Capturing User Experience of Customer-Centric Software Process through Requirement Process: Systematic Review

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Abstract—**Agile and User Experience have become popular for decades due to the ability to understand customer needs. However, both methods have different perspectives on the point of view, value, and quality. Moreover, user research in UX is usually conducted in the long term. The human aspect is a critical thing in Agile, the purpose of this aspect is to understand the value and need of the product, and with the user stories, several developers try to understand the human aspect of customers. In the elicitation process of the UX, developers used user stories to capture customer personality. One important factor is emotion; UX researchers measure emotions from the product journey, but it is unpleasant when the customer finds out the product does not meet expectations. This study aims to research the implementation of capturing emotion in user experience among Agile software development activities from several perspectives. In addition, Limited resources in software projects require innovation that can guarantee the sustainability and quality of the product. In this paper, we used modified systematic mapping to extract, classify, and interpret articles from popular publishers and map the user experience life cycle to answer several existing problems. This research shows that a combination of user requirement and UX increase the product's usability. Moreover, involving the user in the development center increases the project's success.**

Keywords— **Agile; user experience; requirement engineering; emotions; user stories; user persona.**

I. INTRODUCTION

Several researchers agree that Requirement Engineering (RE) is an important factor in the critical phase of software engineering (SE). We can define those requirements are what the system should do and explain how it should do it [1]. RE activities in traditional Software Development Methods (SDM) are detailed activities and a list of the user requirement before coding or implementation; the modern SDM like Agile, is flexible and iterative [2]. This modern method focuses on communication between customers and developers. Moreover, in Agile, customer involvement is something important, which means the developer's interpersonal and social skills in each iteration. Hence, effective and efficient products are delivered to the customers, enlightening the development phase. The incremental requirement in the iterative phase of Agile has given dependency issues in design, rigidity, and mobility. The first issue, rigidity means that every change in the requirement implies sequence in the other modules. And for the second issue means the inability of the

system to encapsulate components that can be reused. Hence, effective collaboration is very important to conduct effective software products. Moreover, collaboration with the customers with appropriate technical skills, interpersonal skills, and understanding of customer issues that combination of this activity we call socio-technical activity. That activity is very important to capture the human aspect of the RE process [1]–[3].

The human aspect of RE has a large area in the research. The purposes of study in this area are to capture both better or worse personalities of customers to improve the RE process. In Agile, we believe every RE activity in each iteration must involve the user. Moreover, with human aspect minimizes miss understanding and bias in the process. Researchers have investigated several areas in human aspects such as emotions [1], [4], [5], personality [5]–[8], motivation [9], [10], communication [11]–[13], and attitude [10].

The popularity of Agile in SDM has also been followed by UX, which has become standard in the software industry [14]–[16] and also become standard in the academic field [13],

[17]. However, in practice, UX is placed in the design phase, which is in the Agile phase and is usually separate. Agile and UX approaches are very different, both in terms of value and quality. The collaboration of the two methods has attracted the attention of several researchers [14], [18], [19]. The main challenge in integrating this method is finding rules based on the same activity.

A user story is a popular method that has been used in Agile [14], [20]. Agile developers usually use user stories in the RE stage to explore the needs and values of the software. Moreover, user stories are comprehensive and negotiable methods among users and developers. However, user stories in UX require long-term studies that emphasize specific issues in the UX, but user stories can be useful in practice and tailored to reduce resources. Understanding the customer's personality in UX by understanding the habits and emotions in their daily work. Hence, understanding the human aspect of Agile and the uniqueness of the customer is useful for dealing with the software. Usually, UX developers measure emotions not captured in the RE process to describe their journey of a product. However, some customers feel frustrated when doing UX testing because the product they get is not what they expected. This can be anticipated when developers can understand the emotions of users when using the existing system or when they interact with their work.

The aim of this paper is to undertake a systematic mapping study on how to capture UX among RE processes while developing products. Focus on this study by structuring UX and RE topics around the software development activity focused, challenges and issues reported by UX developers, and the type of research. This paper aims to explore the topic between Agile and the UX developer to maximum breadth by using a systematic mapping protocol to identify the research gaps for future research. This paper's state-of-the-art will help solo software developers identify guidelines, tools, and techniques to focus on capturing emotions in RE and user experience entities. This research will help Agile development bring users to the development center. Moreover, adopting the UX aspect to all software development activities improves software success rates and negotiations under resource limitations.

This paper is structured as follows: Methods, the planning of the systematic mapping, research questions, and research protocols for the data gathering and interpretation. The next section is Results and Discussion, and finally, the Conclusion and future work directions.

II. MATERIALS AND METHODS

The agile software process was published in 2001 to develop products and services into presence to accommodate business requirements changing and to adapt to the challenge facing modern software development. The agile method became popular because relying on the practitioners and experience that focus on the early delivery quality of the software product and service. The key point of agility in this method is continuous integration, simple design, comprehensive documentation, and customer collaboration. This key point is supported by reinforcing iteration, development, adaptability, and collaboration throughout the development process [21].

Although Agile is a modern development method, it does not renounce the generic development process. However, this method is not a linear waterfall model, each activity takes an iterative approach. Minimizing risk and adopting quick change, the Agile method consists of several small cycles or in inherit of the agile model called small iteration or in Scrum called Sprint. Each small cycle or sprint will develop for continuous improvement in four weeks or less. Moreover, the Agile methods focus on the customer or customer-centric, which helps developers minimize risk and quickly respond to the changes during software development. Customer-centric enables continually improving the software product with the market value that makes the software more competitive and allows the software to be released earlier with its core functions [21], [22].

A. Agile Requirements Engineering

Modern technology makes software products grow faster. It makes the sequential software process no longer relevant with the flexibility and technology dynamic nowadays. Hence, the software process needs to adapt to modern technology with the development models according to its time. Agile (Extreme Programming, Scrum, Design Thinking, Kanban, Rational Unified Process (RUP)) are popular methods in modern technology with their agility for dynamic problems. Takeuchi and Nonaka [23] predicted that a sequential software process is not well suited due to the lack of flexibility. Therefore, there are iterative software processes like Rational Unified Process [24] and Agile methodologies such as Extreme Programming [25], [26], Scrum [27], Design Thinking [9], Lean [28], and Feature-driven Development [29]. There were 2,001 publications on the lightweight software process have been published. Some researchers and practitioners joined and created a manifesto for Agile software methodologies, the core of the manifesto are the values and the principles to optimize the software process and to have strong collaboration [30]. Four cores of the agile manifesto are listed below:

- Individuals and interactions over processes and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change by following a plan.

B. Summary of related works

Agile is a modern method that focuses on the customer with customer-centric approaches. Popular research in the agile software process is integrated with User-Centered Design (UCD). The next paragraphs summarize the selected article. Integration of the Agile software process and UCD are analyzed on how usability issues are addressed in modern software projects [31]. In his literature review, the Agile software process and UCD are integrated with the comprehensive classification based on the system covering and related information. Silva et al. [31] review shows some important roles in the integrated Agile software process and the UCD, like a little upfront design, prototyping, user stories, user testing, and inspection evaluation. In addition, their purpose process model integrated the Agile software process and UCD.

To capture user behavior during development by conducting research and usability testing. A review by Salah, Paige, and Cairns [32] addressed challenges in integrating the Agile software process and UCD. They explored good development practices and challenge issues facing the integration process. Some of the reported challenging issues are the lack of allocated time for upfront activities, the difficulty of modularization, performing usability testing, work optimization, and documentation.

Schön, Thomaschewski, and Escalona [33] compared the Agile software process and UCD to deliver a competitive product with the suitable User Experience (UX). In addition, for the continuous feedback loops, collaboration with stakeholders and users during Requirement Engineering (RE) is an essential process. Some aspects are reported in their review, like stakeholder and user involvement, data gathering, user perspective, integrated methodologies, shared understanding, artifacts, documentation, and non-functional requirements.

In this paper, we used bibliometric analysis in the specific research field. The bibliometric analysis aims to map the current state of the research statistically, quantitatively, and objectively [34]–[36]. Moreover, systematic mapping (SM) with bibliometric analysis represents the impact of the research. The SM study tries to find the answer to the research questions of the objective analysis of future research. The objective of this paper follows the research questions as follows:

- **RQ1.** How is a developer or researcher aware of the user experience in software development?
- **RQ2.** Which area in Agile development has involved the user experience?
- **RQ3.** Which issues and challenges are associated with Agile with the user experience?
- **RQ4.** How do capturing emotions in the UX and the implications of that?
- **RQ5.** What is the correlation between Agile and User Experience in solo software development?

RE and UX research is multidimensional; hence bibliometric method helps the researcher to focus on the subjects. Moreover, we used SM to conduct citation, co-occurrence, and co-citation analyses to provide structured information about RE and UX in specific areas. The number of publications shows the productivity of the research field [37]. The citation frequency reflects the impact of the publication on the research fields [36]. The quantitative overview of the publication it meaning a high degree of objectivity [34], [36], [37]. The first step of this SM is defining the research scope that triggers the publisher's search engine. The author considered to used only peer-review articles composed in English from credible publishers until 2022, the last initial list of publications on 30 March 2022. The author conducts the research scope using the keywords as shown in Table 1. The focus of the article from the publication in the journal and proceeding. The author used Scopus, the curated abstract and citation database from the publishers to extract the bibliographic information related to the keywords.

TABLE I
SEARCH TERM

Category	Keywords
Agile	Agile, scrum, kanban, extreme programming, lean, design thinking
Usability	Usability, UCD, user centered design, user experience, UX
Requirement	requirement

TABLE II
INCLUSIONS AND EXCLUSION CRITERIA

Inclusions Criteria
1. Papers that implicitly contain a minimum of one keyword in each category in Table 1
2. Papers have bibliography metadata.
3. Papers must be written in English.

Exclusion Criteria
1. Papers are written out of computer science subject area.
2. Papers do not have documents

TABLE III
QUALITY CHECKLIST FOR EMPIRICAL STUDIES

Item	Assessment criteria	Score	Description
Q1	Was more than one study conducted?	-1 0 1	Only one study was conducted Two studies were conducted More than two studies were conducted
Q2	Does the study present a detail description?	-1 0 1	No, detail is missing Partially, need to read the references Yes, detail is comprehensive
Q3	Has the paper been cited by other papers?	-1 0 1	No, no one cited the paper Partially, cited by 1-5 other papers Yes, more than 5 paper cited
Q4	Includes the clear aims of the study	-1 0 1	No, aims are not described Unclear aims study Yes, clear and written
Q5	Can the research methodology be repeated by other researchers?	-1 0 1	No, unclear methodology Partially, repeatable but not explained in detail. Yes, described in detail in the form of diagrams or sub chapters.

The second steps are the selection. RE and UX are very multidimensional; due to the number of papers that maybe not be related to our research, we conduct inclusion and exclusion criteria. All these papers must pass our protocol to have the ability to answer research questions. Inclusion and exclusion criteria that we used in this paper as shown in Table 2.

Based on these results, we can conclude the perception of the publication from a specific field of study in the scientific network [37]. The third step is data extraction; hence, we must extract bibliography information for data that we conduct from previous steps. We used Research Information System (RIS) data extracted from a publisher search engine for this step. We used author(s), year, category, title, publisher, abstract, and keywords in this paper. We ensure that each data we extract from the publisher search engine has an exclusive feature with a check manually using Zotero. The co-occurrence analysis used in this paper included keywords, abstract, and author. Furthermore, the co-occurrence analysis

reflects the productivity of the field study from the term, author, and country.

The papers selected from the previous section were evaluated with the quality assessment that was developed with the checklist based on the previous research [38]. We classified based on the category of the articles, SLR, Methods, Models, Case Studies, Literature research, Interviews, and Surveys. These are classified based on recommendations by Hinderks et al. [38]. At the end of the quality assessment, every paper was rated with Table 3 of individual sum results, and we included articles with a score greater or equal to 1.

Figure 1 describes how several protocols limited the number of papers to ensure that quality articles are used in this literature review. The first step is limited to the search strings

based on Table 1. In this step, we used AND logic for each category. The next step is to eliminate nonrelevant articles based on the title, abstract, and keywords from N=5309 to N=394. This huge reduction number for this elimination process is due to articles with the complete document, title, abstract, and keywords that contain keywords in the search term. The next two steps are to remove articles without an Author and non-English language in the full article or document. In addition, we also exclude noncomputer science articles due to the wide range of topics. The last step is manually scanning content with the quality checklist in Table 3. We remove articles with an individual sum of less than one. In the end, 52 articles are selected from the last phase.
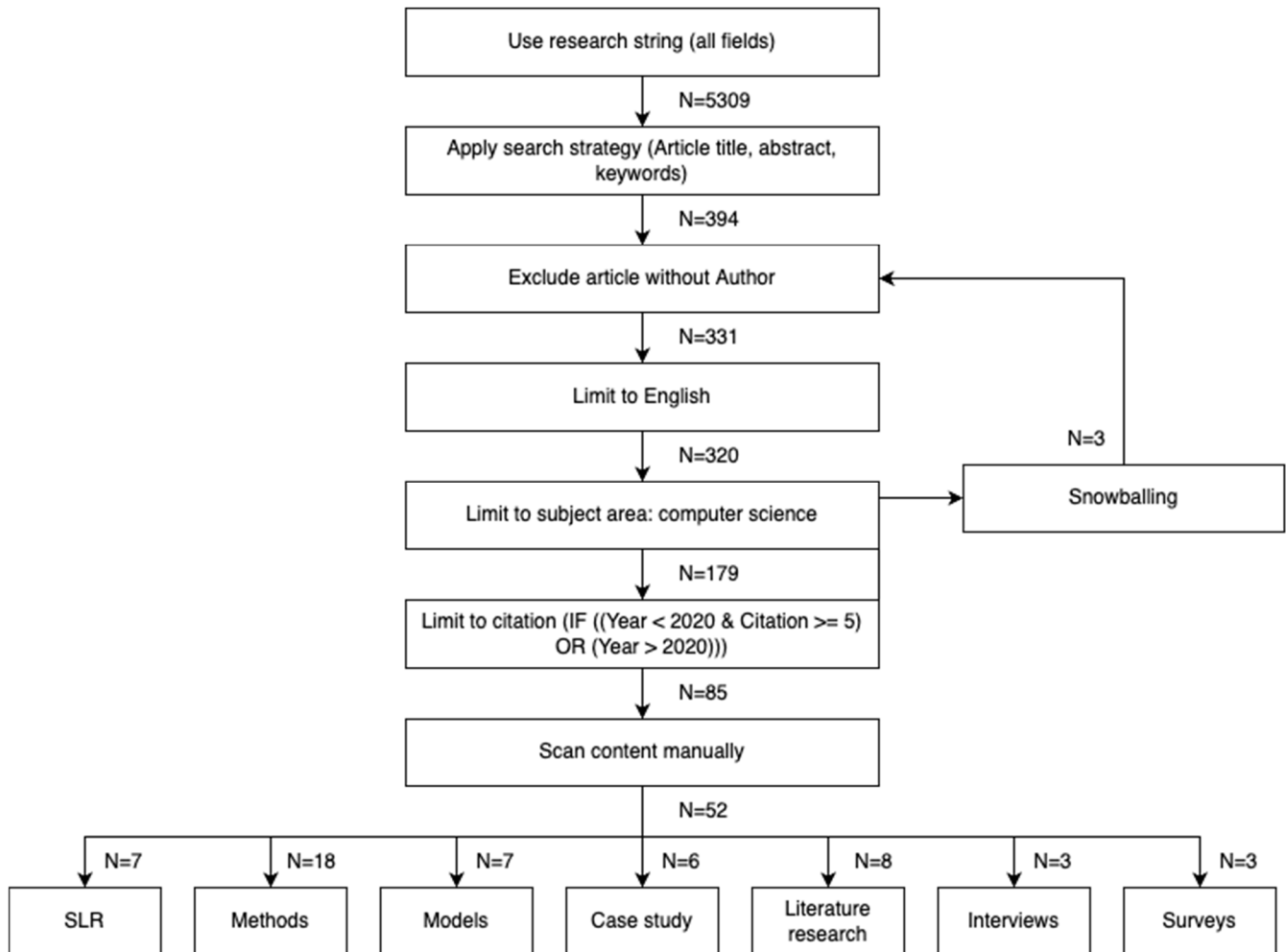

Fig. 1 Search process comprising phase inclusion and exclusion forward and backward snowballing

III. RESULTS AND DISCUSSION

A. Number of Publications and Publications Per Source

The first initial paper on applying inclusion and exclusion criteria was published in 2002. Figure 2 shows the development of the number of published articles related to the selected term in the Scopus search engine. The total of

publications from 2002 to 2014 is half of the total from the first initial paper on this topic until 2022, with a total of 27 articles. Starting in 2007, the number of articles fluctuated. However, since 2013 category of this topic has been more diverse. With the average number of citations from this topic being 62 and the H-index of the dataset being 18, at least 18 publications on this dataset received at least 18 citations.
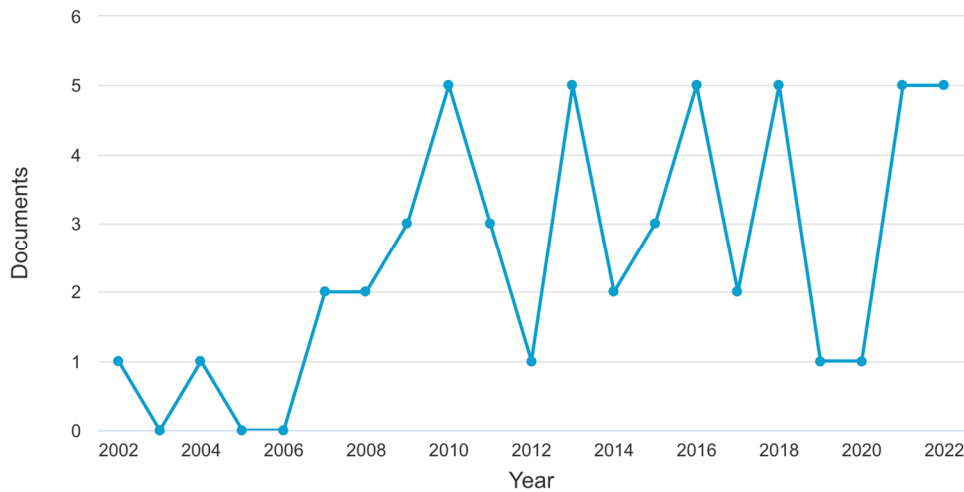
Fig. 2 The annual number of publications on related topics

There are two types of categories from the search results, which are conference papers and articles. Therefore, in this study, it was chosen to use all selected articles Table 4 shows the number of publications per source. In addition, the selected articles are articles on computer science.

TABLE IV
NUMBER OF PUBLICATIONS PER SOURCE

Source	#Articles
Lecture Notes in Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	14
IEEE Software	3
Journal Of Ambient Intelligence and Humanized Computing	3
Advances In Intelligent Systems and Computing	2
Information And Software Technology	2
Ingenierie Des Systemes D Information	1
Interactions	1
International Journal of Advanced Computer Science and Applications	1
International Journal of Sociotechnology and Knowledge Development	1
International Journal of Software Engineering and Knowledge Engineering	1
Journal Of Emerging Technologies in Web Intelligence	1
Journal Of Software Evolution and Process	1
Journal Of Systems and Software	1
Lecture Notes in Networks and Systems	1
Proceedings International Computer Software and Applications Conference	1
Proceedings International Conference on Software Engineering	1
Science Of Computer Programming	1

TABLE V
DISTRIBUTION ACCORDING TO THE RESEARCH METHOD AND YEAR

Year	A	B	C	D	E	F	G
Research method							
2002			[63]				
2004		[45]					
2007					[76] [77]		
2008	[39]		[64]				
2009		[46] [47]					[84]
2010		[48] [49] [50]	[65]	[70]			
2011		[51]		[71]	[78]		
2012					[79]		
2013		[52]	[66] [67]			[85]	[87]
2014				[72]		[86]	
2015		[53] [54]		[73]			
2016	[40] [41]	[55] [56]					[88]
2017	[42]	[57]					
2018		[58] [59]	[68]		[80], [81]		
2019		[60]					
2020	[43]						
2021		[61]	[69]	[74]	[82] [83]		
2022	[38] [44]	[62]		[75]			[89]

A: SLR, B: Methods, C: Models, D: Case Studies, E: Literature research, F: Interview, and G: Surveys

B. Co-Occurrence Analysis

Figure 3 shows the co-occurrence analysis and its link. For this paper, we used five for the threshold to display the keyword [37], meaning how often keywords appear in the article used for analysis. With the visualization from VOSviewer, we analyze the co-occurrence of the article. Representation of the co-occurrence separated with a cluster that also represented the research field of the topics. From the threshold we used in VOSviewer, we get results of 1241 terms, and 59 meet the threshold. The number of the most relevant that will show in VOSviewer based on the default number of the configuration, 60% of the total terms with the number will be selected is 35.

Cluster representation in the VOSviewer indicates the correlation between the keyword and the link related to the other keyword. Moreover, from Figure 3 (A), we can see that the topic is separated into five clusters based on the threshold we defined in the first study. Cluster 1 (red), cluster 2 (green), cluster 3 (blue), cluster 4 (yellow), and cluster 5 (purple).

When we analyze Figure 3 (A), we can see that cluster 1 is related to 4, and cluster 2 is related to cluster 3. Cluster 5 distinguished itself from an automation perspective. Figure 3 (B) shows the visualization based on the years. Agile and Experience popular in the range 2014 to 2016. Design thinking is quite new to the Agile method that was popular from 2016 to 2018. Moreover, the software process model and quality are timeless. We can find this topic in the whole of the range time.

(a)

(b)

Fig. 3 (A) Network and (B) overlay visualization

C. Discussion

The study shows the evolution of research on UX and the requirement process between 2002 and 2022 in terms of scholarly publications. According to the datasets, the last ten years have embraced most publications on related topics. Moreover, the citation analysis shows that UX and requirement processes are related to user behavior and emotions. The bibliometric analysis has provided the background for the quantitative overview of the publication's landscape. The first noticeable from this research is that this topic's impact is wider than a computer science major.

UX disciplines clearly show that UX is a highly interdisciplinary topic. Biology-related publication shows that UX is also an important part of that topic. Moreover, the cross-relation with psychology shows that the correlation between UX and human perception is the most discussed issue. Quantitative research with bibliometric analysis answers the first question of this research.

1) RQ1. How is a developer or researcher aware of the user experience in software development?

Table 5 shows the number of publications per research method from selected topics. It is important to notice that the interpretation of Table 5 is based on the data from Scopus with the specific term. We make limitations from this paper based on the inclusion and exclusion criteria. Computer science takes most of the publications on this topic, with more than 31% of the total datasets showing that it is interesting. Moreover, the average of the citable document per paper is 30, which makes clear that the quality of the publication is also important for this topic. With more than 2956 authors from the 1735 document, it is evident that this topic will increase significantly over the past decade.

The total link strength and occurrences show that most publications are related to the software. Hence, the focus of the UX and user behavior for the first steps focus on the software or user interface. Moreover, study usability and human research, for example, interaction, experience, behavior, and emotions.

2) RQ2. Which area in Agile development has involved the user experience?

- Software Process and Correlation with UX

This research focuses on identifying the correlation between user behavior in UX and user requirements. Table 6 presents the results from the references discussing the software process. The number in parentheses symbols indicates the methods used in the references article. Most publications used Agile as a software process combined with the UX and requirement process based on the keyword. In addition, Scrum, Design Thinking, and Extreme programming are also popular in research.

The problem of an agile software process such as extreme programming (XP) has the drawback of placing too much emphasis on analytical and technical problem-solving [39]. In addition, another Agile method, such as design thinking (DT), blends knowledge from the design, social sciences, engineering, and business fields to create rapid prototypes centered on people's needs. There is no assurance that a software process will guarantee that software product or services are delivered on time, meets customer needs, or possesses the technical traits that will result in long-term quality characteristics [40]. Hence, the integration of two or more methods commonly happens in the software process.

TABLE VI
SOFTWARE PROCESS

Software Process	References	Total
Agile	[41], [42], [43], [44], [45], [46](2), [47], [48](2), [49](3), [50], [51](2), [52](2), [53](2), [54](2), [55], [56], [57](2), [58], [59], [60], [61], [62], [63], [38], [64], [65](2), [66], [67]	28
Scrum	[68](1), [69], [70], [48](1), [49](2), [71](1), [54](1), [72], [73](1)	9
Kanban	[74]	1
Extreme programming	[75], [68](2), [76], [77], [71](1), [39](1)	6
Lean Product Development	[51](1), [78]	2
Design thinking	[46](1), [79], [57](1), [80], [39](2), [73](2), [81]	7
Usage-centered engineering	[82]	1
Agile User Centered Design	[83], [84]	2
Little Design Up Front	[85]	1
Web Test Driven Development	[86]	1
Inter-combined Model/ InterMod	[87], [88]	2
Agile Usability Software Engineering Lifecycle	[49](1)	1
Pair programming (PP)	[52](1), [53](1)	2
User-centered behavioral	[89]	1
Rapid software development	[65](1)	1

- Integration software process

Integration of UX and Agile in the software process is to improve the value of the software products. From the selected article, integration of the software process and UX is common in the requirement and evaluation process. In addition, there is no assurance that guarantee software products are meets customer needs with a single software process.

Sohaib et al. [39] in their research combine design thinking and extreme programming to improve the quality of software products for the end-users and it enables the software development activity to achieve creativity and innovation. Integration DT and XP present DT best practices such as empathy, define, persona, and user stories. The best practice in the DT is adapted in the XP phase in the prototyping and usability evaluation. There are five best practices integration of DT and XP:

- Integrate user stories with persona-based design.
- Multidisciplinary teams for collaboration and creativity.
- Prototype development.
- User-centered design and user acceptance testing.

- Agile usability testing throughout the development process.

Choma, Zaina, and Beraldo [54] integrate UX and Agile, with the User X Story. A grammar for the stories of interaction to remedy the difficulties teams encounter to insert UX aspects and usability requirements in the first phase of the software process. There are two steps to building a user story template. The first step is an ethnographic study to understand how the product owner was developing user stories. The second step is a literature survey to investigate Agile's best practice user stories. These two activities are an iterative process that needs improvement at every step.

Güncan and Durdu et al. [89] purposed user-centered behavioral (UCB) that combines usability and Agile with behavior-driven development (BDD). BDD is an Agile method that enables the project owner to understand and analysis of the requirements better. Best practices from this research to improve the requirement with the style guides, usability test, heuristic evaluation, and Wizard of OZ. Implementation of this method is divided into different iterations starting from iteration-0 to iteration-n, for each iteration composed of phase, sub-phase, and input-output.

3) RQ3. Which issues and challenges are associated with Agile with the user experience?

Table 7 shows the relevant publications on the topics of user behavior and user requirement to capture emotions. In the software development process, user requirement is an important process that might be focused on in the first phase of development. Moreover, the project's success depends on the requirement engineer's ability to elicit the user's needs. Although the user requirement is how we interact and understand what the user needs, combining it with the UX method is another way to reduce the development phase and schedule.

Focus on the user for the development phase to elicit their emotions is also important to understand their feelings when they use the software. Moreover, the software is designed to solve the existing problems in the user's daily activities. To elicit user requirements with the UX method, a researcher usually uses some tools, such as user stories, customer journeys, and modeling tools.

TABLE VII
SELECTED PUBLICATIONS WITH THE FINDINGS

Ref	Tools	Findings
[14]	User stories	1. Integrating agile development with the small scale. 2. Inclusive, reflective, and reciprocal communication.
[90]	Human-oriented RE	1. Develop Visual Care Plan Modelling Language (VCPML) to provide Domain Specific Visual Languages (DSVL). 2. Capture positive and negative emotions.
[91]	Intel Real sense Camera	Capture anger, contempt, disgust, joy, sadness, and surprise with Intel Real sense Camera.
[92]	Videogame Emotion Language	1. Apply VEL for Domain-specific modeling language (DSML). 2. The purpose of the VEL is to elicit

Ref	Tools	Findings
		fundamental domain concepts to be represented in the prototype.
[93]	Learner Experience (LX), Learning Journey Map (LJM)	1. Defined user-centered problems with empathy by design thinking approach. 2. Solve learner problems with the LX and evaluate with LJM.
[94]	Kansai Engineering (KE)	1. KE translates human psychology (feelings and emotions) into product design attributes (size, shape, and other attributes). 2. Data from the synthesis steps are presented in the relational model. Models are built from each Kansai word and product attribute.
[95]	Psychological-driven goal models	1. Captures and models stakeholders' personal values, motivations, and emotions. 2. Grounded theory for constructing theory from data (coding, conceptualization, categorization, theorizing).
[96]	User stories	1. Three basic steps for an affective user story, are express, experiment, and evaluate. 2. Agile requirement engineering contains mental quality attributes (utility and usability) and non-instrumental attributes (motivation and emotion).
[97]	Prioritizing feature improvements	1. Requirements are routinely extracted from post-release user feedback. 2. Issues reported in app reviews (bugs and enhancement requests). 3. Three prioritization approaches (individual attribute-based approaches, weighted approach, and regression-based approach) to evaluate four attributes (frequency, rating negative emotions, deontic).

4) RQ4. How do capturing emotions in the UX and the implications of that?

Figure 4 shows how integrating the requirement process in the software development phase with the UX. The basic idea of the two combinations of this development method is to increase the usability of the product. Moreover, the combination of the software requirement and UX reduces the usage of the resource that may be allocated for another project. With the advantages of the combination of the user requirement and the UX, the user is involved in every phase of the activity. Focus on the requirement process, there are three main activities, elicitation, prioritizing, and validation and verification. The user story is the most common tool to elicit user requirements and UX activity. For the prioritizing, based on [97] three methods are potentially used, individual attribute-based approach, weighted approach, and regression-based approach. The purpose of each approach is based on how important each requirement is. The last is verification and validation, which can be solved with the customer journey based on the user activity.
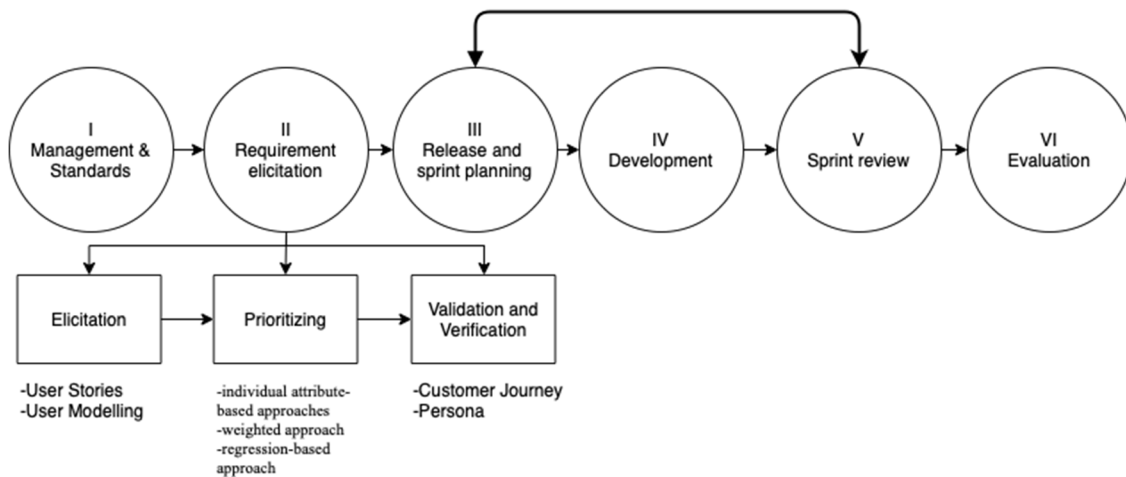
Fig. 4 Implementation of UX into the requirement phase

5) RQ 5. What is the correlation between Agile and user experience in solo software development?

User experience is more than software quality that developers measure in the last development phase. Commonly, developers measure the user experience when the user is used in the long term. Those steps may be acceptable because sometimes users need to adapt to the new system and environment. However, the percentage of users who want to adapt to the new system may be fewer than those who are disappointed with the new system. In this case, it may happen because developers do not involve users when developing the systems. The user experience approach in software development minimizes the user and developer gap.

One of the challenging for software development is the resources, a small team like a pair or individual is one of the impacts the resource allocation. There are many solo software development methods, one of the popular is Personal Software Process (PSP), this method is accepted by both industrial and academics and has a positive impact on product quality [20]. A combination of PSP and Extreme Programming produces a lightweight method of Personal Extreme Programming (PXP). Normal Agile software development as shown in Figure 4 mentions that each step has an activity that is a big problem for the solo developer. However, with the UX approach, we can minimize the effect of resource problems.

Moreover, we can combine the previous study in each step with the UX method. The first is requirement and elicitation. From this step, we can use User Centre Design (UCD) to elicit the functional and non-functional requirements by using user stories, persona, and several methods mentioned in Table 8. Developers can gather the system requirement while understanding the user needs like their habits, goals, limitations, and rule in the organization. For the second evaluation, the developer can start with internal reliability to ensure that the system works properly and then make sure that the system passes the functionality of the user's needs. Hence, developers using the UX approach in the development phase can reduce resources in the evaluation tasks. When developers put users at the center of the development, every change or version of the system should have user agreements. However, it should mention in the first phase that in requirement and elicitation, both the user and developer should have strict

requirements and limitations because every change or addition of requirements can affect the time to finish.

TABLE VIII
HCI TECHNIQUES RELATED TO THE REQUIREMENT ENGINEERING

Requirement Phase	HCI Techniques		References
Elicitation and analysis	Elicitation	Contextual Inquiry	[87], [98]
		Contextual Interviews	[98]
		Ethnographical Observation	[79]
		Card Sorting	[18]
	User Analysis	Personas	[79]
		Questionnaires	[78]
		Surveys	[99]
		Interviews	[100]
	Task Analysis	Use Cases	[45], [56]
	Concept	Task Scenarios	[55]
		Task Sorting	[55]
		Scenarios	[55]
		User Stories	[56], [77]
		Storyboards	[55]
	Prototyping	Prototyping	[70]
		Paper Prototypes	[55]
		Scripted Prototypes	[55]
		Wizard of OZ	[71]
Verification and Validation	Inspections	Collaborative Inspections	[79]
	Cognitive Walkthrough	Cognitive Walkthrough	[55]
	Evaluation by experts	Evaluation by experts	[55]

The systematic literature review may be vulnerable to several restrictions. The most vulnerable is because of the individual representation based on the results of the author's subjective understanding. Moreover, some articles may include or exclude from this research based on the understanding and how the researcher as explicitly ways describes the topics. The lack of information provided by the publisher's search engine may be affected by this research.

Moreover, the result is also influenced by the limitation of the term, and the logical feature.

This study conducts reliable data from popular publishers with some treats. We used strict rules in inclusion and exclusion criteria to mitigate that problem. We also used proper development research protocol from previous research. We also used a combination of the synonym and acronym from the term. The research protocol in this paper is independent, without intervention from external resources. All authors mutually establish and test every step we conduct in this paper.

IV. CONCLUSION

UX has become popular in the recent decade, especially as a center of product and technology innovation. The ability to maintain what the user needs with flexibility is also an important thing that encourages UX gained as a concept and optimization tool in each aspect.

In this paper, we used a modified systematic literature review to conduct results of the combination of the user requirement and UX to elicit the user's emotions. Combining the two methods (as shown in Table 6) increases the product's usability. Moreover, previous research combinations of these two methods reduce resource usage.

Bibliometric analysis of scholarly publications from 2002 to 2022 mapped the research on this topic has increased significantly. Citation analysis, co-citation analysis, total link strength, and co-occurrence analysis were used to evaluate the productivity, and the impact of the publication has been successfully proven with the quality results.

Due to the limitation of this research, we believe that the combination of the user requirement and UX increase significantly for the method and analysis. Moreover, involving the user in the center of development increases the project's success. Future works are needed to investigate the quality attribute and good implementation practices in industry and academia.

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