Participatory design as a co-creation methodology for health literacy games: the case of the TRIO project

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Abstract

The co-creation of games is a research area that has shown very promising results in identifying technological requirements. It is an approach where the researcher usually adopts the role of a participant observer, guiding the dynamics of co-creation acts. This situation limits the opportunities for replicability of co-creation methods by independent facilitators, which could elucidate the quality and improvement opportunities of these methods, contributing to their more widespread application. In this paper, we present a methodology that aims to overcome this limitation, allowing the replication of co-creation workshops by different independent facilitators. This methodology was conceived in the context of collecting relevant information for the design of an educational digital platform that intends to use gamified resources for adult education in digital health data literacy. Specifically, co-creation workshops were used to gain an overview of the difficulties of different age groups in this area and their perspective on which games would best address these difficulties. The workshops were conducted in five countries with planning oriented so that each country could have a different facilitator, not requiring the presence of the researcher who designed them. The challenge of this planning was to maintain the approach of the facilitators identical in all countries, as best one could. We present here the method adopted through its planning and materials designed for information collection, which included brainstorming using card sorting and game ideation with the use of templates. The analysis of replicability by independent facilitators was done by scrutinizing the produced elements, which allowed us to observe the aspects of coherence and divergence among the various facilitators. Thus, we conclude that this approach is a good starting point to overcome current limitations and identify possible lines of improvement.

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CCS Concepts

• **Human-centered computing** → Ubiquitous and mobile computing design and evaluation methods.

Keywords

participatory design, co-creation workshops, digital literacy, health literacy, data literacy, digital games, e-learning

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1 Introduction

Co-creation workshops (CCW) are a participatory design technique that reorients user-centered design research towards co-creation, seeking to create new domains of collective creativity. This method of co-creating, cooperating, and co-designing is an approach that involves all stakeholders actively in the design process – employees, customers, end-users, partners, designers, and researchers. The use of CCW with technology experiences has been a practice for decades [1]. This multidisciplinary participation in a co-design environment facilitates the production of more inventive concepts and ideas [2], and when experts are involved, there is a strong opportunity for these participants to contribute to the development of information, ideas, and concepts [3]. The idea that the participation of end-users is crucial to the creative process is based on the concept that it brings together perspectives, beliefs, desires, and preferences of each participant, which will reflect in the production of joint solutions with great applicability [4]. However, the large-scale applicability of CCW in technology development projects remains a recognized problem in the literature [5].

CCW employ techniques such as brainstorming, ideation, contextual scenarios, among other practices [6]. The challenges involved in their preparation and development are: (1) capturing and gathering insights; (2) socialization issues related to (2a) engagement

between participants, maintaining a healthy and engaging environment, (2b) handling participant heterogeneity, (2c) maintaining democratic control, and (2d) continuous motivational involvement; (3) application of participatory methods; and (4) ensuring the project's suitability for the use of participatory design (PD). In large-scale settings, these are logistical and socio-political challenges [5]. There are various methodological approaches for conducting CCW: a recent literature review on this topic focused on CCW in the health area identified three classes of activities: (1) producing material objects (prototyping); (2) representing, enacting, and playing (gamification); (3) talking, telling, and explaining (discussion). It also recommended that these approaches should focus on: "(1) the design problem, (2) the characteristics of the participants, and (3) the available resources". In general, it posits that CCW are based on the concept of "learning from users" by applying techniques and instruments that allow collecting materials that support a fact-based evaluation [7]. These evaluation support materials can be very diverse. For example, in CCW for technology development, like any others whose goals involve artifact production, the main activities are channeled into prototyping. The usual approach is what is commonly referred to as low-tech or low-fidelity prototyping (regardless of whether physical or digital technologies are used) [8]. These prototypes embody the principles, priorities, and intentions of the participants who co-created them, as well as their connection to the practices and technical environment in which they are envisioned [9]. As another example, if CCW have objectives related to practice development, gamification techniques are often used, including games and simulations that allow for the collection of contextualized observations on how participants act in a simulation. In either case, the prototypes and practices thus co-created can also lead to an oriented discussion of these results or other techniques such as interviews or joint annotation that capture data on participants' subjective experiences, perspectives, and perceptions.

These processes imply a structured or semi-structured conversational flow, using scripts. In addition to the prescribed indications or questions in the scripts, other spontaneous ones can be added to explore responses or occurrences, as well as brief comments. This spontaneous nature of exploration questions and comments raises difficulties in comparing different CCW sessions. Different facilitators and different participants create different dynamics at this level – not forgetting that even if the facilitator and participants remain the same, their interpretation and reaction are not identical in different sessions. These and other difficulties in comparing CCW sessions, which affect their replicability, are a current problem in applying this methodology, which this work aims to address. The usual recommendations to minimize replicability problems to strengthen knowledge production with CCW involve careful planning and addressing differences between facilitators and participants. For example, preparing and training facilitators and including an independent participant observer. However, it is not always possible to ensure the presence of independent observers specialized in data collection or the homogeneity of facilitators' preparation and skills. Therefore, new methodological contributions are needed to strengthen the applicability and replicability of CCW as a means of knowledge production in participatory design.

2 Methodology

This work was carried out within the Erasmus+ TRIO project (Cooperation partnerships in adult education programme under grant agreement no. KA220-ADU-000033817. https://trioproject.eu/), which aimed to develop educational tools for adult empowerment through informal education in the areas of digital health and data literacy. The project provided these tools in an online course, accompanied by a manual and a guide for trainers who wish to use them in activities. The TRIO project used CCW to identify requirements for this online course, aiming to identify participants' difficulties regarding digital literacy in the health area. As a secondary objective, it aimed to identify digital means and games that participants considered suitable for learning activities.

These TRIO project CCW had to be conducted in 5 different countries in a short period, with three focus groups in each country (3 to 4 participants per group). During the consultation process with organizers, it was found necessary to hold sessions involving all groups from one country as well as smaller sessions with just one group. These conditions required facilitators with diverse personal and professional characteristics. In other words, facilitators whose preparation and training alone could not ensure homogeneous approaches and respective competencies. Thus, it was necessary to define practices for conducting CCW that minimized this problem. These CCW were organized into four phases: 1) an "understanding" phase to warm up participants to the context with icebreaker activities to engage participants in a relaxed and collaborative environment; 2) a "brainstorming" phase among participants to foster content discussion; 3) an "ideation" phase to support solution design; and 4) an "evaluation" phase to identify how the CCW went. For planning these phases, the general objectives mentioned above were outlined in more specific milestones. To identify the requirements for developing the online course, it was agreed among project partners that it should be created on the Moodle platform and planned to allow two types of learning: autonomous, free navigation through content, and trainer-led in physical, hybrid, or online environments. The informational structure should be supported by gamified activities that validate and support knowledge acquisition. Additionally, during the planning of these phases, preliminary content to be addressed in CCW was identified through a preliminary information collection study with health professionals, statistical data, and best practices, which enabled the creation of reports. Subsequently, the data collection objectives of the CCW were specified. For this case, they were as follows: a) identify participants' difficulties related to health literacy; b) identify preferred media types for health information; and c) identify preferred games to help learn health content. Finally, as the last planning phase, the way to collect this information in CCW was specified. It was decided that facilitators would make photographic records and were provided with forms for observational records of participants' behaviors. A final descriptive report was also requested.

3 Development

One of the difficulties encountered in implementing detailed planning and facilitator preparation was the lack of prior knowledge about participants' context, particularly cultural issues that could

be disruptive. To mitigate these problems, we conducted a preliminary test with the project team, where it was possible to test the sequence and timing of activities to identify their applicability. We also tested the collaborative online work of selecting the questions to be presented to participants in card form. This allowed us to detail the planning of the three phases further. For the brainstorming phase, the original plan included using cards with questions to gather elements for the first CCW objective (digital health literacy). As the TRIO project had organized this objective into three thematic groups (digital literacy (DL), health literacy (HL), and data literacy (DTL)), these question cards were also organized into the same three groups, with blank cards for possible new questions.

All facilitators received a workshop kit in their language, containing: 25 question cards with three colors corresponding to the themes; 14 media type cards with corresponding images; 9 game template cards; 5 activity title cards, and post its. To ensure everyone knew what was expected, numbered cards with activity identification were presented by the facilitator

The workshops had a relaxed atmosphere without using computers, held differently in Romania where all three focal groups (18-35; 36-50 and 51+) participated on the same day with a facilitator for about two and a half hours. In the Netherlands, they were held in 2 locations with different facilitators lasting 2 hours; in Spain, Germany, and Portugal, they were conducted by the same facilitator on different days, lasting between an hour and a half to two hours. In the "understanding" phase, an icebreaker activity "two truths and a lie" was used for each participant to describe themselves to create an empathetic environment. This was followed by brainstorming activities among participants organized into groups where the result comes from negotiation between participants. The mediation of this activity was carried out with the help of question cards (8 from DL and HL and 9 from DTL). These were prioritized by questions, followed by a matching activity between question cards and media type cards. Next was the "ideation" phase where participants chose a set of game templates with which they would like to learn. For this activity, they had a game template card with the game design on one side, and on the opposite side, the question cards were placed, and the selected media type icons were chosen. For this activity, the two biggest doubts from each theme were chosen, resulting in a selection of 6 games. In the "evaluation" phase, facilitators informally asked participants if the experience was positive and if they would like to participate in the project. After the sessions, facilitators filled out an online questionnaire identifying their perception of the functioning of the different phases of the methodology. They also had to upload images of all the material collected. To understand how they went, facilitators were asked to fill out an online activity evaluation form on a Likert scale of 1-5 where 1. Very good; 2. Well but not everyone participated in the same way; 3. Bad, participants didn't understand the request; 4. Not required; 5. Not adequate; 6. Other. They were also asked to fill out a results table. For the individual country report, we presented each local facilitator with a report model to support the overall analysis. This model was organized with a brief description of how it was organized: containing the number of participants by age group and gender, elapsed time, and the number of facilitators. The description of each activity and presentation of collected results through tables highlighting the two biggest difficulties by age group and theme. Ending with a qualitative discussion of the results.

4 Results

To conduct a research activity, it is necessary to ensure the recording and data collection of participants. Therefore, an information management plan was used, which was previously presented and discussed. It consists of collecting informed consents from sessions, capturing anonymous images on the server where the information is stored. There is also a Quality and Risk Plan that safeguards participants' well-being.

Next, we present the intended outcomes of the workshops (data competencies and game types) and analyze the results of our planning approach concerning research focus, replicability, and applicability. By analyzing the images captured during the brainstorming activity with card sorting, we identified the most significant difficulties in each group and country. This information was crucial for designing the platform's structure and determining the content for each group. From the twenty-five cards presented, we selected fourteen to be included on the platform. It was also possible to identify that the "data literacy" theme had the most consensus in all countries, as the three biggest difficulties were the same. This determined the 3 questions to be presented at three access levels (Getting Started; Moving Forward; Advancing and Engaging) corresponding to the three age groups. Therefore, it would be possible to start at the first level and progress in difficulty. The following table 1 identifies the three groups: L1 representing the results of the 51+ group (who exhibited difficulties in accessing digital information), L2 for the 36/50 group (who exhibited difficulties in understanding digital information), and L3 for the 18/35 group (who exhibited ease both in manipulating and understanding digital information). All groups revealed difficulties in health data digital literacy related to the lack of information about existing services and the ability to buy health products online. The 51+ group (L1) presented difficulties related to manipulating and accessing information, the 36/50 group (L2) presents difficulties related to using services and interpreting results, and the 18/35 group (L3) presented concerns with accessing new forms of information visualization, such as using 3D images. Health literacy had equivalent results among groups related to the ability to read health documents, such as blood test reports. The 51+ group (L1) participants had difficulties understanding what is important to accept or decline in an app related to their personal information.

In the activity of selecting the preferred media type to learn health-related content, six preferred media types were identified by each group. In Figure 1, the numbers correspond to the number of countries that chose those media types within their top 6. In a global analysis (including all age groups), the preferred media types by order of preference were Video, Chat, Infographic, E-mail, and "Step by step". No media type was excluded by everyone; however, "Text only" and "Videoconference" were excluded by the oldest group, even though this group chose "Newspaper" and "Chat" as preferred media types. The youngest group 18/35 preferred "Social media posts", "E-mail", and "Video". The 36/50 group preferred "Videoconference" and "Infographic".

Table 1: Questions used for each group (L1-Getting started); (L2- Moving forward); (L3 - Advancing and engaging).

DIGITAL Literacy	L1	L2	L3	HEALTH Literacy	L1	L2	L3	DATA literacy	L1	L2	L3
s. Identify which digital health services are available	x	x	x	u. Ability to read documents like diagnoses, blood tests etc.	x	x	x	d. Identify why some health apps are more trustworthy than others.	x	x	x
v. Ability to use the digital services that are available.	x	-	-	q. Make use of social media for getting health information.	x	x	-	o. Identify the accuracy of health information on the Internet	x	x	x
x. Ability to buy health products online.	x	x	x	t. Ability to use health information in real life.	-	x	x	e. Make sure your personal health record is protected.	x	x	x
p. Understand new types of health information, such as using 3D images of a body.	-	-	x	r. Identify the best food choices.	-	-	x	b. Identify why it is important to accept or decline access to your private data in an app.	x	-	-
l. Become familiar with information data with graphs.	-	x	-								
m. Ability to access health information on the Internet.	x	-	-								

MEDIA TYPE	51+	36-50	18-35	Totals
Video	3	3	4	10
Chat	4	3	3	10
Infographic	2	4	3	9
E-mail	3	2	4	9
Step by step	2	3	3	8
Graphs	3	1	3	7
Podcast	3	3	1	7
Video conference		4	2	6
Social media post	1	1	4	6
Image	2	1	2	5
Augmented reality	2	2	1	5
Newspaper	4		1	5
Text only		2	2	4
3D	2	1		3

Figure 1: Media type preferences. The results indicate the number of countries that selected each option.

The following activity of linking media types to the two cards with the most difficult questions revealed that it was important to support the information format to be used in the games. It did not have very expressive results, with lack of consensus among countries and age groups. The "ideation" phase corresponds to the activity of selecting games that best suit learning content. The analysis of the results allowed identifying the preferred games from the nine presented by all age groups. Figure 2 identifies the countries that chose each game type. Thus, five countries chose the "True or false" game type, and four countries chose "The intruder" game type in all age groups. The type "Interactive game progress" was chosen by four countries in the 51+ and 18-35 groups; the "Quiz" was chosen by all countries in the 36-50 group. With a four countries' choice, we have "Image pairing" in the 18-35 group, "Order images" in the 36-50 group, and "Sort the paragraphs". The least chosen type was "Missing words". These results allowed validating the presented game types and understanding their suitability to age groups. For the learning platform, it was possible to identify that participants prefer games with simple mechanics without much text, and like diverse games for learning. The favorite game types would then be used for all groups.

The results of the adopted planning approach, analyzed through forms and descriptions in open responses collected in the reports, allowed identifying how the CCW went. The statistical data from the form had different results depending on the proposed activities. In the initial "understanding" phase, the icebreaker activities that were considered less useful in the forms coincided with CCW where participants already knew each other (as indicated in the reports). The statistical analysis allowed us to conclude that, although most of the facilitators (46,7%) reported this activity as "Very Good",

GAMES	51+	36-50	18-35	Totals
True or false	5	5	5	15
The intruder	4	4	4	12
Interactive game progress	4	3	4	11
Quiz	3	5	3	11
Image pairing	3	3	4	10
Order images	3	4	3	10
Find hotspots	3	3	3	9
Sort the paragraphs	4	2	2	8
Missing words		2	2	4

Figure 2: Game types. The results indicate the number of countries that selected each game type.

33,3% believed it was not necessary, and 20% evaluated it as having worked "Well, but not everyone participated in the same way".

The "brainstorming" phase with the card selection activity was very productive in terms of guiding the conversation, allowing the group to focus and discuss effectively, with no indication that any participant wanted to impose their ideas. The negotiation between participants to sort the cards started by discarding three cards and sorting from the most difficult to the easiest. However, it was found that in Germany, this mechanism was perceived differently, and the group ranked as 1-8, with 1 being the least difficult. The overall evaluation was analyzed with the results with and without Germany and presented to the project group for final validation. Overall, the activity was rated as "very good" in all countries.

The third activity of selecting the preferred media type for receiving health information showed in the form analysis that in Germany, this activity did not work the same way as in the other countries, as they only considered it to have worked "Well, but not everyone participated in the same way" (6.7%) In the other countries, it was found to be "very good" (93,3%).

The fourth activity of linking media types to the two cards with the most difficult questions revealed to be the least understood, as shown in the forms, particularly in Germany, which considered it went "Bad, participants didn't understand the request" (6,7%) and some results indicating it went "Well, but not everyone participated in the same way" (13,3%). These results were presented and discussed in a face-to-face meeting where it was understood that the difficulties were related to the challenge of some participants in relating a question to a solution. Overall, this activity was very positive as it helped understand the preferences of each group, with most facilitators reporting it as "Very good" (80%).

The ideation phase (Figure 3) with the fifth activity was to choose the games that best fit learning of health-related content. In general, the facilitators reported that this activity helped understand health information with a "Very Good" rating (66,7%). This was worse in Germany with the 36-50 group reporting "Well, but not everyone . . ." (20%) and the other two groups considering "Bad, participants didn't understand the requests" (13,3%) revealing some misunderstanding of what was requested. In the discussion, it was understood that the issue was related to the difficulty of idealizing a game with a media type and a question. This situation might have been expected as these groups revealed not understanding the previous activities well. Other groups that reported it went "Well, but not everyone participated in the same way" were those of older Dutch and younger Romanians.

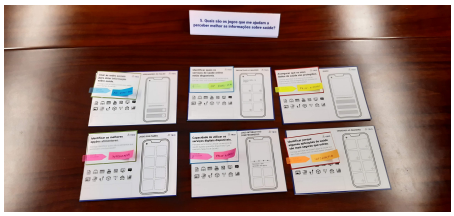

Figure 3: Results of idealization phase.

5 Discussion

The analyses were presented and discussed in a meeting with the whole team and served to prepare the educational platform. The platform, it was then decided, would be organized by themes with the choice of the most difficult questions for each group. This formal organization allowed preparing the content focused on responding to participants' doubts. In summary, the CCW were evaluated by all partners as effective in identifying difficulties and adapting games to all age groups. In the brainstorming phase, very fruitful discussion moments were created, leading to self-awareness about each one's difficulties. Participants revealed that the workshops allowed them to have a good moment of interaction and introspection and that they are interested in using the platform. The results obtained in CCW were equivalent; this could be scrutinized by the images and data presented. The remaining cards were easily identified by images and drawings, facilitating interpretation.

The above results show that the workshops achieved their specific objectives: identifying content, games, and the way to present them. They also generated unforeseen elements that emerged from the co-creation process: adaptation criteria for each group, knowledge progression levels, both aspects reflecting an emerging concern from the workshops with individual adaptation.

Regarding the replicability of CCW, the icebreaker activities worked well, however, for the future, it will be necessary to foresee diversified activities to better adapt to the social relationship between elements, especially if they already know each other. The "brainstorming" phase was the one that brought more results for the project, the way it guided the conversation was very positive, allowing the facilitator not to deviate from the theme and align the conversation so that, in the end, the results were comparable between countries. Sorting the cards was essential to prioritize difficulties and allowed reducing the number of questions, thus finding consensus. The media selection activity worked well, however, the subsequent activity of associating media types with difficulties proved to be a hard task. This should be reformulated in the future. Indeed, the underlying idea of identifying the type of images/videos/texts of the content proved to be a difficult task to reach global conclusions. Similarly, selecting game types aligned with the media was also a difficult task to reach a global conclusion, hence the conclusions that emerged were the choice of mechanics and their suitability to the audience. In the future, the activity should be reconsidered as it proved to be too many ideation tasks in the proposed time. This aspect should be considered as the ideation phase may need to occupy more time.

There are aspects where the adopted methodology did not fully work, as exposed above concerning Germany and more specific situations in other countries. These aspects led us to reflect on how poorly conducted initial instructions can influence the understanding of subsequent activities. However, the result was not compromised as clarification was made through a report request and subsequently, the results were scrutinized by all partners through the presentation of results with and without Germany.

This inconsistency of results reflects how difficult it is to replicate CCW even with careful planning and using the same materials, the interpretation situations of each facilitator are a limitation and can prove to be an important deviation point. One possible way to mitigate this situation can be resolved by including an observer who supports the facilitator in implementing the protocol and can support the qualitative information collection that helps to interpret the context. For this, observation notes are usually used. These are important tools for analyzing this type of participatory activity; however, their applicability generates a lot of data, which can be a limitation of this type of research. However, we consider that their inclusion is important, and this pointed limitation could be supported by content analysis tools with indicators. This analysis process is more facilitated when online tools are used for CCW.

One of the identified implementation difficulties of CCW in the literature review is the multicultural issue of participants. Therefore, in the planning phase of CCW, it was identified that there was prior unknown context about participants, particularly cultural issues, which could have been a problem in brainstorming activities. Also, the significant differences in health services in each country meant that the content decision process required considering each country's reality. For this, some differentiating situations of health policies were previously discussed. The reality of each country was considered in the discussion, and questions that adapt to all realities were found.

The analysis of coherence and how the results of each workshop emerged was carried out through session evaluation forms and by filling out the results of each activity. This analysis showed that there was a discrepancy in the way results were presented in Germany, so a more detailed analysis report of each country was requested to detect the source of the discrepancy. This complementary report available online is one of the project results that demonstrate the methodology implemented in each country and the "vision of each facilitator" (TRIO Co-creation workshops reports: https://trioproject.eu/language/en/resources/). This report supports the overall analysis of results by making explicit the personal views of facilitators that would otherwise be omitted from the results. As mentioned in the theoretical framework, one of the limitations of co-creation methodology reproducibility is the different human dynamics of the intervening parties that result in the production of reports and can influence element choice. By making part of the facilitators' personal views explicit, the report allows people comparing or contrasting CCW results to understand potential divergences in these dynamics. This involvement can "lead" the participant to a particular result even unintentionally (e.g., by better describing a particular game). One possibility we suggest is including an observer who supports the facilitator and "points out" facilitator deviation considerations, and this might even be a co-intelligent artificial intelligence agent. Another way to control this possible situation is to include a description in each manipulable material of simplified and accessible text for participants. The proposed methodology aimed to disaggregate the results of facilitators' intervention through replicable CCW, reducing the risk of "reflexibility", a negative factor pointed out in the use of this type of co-creation methodology.

6 Conclusions

Although there are specific frameworks for workshops, the adoption of these frameworks by workshop facilitators and researchers is ambiguous. Future studies should focus on conceptual and methodological frameworks that link research questions and project objectives to the activities and results to be focused on in the ideation phase. The brainstorming phase is crucial in anticipating the ideation phase, as it allows personalization and personal insights collection. It enables the group to get to know each other and adopt a democratic stance in creating the proposed solution.

These workshops confirmed the literature in the area related to replication difficulties, finding that they are challenging mainly because they are conducted by different facilitators with their ways of understanding and scrutiny. However, if we follow a planned methodology to mitigate these situations, these difficulties are minimized. Therefore, it is necessary to prepare the different phases and find strategies to achieve comparable and coherent results. The points of failure or doubt in the planned CCW strategies allowed identifying improvement recommendations, such as:

a) In the initial preparation, consider the culture and policies of each country to ensure the universality of data.
b) Introducing observers in CCW can be important to support the facilitator, ensure methodology application, and collect insights on participants' and facilitators' context and posture.
c) A qualitative description of the context and sequence of activities with a structured report should accompany the forms and material results.

d) Presenting results in a table with pre-formatted fields allows facilitators to identify inconsistencies in their results.
e) A platform with data related to activity suitability and participants' and facilitators' appreciation allows a quick introduction of results.
f) Presenting information in organized reports according to the intended objectives facilitates result analysis and discussion by all partners.

As future work, we suggest prioritizing the construction of a support platform for CCW, with the possibility of supporting result insertion (implemented methodology and collected materials), presenting reports that show how each workshop worked and allow comparing and presenting joint results. These results should be presented with different visualizations such as maps, diagrams, and charts. As a promising idea for this solution, we are working on the "Inven!RA" concept (a software architecture that provides a means for situational awareness of immersive learning activities to support pedagogical decision-making, [10] which allows planning a training action, accessing collected data, and understanding how this action took place through personalized reports. Continuing research in this area of CCW replicability seems, therefore, to be a valuable contribution to providing the global research community with a rich resource for information collection in participatory design contexts.

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