opportunity to review and repeat work processes [3].

3 Method

3.1 Research Method

In this study, a systematic literature is chosen as research method. A systematic literature search aims to synthesize knowledge and build foundations [16]. Hence, research questions one, two and three can be answered, because they ask for patterns that lead to a negative or positive UX. In addition, an effective systematic review of relevant literature on a given topic helps to identify areas of overplus research and gaps so that future research directions can be recommended [16]. This research method, therefore, also addresses research questions four and five.

3.2 Literature Search Process

As recommended in general, an attempt was also made to examine publications in the peripheral areas of IS research, in particular, computer science [12] and business administration [16]. The databases to be used for the search have been selected to cover the relevant disciplines. The used databases are briefly presented below. The AIS eLibrary covers most of the pure IS literature, especially those considered as leading journals and conferences by the research community in this field e.g. [18-19]. The ACM Digital Library and IEEE Xplore Digital Library were selected because they contain a wide range of literature from the computer science disciplines. Furthermore, the database ProQuest ABI/INFORM® and Scopus were searched. ProQuest ABI/INFORM® contains a variety of business science-related journals, conference papers, and proceedings. Scopus is an interdisciplinary database, including ScienceDirect for example, that covers peer-reviewed literature, with a focus on social science and technology publications. This also includes EBSCOHost Business Source Complete, which covers a large part of the academic literature from the field of business and economics. In order to ensure a reliable base for knowledge creation, the search was limited in advance to scientific journal articles and conference proceedings. Especially those that ensure a peer-review process. This selection covered the most important database for IS research [19].

A search for ("Creativity Support Tool" OR "Creativity Support System") AND "User Experience" returned only fourteen results on Scopus and four in the AIS eLibrary. Also, the search in the other database yielded only few results. However, most of them referred to tools to support creative writing or painting processes, but none of the results could provide recommendations on user experience regarding Creativity Support Tools for business and management context. Therefore, it was decided first to search the tables of contents of three major journals and conferences

https://doi.org/10.30844/wi_2020_r14-sengewald

related the area of User Experience, the idea being to perform a kind of screening similar to what Webster and Watson [16] recommend as a starting point for a literature search. These were the ACM Conference on Human Factors in Computer Systems (CHI), ACM SIGCHI Conference on Creativity and Cognition (C&C), the Journal ACM Transactions on Computer-Human Interaction (TOCHI) and AIS Transactions in Human-Computer Interaction (THCI). The tables of contents were not scanned manually, but their directory was used in the ACM Digital Library and searched for the keywords "Creativity Support Tool" OR "Creativity Support System". In the directory of the THCI in the AIS eLibrary, the search term "Creativity" was searched because the others did not provide any results. By this procedure, the first relevant results could be found, and the first subset of further keywords could be defined. Since within this topic the search with very specified search terms produced few relevant hits, the search was broadened - according to the approach of Bandara et al. [19] - and the 61 results found were later examined more closely with a tool for qualitative data analysis. This procedure is explained in more detail in section 3.4.

Based on the literature pool found, a backward search was carried out by analysing the references of the different research work. Besides, a forward search was performed, which means that work was searched that cited the research papers found so far. A Backward and forward search were then repeated sequentially [16]. Google Scholar was used for the forward search because the count of 'cited by' references was higher than in the databases like Scopus. The backward search identified another 23 possible relevant works and, the forward search identified another 3.

3.3 Literature Selection Process

The search results found were first evaluated based on ratings for the assessment of scientific quality. The use of rankings is discussed in the research community, but it seems to be an appropriate approach to ensure effective and qualitative results e. g. [13], [18], [20]. However, the ratings were only used to ensure the scientific standard (e.g. peer review) of the selected publications. The rankings used and the ratings accepted can be found in Table 1.

Table 1. Used Rankings

Name	Year	Rates	Discipline	Accepted Ratings
VHB-JOURQUAL3[1]	2015	Journals Conferences	BM / IS	AA / A / B / C / D
CORE 2018[2]	2018	Conferences	CS / IS	A* / A / B / C
ERA 2010[3]	2010	Journals	CS / IS	A* / A / B / C
Academic Journal Guide[4]	2018	Journals	BM	4* / 4 / 3 / 2 / 1
BM = Business and Management / CS = Computer Science / IS = Information Systems				

[1] The Ranking can be found here: https://vhbonline.org/VHB4you/jourqual/vhb-jourqual-3/
[2] The Ranking can be found here: http://portal.core.edu.au/conf-ranks/
[3] The Ranking can be found here: http://portal.core.edu.au/jnl-ranks/
[4] The Ranking can be found here: https://charteredabs.org/academic-journal-guide-2018/

https://doi.org/10.30844/wi_2020_r14-sengewald

By screening the abstract and the title, it was decided whether the work could be relevant for the review.

3.4 Literature Analysis and Synthesis

In order to synthesize the literature in a useful way, a concept-centred approach instead of an author-centred approach was chosen, as it is generally recommended [13], [17]. At first, only the title and abstract of each work were screened in order to create a first rough assignment to subject areas - which is a common procedure in literature reviews [19]. These were then further refined and supplemented during full-text analysis and synthesis. The coding was done in two levels, as Bandara et al. [19] recommend, and the results were recorded in a concept matrix using Excel. A further coding was carried out and assigned to the phases and activities defined in section 2 within Creativity Support Tools in order to give an overview of the gaping and overplus research areas. For the categorization on the first level, the questions were arranged according to the addressed research questions, and on the second level, a deeper understanding of the sub-topics was sought [19]. For a more detailed analysis, the research papers were loaded into a program for qualitative data analysis [19], the author used the program MAXQDA for this purpose. A lexical search - a function within the tool - then marked the text passages in the papers that contained the terms in question and then examined the context for relevance to the paper [19]. From the 87 works found, a total of 19 were selected for the review.

4 Results

4.1 Analysis of Scientometrics

The overview in Table 2 contains the year of publication, the journal or conference name, the research paradigm, the research method, and the unit of analysis.
No research paradigm seems to predominate strongly in the studies studied, since both, the behavioural and design science paradigm, were used relatively equally so that this field of research probably also benefits from the respective advantages of both paradigms. Many of the papers selected for this review did not examine a specific domain, and almost no mechanisms investigated that can be applied in particular to Creativity Support Tools in the business context. In addition, often only a specific user group or a particular system was examined and rarely the use within an organization.

Table 2. Analysis of scientometrics

Source	Journal / Conference	Research paradigm	Research method	Unit of Analysis	Domain
[15]	CACM	behavioural science	case study	system in use	General
[20]	C&C	behavioural science	empirical study	group	General
[21]	C&C	behavioural science	empirical study	group	General
[22]	C&C	behavioural science	literature review	group	General

https://doi.org/10.30844/wi_2020_r14-sengewald

[23]	C&C	design science	empirical study	group	Painting/ Sketching
[24]	CHI	design science	mixed method	group	Painting/ Sketching
[25]	C&C	design science	mixed method	group	Painting/ Sketching
[26]	CSCW	design science	case study	organization	Business
[27]	C&C	design science	mixed method	group	General/ Design
[28]	C&C	design science	user study	group	General
[29]	CSCW	behavioural science	empirical study	group	General
[30]	COOP	behavioural science	expert interview	group	General
[31]	CACM	behavioural science	case study	group	General
[32]	CACM	behavioural science	X	X	General
[33]	CSCW	behavioural science	mixed method	group	General
[34]	CSCW	behavioural science	case study	system in use	General
[35]	C&C	design science	case study	organization	General/ Business
[36]	CHI	behavioural science	semi-structured interview	group	General/ Design
[37]	CSCW	design science	user study	group	General

4.2 Content-based Analysis of Results

In Table 3, the work was assigned to the various activities from the Genex Framework in order to give an overview of the phases in which few user experience concepts could be found.

Table 3. Assignment to the Genex Framework

Source	Genex Framework Phase							
	Collect		Relate	Create				Donate
	Searching	Visualizing	Consulting	Thinking	Exploring	Composing	Reviewing	Disseminating
[15]				X				
[20]				X				
[21]				X				
[22]			X	X				
[23]			X	X				
[24]			X	X				
[25]	X	X	X				X	
[26]			X					
[27]				X				
[28]				X				
[29]			X					
[30]			X		X			X
[31]			X	X				
[32]		X	X	X		X		
[33]	X	X	X	X	X		X	
[34]			X					
[35]	X	X	X					X
[36]	X							X
[37]	X	X	X	X				
Total	**5**	**5**	**13**	**12**	**2**	**1**	**2**	**3**

https://doi.org/10.30844/wi_2020_r14-sengewald

As Table 3 shows, at least concepts for the exploration, composing and reviewing phases could be identified. Especially for the phases Consulting and Thinking, many concepts could be identified.

Table 4 below shows the concept matrix, which contains the addressed research objectives as well as the core topics identified during the analysis. The concept matrix also reflects whether the paper has addressed the negative or positive impact on user experience and the three most addressed themes in the found literature. As Table 4 shows, the impact of feedback on user experience has been a common theme. For example, Gill [38] argues that the user experience of interactive applications using collaborative intelligence and distributed creativity should be further explored to improve these systems. In particular, the effects of computational or AI feedback on the creativity and experience of users will be investigated by various studies e. g. [22], [23], [24], [25]. While effective feedback can help to improve creative performance, an improvement process in complex fields still takes much time, as it is often difficult for users to deduce the exact cause of an error from the feedback. A misguided improvement attempt can then lead to another error or deterioration of previously good quality [32].

Traditional collaboration among human users was a further identified topic. In principle, when designing collaborative systems for the user, the different requirements should be taken into account - both for activities that he performs as an individual and for activities that he performs as a member of the group [34]. For example, the authors [28] developed a digital whiteboard with sticky notes to encourage creativity and collaboration in distributed teams. An interesting aspect was that this system was able to work synchronously and asynchronously to support the needs of users in different phases and helped to overcome problems of these different modes of communication [26].

Table 4. concept matrix

Source	Concept matrix				
	positive UX	negative UX	computational feedback	collaboration	hardware usage
[15]	X	X			
[20]	X	X	X		
[21]	X	X	X		
[22]	X	X	X		
[23]	X				X
[24]	X	X	X		
[25]			X		
[26]	X			X	X
[27]	X			X	X
[28]				X	X
[29]				X	
[30]	X	X		X	X
[31]				X	
[32]			X		
[33]				X	
[34]		X		X	
[35]				X	

https://doi.org/10.30844/wi_2020_r14-sengewald

[36]	X	X			
[37]	X			X	X
Total	**11**	**8**	**6**	**10**	**6**

Consulting in interdisciplinary teams can help in creative processes, but this is accompanied by various barriers that have to be overcome in order for teamwork to be successful. This includes trust among users, especially so that each team member can explore and develop ideas [31]. If the collaboration teams are heterogeneous, the different backgrounds of the users can hamper or even block the effective use of technologies to support creativity. Therefore the IT infrastructure should be carefully selected and adapted to the needs of the respective users [30]. However, the added value of digital support systems for creativity collaborations cannot always be determined. For example, digital and analogue sticky notes have different advantages, but in one experiment, there were no significant differences in the result of a brainstorming session. Nonetheless, it was found that the users adapted to the respective usage possibilities and that the digital sticky notes stimulated more interaction [33].

Another important topic examined with regard to the user experience of Creativity Support Tools is the usage characteristics of the hardware used e. g. [32], [33]. By combining different hardware devices, their own advantages can be used to optimize the consulting process in group work. By dividing team presentation devices and individual devices for each participant with software support for a team and a private workspace, an idea from the team workspace can be adapted and locally modified at any time and then made available to the team again for discussion [27].

5 Discussion

With regard to the possible use and interpretation of the results, some important limitations of the procedure model and the results must be mentioned. Since only literature published in English was examined, important contributions possibly published in other languages may not have been considered. Since the keyword search referred only to the title, abstract, and keywords provided by the author, and no full-text analysis was carried out to identify the relevant literature, partially relevant work may be overlooked. Since the search was mainly limited to scientific journal articles and conference proceedings and contents from books or book chapters were only included in exceptional cases and literature outside the scientific field was not considered at all, it was not possible to give an overview of the entire literature landscape on this topic.

Future researchers could extend this literature review by giving a complete overview of the entire literature landscape and not just a limited like this one, as shown in the limitations. Since in this study predominantly only related works, so-called "second papers" could be identified - as defined in the work of Bandara et al. [19], future research work may investigate the applicability of these concepts or possible opposing assumptions. Although attempts have been made to proceed with a rigorous scientific methodology and to identify all relevant topics, important concepts

https://doi.org/10.30844/wi_2020_r14-sengewald

may not have been included due to the branching of the subject and novelty. Future literature searches may, however, extend these concepts. Further studies could be carried out on the gaps identified in the exploration, composing, and reviewing phases, but a literature review in related areas may also be helpful in uncovering concepts.

A contribution was made by documenting the literature search process in detail so that others could more easily extend this review or uncover gaps. In addition, the search strategies used may be extended or adapted for similar problems [12]. In accordance with a systematic literature search [16], the existing knowledge was collected and summarized so that a contribution was made to the knowledge base of IS research. It was also shown that this is an interesting and important area of study which still has some research gaps. Especially if one considers the actual goal of these tools, as Shneiderman [5] defines it, to help more users to be creative more often.

6 Conclusion

It has been shown that within the research on Creativity Support Tools used in the business and management context, the impact on the user experience is still relatively unexplored. The approach of these tools to support idea generation and problem-solving by fostering creativity corresponds to current innovation challenges in the business environment and could possibly be used as support for employees or entrepreneurs. Since the user experience may have a strong influence on a user's creativity, both in a positive and negative sense, the exploration of such design patterns may have a beneficial effect on the output by using such tools.

Researchers who wish to identify relevant literature should consider some particularities in their methodology in order to find the widely dispersed, relevant knowledge for this area. When searching for relevant literature, the different terminologies should be taken into account; in computer science literature, for example, the term Creativity Support Tool is used rather than the term Creativity Support System in IS literature. Likewise, it makes sense to explore research on the user experience of related systems such as Group Support Systems or Decision Support Systems in relation to creativity support functions. It may also be advisable to use broader keywords such as Creativity or User Experience to get a comprehensive but smaller result set. Generally, the assumption of Bandara et al. [19] can also be confirmed that the use of qualitative data analysis tools is helpful and useful in carrying out a systematic literature search, where a large number of papers have to be scanned.

An overview of the existing design patterns in current research and their influence on the user experience was given. It was found that research is particularly concerned with how user experience can be improved in collaboration environments and what effects feedback in general or computational feedback, in particular, can have on user experience. Moreover, the work on the activities defined by Shneiderman [3] was assigned in a creative process. This overview can be used in practice for the development of Creativity Support Tools as well as for future studies by researching

https://doi.org/10.30844/wi_2020_r14-sengewald

the identified gaps. Altogether 19 relevant papers were identified, summarized, and processed in this literature review.

References

1. Frich, J., Mose Biskjaer, M., Dalsgaard, P.: Twenty Years of Creativity Research in Human-Computer Interaction. In: Proceedings of the 2018 Designing Interactive Systems Conference. pp. 1235–1257. , Hong Kong (2018).
2. Frich, J., MacDonald Vermeulen, L., Remy, C., Biskjaer, M.M., Dalsgaard, P.: Mapping the Landscape of Creativity Support Tools in HCI. In: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI '19. pp. 1–18. , Glasgow (2019).
3. Shneiderman, B.: Creating creativity: user interfaces for supporting innovation. ACM Trans. Comput. Interact. 7, 114–138 (2000).
4. Shneidenman, B.: Supporting Creativity with Advanced Information-Abundant User Interfaces. In: Earnshaw, R.A., Guedj, R.A., Dam, A.., and Vince, J.A. (eds.) The Craft of Information Visualization. pp. 469–480. Springer, London (2001).
5. Shneiderman, B.: Creativity Support Tools. Commun. ACM. 45, 116–120 (2002).
6. Elam, J.J., Mead, M.: Can Software Influence Creativity ? Inf. Syst. Res. 1, 1–22 (1990).
7. Massetti, B.: An Empirical Examination of the Value of Creativity Support Systems on Idea Generation. MIS Q. 20, 83–97 (1996).
8. Wierenga, B., van Bruggen, G.H.: The Dependent Variable in Research into the Effects of Creativity Support Systems: Quality and Quantity of Ideas. MIS Q. 22, 81–87 (1998).
9. Hassenzahl, M., Tractinsky, N.: User experience - A research agenda. Behav. Inf. Technol. 25, 91–97 (2006).
10. Rooij, A. De, Corr, P.J., Jones, S.: Creativity and Emotion: Enhancing Creative Thinking by the Manipulation of Computational Feedback to Determine Emotional. In: Proceedings of the 2017 ACM SIGCHI Conference on Creativity and Cognition. , New York (2017).
11. Müller, S.D., Ulrich, F.: Creativity and information systems in a hypercompetitive environment: A literature review. Commun. Assoc. Inf. Syst. 32, 175–200 (2013).
12. vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., Cleven, A.: Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process. In: European Conference of Information Systems (ECIS) (2009).
13. Warr, A., O'Neill, E.: Understanding design as a social creative process. In: Proceedings of the 5th conference on Creativity & cognition. pp. 118–127 (2005).
14. Morris, D., Secretan, J.: Computational creativity support: using algorithms and machine learning to help people be more creative. CHI '09 Ext. Abstr. Hum. Factors Comput. Syst. 4733–4736 (2009).
15. Greene, S.L.: Characteristics of Applications that Support Creativity. Commun. ACM. 45, 100–104 (2002).
16. Webster, J., Watson, R.T.: ANALYZING THE PAST TO PREPARE FOR THE FUTURE : WRITING A REVIEW. MIS Quartely. 26, xiii–xxiii (2002).
17. Willcocks, L., Whitley, E.A., Avgerou, C.: The ranking of top IS journals: A perspective from the London School of Economics. Eur. J. Inf. Syst. 17, 163–168 (2008).
18. Peffers, K., Ya, T.: Identifying and evaluating the universe of outlets for information systems research: Ranking the journals. J. Inf. Technol. Theory Appl. 5, 63–84 (2003).

https://doi.org/10.30844/wi_2020_r14-sengewald

19. Bandara, W., Miskon, S., Fielt, E.: A systematic, tool-supported method for conducting literature reviews in information systems. In: European Council on Information Systems (ECIS) Proceedings. pp. 1–14 (2011).
20. de Rooij, A., Corr, P.J., Jones, S.: Creativity and Emotion: Enhancing Creative Thinking by the Manipulation of Computational Feedback to Determine Emotional Intensity. In: Proceedings of the 2017 ACM SIGCHI Conference on Creativity and Cognition. pp. 148–157 (2017).
21. Rooij, A. De, Corr, P.J., Jones, S.: Emotion and Creativity: Hacking into Cognitive Appraisal Processes to Augment Creative Ideation. In: Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition. , Glasgow (2015).
22. Rooij, A. De, Jones, S.: Mood and Creativity: An Appraisal Tendency Perspective. In: Proceedings of the 2013 ACM SIGCHI Conference on Creativity and Cognition - C&C ’13. pp. 17–20. , Sidney (2013).
23. Giannakos, M., Leftheriotis, I.: How Space and Tool Availability Affect User Experience and Creativity in Interactive Surfaces? In: Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition - C&C ’15. pp. 201–204. , Glasgow (2015).
24. Oh, C., Song, J., Choi, J., Kim, S., Lee, S., Suh, B.: I Lead, You Help but Only with Enough Details. Proc. 2018 CHI Conf. Hum. Factors Comput. Syst. - CHI ’18. 1–13 (2018).
25. Williford, B.: SketchTivity: Improving Creativity by Learning Sketching with an Intelligent Tutoring System Graduate Student Symposium. In: Proceedings of the 2017 ACM SIGCHI Conference on Creativity and Cognition - C&C ’17. pp. 477–483. , Singapore (2017).
26. Gumienny, R., Gericke, L., Wenzel, M., Meinel, C.: Supporting creative collaboration in globally distributed companies. In: Proceedings of the 2013 conference on Computer supported cooperative work. pp. 995–1007. , San Antonio, Texas, USA (2013).
27. Hailpern, J., Hinterbichler, E., Leppert, C., Cook, D., Bailey, B.P.: TEAM STORM: Demonstrating an Interaction Model for Working with Multiple Ideas During Creative Group Work. In: Proceedings of the 6th ACM SIGCHI conference on Creativity & cognition. pp. 193–202. , Washington, DC, USA (2007).
28. Hilliges, O., Terrenghi, L., Boring, S., Kim, D., Richter, H., Butz, A.: Designing for collaborative creative problem solving. In: Proceedings of the 6th ACM SIGCHI conference on Creativity & cognition. pp. 137–146. , Washington, DC, USA (2007).
29. Hymes, C.M., Olson, G.M.: Unblocking brainstorming through the use of a simple group editor. In: Proceedings of the 1992 ACM conference on Computer-supported cooperative work. pp. 99–106. , Toronto, Ontario, Canada (2004).
30. Herrmann, T.: Design Issues for Supporting Collaborative Creativity 1 Introduction : Collaborative Creativity. In: Proc. of the 8th Int. Conf. on the Design of Cooperative Systems. pp. 179–192 (2008).
31. Mamykina, L., Linda, C., Edmonds, E.: Collaborative Creativity. Commun. ACM. 45, 96–99 (2002).
32. Thomas, J.C., Lee, A., Danis, C.: Enhancing creative design via software tools. Commun. ACM. 45, (2002).
33. Jensen, M.M., Thiel, S.K., Hoggan, E., Bødker, S.: Physical Versus Digital Sticky Notes in Collaborative Ideation. Comput. Support. Coop. Work CSCW An Int. J. 27, 609–645 (2018).
34. Gutwin, C., Greenberg, S.: Design for individuals, design for groups. In: Proceedings of the 1998 ACM conference on Computer supported cooperative work - CSCW ’98. pp. 207–216. , Seattle, Washington, US (1998).

https://doi.org/10.30844/wi_2020_r14-sengewald

35. Cohen, T., Clemens, B.: Social networks for creative collaboration. In: Proceedings of the 2005 ACM SIGCHI Conference on Creativity and Cognition - C&C ’05. p. 252. , London (2005).
36. Herring, S.R., Chang, C.C., Krantzler, J., Bailey, B.P.: Getting Inspired! Understanding How and Why Examples are Used in Creative Design Practice. In: Proceedings of the 27th international conference on Human factors in computing systems. pp. 87–96 (2009).
37. Hartmann, B., Ringel Morris, M., Benko, H., Wilson, A.D.: Pictionaire - Supporting Collaborative Design Work by Integrating Physical and Digital Artifacts. Proc. Int. Conf. Comput. Support. Coop. Work. 421–424 (2010).
38. Gill, Z.: User-driven collaborative intelligence. In: Proceedings of the 2012 CHI Conference on Human Factors in Computing Systems - CHI ’12. p. 161. , Austin (2012).
39. Kühn, R., Korzetz, M., Büschel, L., Korger, C., Manja, P., Schlegel, T.: Natural Voting Interactions for Collaborative Work with Mobile Devices. In: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI ’16. pp. 2570–2575. , San Jose (2016).

https://doi.org/10.30844/wi_2020_r14-sengewald