

“Marked as Solved?”: Identifying Characteristics that Promote Successful Problem-solving in User

Support Forums

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Abstract

User support forums are an important customer support tool for companies providing complex products or services. Despite their importance for customer support, there is a lack of research in what causes forums to be successful or unsuccessful. Therefore, this study was aimed to identify thread characteristics and post characteristics and how they affect the success of a user support forum thread. 50 threads were collected in total from the Adobe XD Support Forum and the Figma Support Forum. The threads and posts were analysed using a codebook consisting of characteristics found in previous studies on virtual communities. The findings indicated that most successful threads are aimed to start a discussion, have an active small group of participants, few visible lead users, and a uniform opinion. However, successful threads also depend on the helpfulness of the post, but what makes a post helpful largely depends on the content of the post itself. This study presents implications for future research as it demonstrated using qualitative characteristics to study user support forums and the use of critical-thinking perspectives outside of virtual learning communities. Companies hosting user support forums should aim to moderate them to keep the threads from becoming too large and use forum design to encourage users to critically assess suggestions and provide comprehensive information.

Keywords: user support forum, thread characteristics, post characteristics, problem-solving

Introduction

As technology is now already fully integrated into every aspect of life, there are times when people may encounter complex technological problems. This is why when dealing with a complex device or software, users often turn to user support forums to seek help. User support forums or customer support forums are forums where users can discuss or ask for help on how to work with a certain product or service (Ellwood, 2023). These forums are often hosted by the companies owning the specific product or services. These virtual communities are essential to said companies, as it becomes a platform for them to share information with users, for customer support, and for problem-solving. User support forums are an integral part of modern customer service. Instead of users having to call support or file tickets directly, they can search for a thread that addresses their specific problem (Kilroy, 2022). The benefit of this user-generated content is that the problems that come up are from the real-life experience of actual users, which means other users are more likely to find immediate help for their niche problems (Swarts, 2015). With the information from these support forums, businesses can improve their user experience, take inventory of issues better, and provide help to their user base faster.

Despite user support forums being so prevalent, most of the threads in these forums do not have a successful outcome. For a user support forum thread to be considered successful, the problem discussed in the thread must be solved for everyone and there must be an agreement among all participants on the solution. This is why not every thread that is marked as “solved” is successful, since even though it is marked as such the participants never reached an agreement on a solution (Gritsenko, 2016). There are many factors involved as to why several threads are unsuccessful. Users may often post repeating complaints or repetitive suggestions (Beckman & Weber, 2016), which derails the discussion from solving the problem. Sometimes threads may also become too large to be properly moderated (De Almeida et al., 2014; Lertwachara & Erickson, 2013), or the opposite, neglected and forgotten. Threads that are unsuccessful could also be missing key factors that could make them successful. Every discussion needs

one person to lead the discussion and with experience to contribute and create a solution. Having an expert to share their knowledge is important since most users in these forums rely on others to solve their problems (Gritsenko, 2016). However, experts would still need sufficient information to find an applicable solution, which not every user provides. Identifying the exact factors that would promote the success of problem-solving in a thread is important to make user support forums an effective customer support tool.

Despite problem-solving being the main activity in these user support forums, there is still a gap in research on what leads to successful problem-solving in user support forums. Studies need to be done to investigate why certain threads lack an end result (Gritsenko, 2016). Meanwhile, research on problem-solving in virtual communities mainly focuses on educational platforms (Chen & Chiu, 2008, Hou et al., 2008, Khlaif et al., 2017, Kwon et al. 2017). Additionally, research on the quality or helpfulness of user support forums mainly focuses on thread characteristics and post characteristics that are quantitative (Lee et al., 2014). Thread and post characteristics that affect the success of a thread are not only quantitative but also qualitative, so there is still a gap on research on qualitative characteristics affecting the outcome of a thread. Therefore, a study needs to be done on qualitative factors that can lead to successful problem-solving in IT support forums.

This study aims to explore the possible characteristics that can help a thread in a forum to be successful. Possible thread characteristics and post characteristics were identified by drawing on existing literature. The effect of these characteristics on the thread outcome and post helpfulness were analysed using a qualitative content analysis. The results of the content analysis were outlined and compared with findings from previous studies. Implications for future research and practical implications were also described. The central research question of this study is:

RQ: How do thread and post characteristics affect the success of forum discussions in product user communities?

Theoretical Framework

Interaction in Virtual Product User Communities

Virtual communities consist of a group of people who never met each other but interact with each other online based on shared interests (Porter, 2004; Rheingold, 1993). Virtual communities that centre around solving issues and developing knowledge are called Virtual Communities of Practice (Wenger et al., 2001). There are different types of Virtual Communities of Practice (Li & Cox, 2021), but they all mainly consist of user-generated content (Frith, 2017). Porter (2004) described five elements that characterize a Virtual Communities of Practice, which are purpose, place, platform, population, and profit. Based on these elements, Li and Cox (2021) distinguished online help forums that are for specific product users and refer to them as “Virtual Product User Communities”. The difference between a Virtual Product User Community with other Virtual Communities of Practice is that Virtual Product User Communities consist mainly of discussion boards, users of a specific product, and topics surrounding solving technical problems and sharing product experiences (Li & Cox, 2021). The distinct characteristics of Virtual Product User Communities makes it an interesting subject to study.

Interaction in virtual communities can vary. Khlaif et al. (2017) found in an experiment involving online learning forums that the interaction pattern can either be cyclical (initiator has a two-way communication with one or two respondents), branching (initiator receives two or more responses at the same time), or complex (a mix of different patterns). The interaction occurring can be solution-oriented or problem-oriented, with solution-oriented interactions resulting in finding better solutions (Kwon et al., 2017). Problem-solving in virtual communities is similar to the critical thinking process, and starts with describing the problem, exploring the problem, matching with similar problems, breaking down the problem to smaller issues, getting new resources, and adding a solution statement, although the order can vary for each forum (Casalini et al., 2006; Gunawardena et al., 1997; Hou et al., 2008, Li et al., 2021). However, some discussion threads may end up not being helpful, or the thread stops before an agreement

on a solution is reached (Gritsenko, 2016; Hou et al., 2008, Lertwachara & Erickson, 2013). In conclusion, problem-solving is an integral part of Virtual Product User Communities, which makes it a relevant subject to study factors contributing to problem-solving success.

Thread Characteristics

Discussion threads have different characteristics. There have been research findings on the possible effect of group size, presence of lead users, and diversity of participants on problem-solving success in a discussion thread.

Group Size

Group size can indirectly affect problem-solving success in discussion threads. Group size in the context of a discussion thread in a Virtual Product User Forum refers to the number of participants in the discussion. Gritsenko (2016) identified three types of group sizes of threads in the Apple Support Forum. The first type is a small group (consisting of less than ten participants) whom are all active in the discussion. The second type is also a small group, where only some are active in the beginning, but other active participants joined later in the discussion. The third type is a large group (more than ten participants), where only some are actively engaging in the discussion. Wang et al. (2015) also found that discussions with limited participants resulted in more intense interactions between the participants, creating more depth and making the discussion more likely to be effective. Discussions in “cliques” (small group of users who have intense interactions between them) are also more effective because the limited number of participants allows for opinions to be spread quicker, which leads to a faster rate of reaching consensus (Mavriqi et al., 2016; Wang et al., 2015). In contrast, a large amount of community members can hinder the discussion to reach an agreement, because they are harder to coordinate and can make participants lose motivation to continue (De Almeida et al., 2014). Lertwachara and Erickson (2013) found that larger groups create many messages, which overwhelms participants and prevents them from

conversing with each other and paying attention. Overall, a smaller group size was found to often lead to more intense interactions, which allows for a faster rate of opinion propagation, leading to participants to reach an agreement faster. However, there is still a gap on how group size can affect a solution to be found, and how activity levels can affect the outcome of a thread.

Presence of Lead Users

The presence or absence of a leading role has an indirect effect on whether a consensus is reached in a discussion forum. As discussed in the previous section, the depth of a discussion is crucial for participants to agree to a solution. Users rely on other users to solve problems (Gritsenko, 2016), and they use forum design interfaces such as likes, upvotes, or reputation badges to gauge whether a source is reputable or not (Frith, 2017). That is why a perceived “expert” user can help in providing some guidance, which leads to more depth in a forum discussion (Hou et al., 2008; Frith, 2017; Wasko & Faraj, 2005). Expert users in Virtual Product User Forums are often employees who are the support team of the related product, or even professionals in the related field. These users are viewed as lead users through a reputation system that are often present in user forums, by earning social capital such as upvotes or likes (Lertwachara & Erickson, 2013; Wasko & Faraj, 2005). If an online forum has a visible forum leader, whom non-expert users can feel close to and gain recognition from, other non-expert users will be motivated to participate, thereby making the discussion gain more depth (Ye et al., 2015).

The interface elements used to make lead users visible such as upvotes, badges, or titles can be incentives for users to join a discussion. However, Lertwachara & Erickson (2013) found that these social incentives do not necessarily motivate users to participate. Both Wasko and Faraj (2005) and Yan et al. (2019) found that social capital is only a motivation of knowledge contribution for non-expert users, because expert users at some point will have enough capital. This can lead to discussions being less helpful, as the ones contributing would be non-lead users (Wasko & Faraj, 2005). Users who accumulate this social capital then might not always be expert users, but instead non-lead users who post often and

receive a lot of upvotes. In conclusion, having a visible expert user can provide depth to a discussion, and be a reliable source that non-lead users can rely on. However, interface elements that are used to make these lead users more distinctive act more as a motivation for non-lead users than actual expert users, which means users with these badges or titles may not always be an expert user. Studies on expert users in forums mainly focus on their accumulated social capital or their post characteristics, so it is worth studying expert users from the perspective of whether their contribution itself is helpful or not.

Diversity of Participants

Diversity in a discussion thread can affect the success of a discussion. Diversity in this case refers to the diversity of user characteristics and the opinions they hold. De Almeida et al. (2014) suggested that perceived diversity (the way users perceive themselves to be similar or not to other users) in online problem-solving communities can be helpful for complex technical issues. Mavriqi et al. (2018) found that user similarity (similar content in their contributions, similar network of people they communicate with (Akcora et al., 2013)) reduces the intensity in communication between low-status users and high-status users and intensity in communication among low-status users only. The former condition is a desired effect, as this means that the opinions of high-status users would not be affected by low-status users. However, the latter condition is not a desired effect, as intense communication between low-status users is needed to increase opinion propagation. When communication between low-status users is reduced, the rate of these users reaching an agreement becomes slower. Additionally, Wang et al. (2015) found that having diverse participants in a discussion, with at least three knowledge-sharing users who engage in intense interaction, are more likely to lead to successful problem-solving. Overall, diversity in participants characteristics can lead to a discussion being more likely to be helpful, however the composition of the social statuses (lead or non-lead users) of the users and from where the information comes from affects whether diversity positively affects problem-solving success or not.

Aside from diversity in participant characteristics, the opinions that are held within these discussion threads can also be diverse. According to Gritsenko (2016), some threads can have two opposing beliefs. Having users disagree with each other can be beneficial for a discussion thread, as disagreements encourage participants to continue a constructive debate as it causes a stronger emotional response (Chen & Chiu, 2008; Khlaif et al., 2017). Disagreements can lead to longer threads, which has been found to be more likely to be helpful to users as a longer thread is usually more comprehensive (Grosse et al., 2018; Lee et al., 2014). However, the effect of opinion diversity depends on the desire of users to affiliate. When users have low desire to affiliate, disagreements can be unhelpful as even optimal solutions are contradicted (Hamilton et al., 2017). Similarly, users who have high desire to affiliate can also be unhelpful to the discussion as suboptimal solutions would be agreed on. Overall, whether opposing opinions during a discussion leads to successful problem-solving or not depends on the helpfulness of the opinion that is being shared and the users desire to affiliate.

Post Characteristics

Thread characteristics alone do not determine the success of problem-solving in discussion threads. Participant-related characteristics and the quality of their contributions can lead to users finding a helpful and agreed solution. Participant-related characteristics that can influence the success of a discussion thread are social status and demonstration of critical thinking abilities.

Social Status

For a discussion thread to be successful, the options being shared should be a helpful and applicable solutions. As expert users or lead users acquire this reputation by earning likes and upvotes on their contributions, they are more likely to provide helpful solutions. Expert users in online networks are characterized by having high centrality in the network, replying to a lot of posts (usually posts that have few contributions), having posts with long lengths, receiving a lot of post replies, having many followers,

and being active in multiple subgroups (Lee et al., 2014; Yang et al., 2021). As mentioned in the previous section, longer posts are more likely to be detailed and comprehensive, which leads to these posts being more helpful to participants (Grosse et al., 2018; Lee et al., 2014).

Aside from surface-level characteristics of expert users (following, likes acquired), expert users also have distinct characteristics in the type of content they post. Expert users are more likely to be solution-oriented in their problem-solving approach, spending less time on defining a problem, which is an approach that often leads to finding better solutions (Kwon et al., 2017). They also tend to be more helpful because they are more innovative and more eager to help (Grosse et al., 2018). In addition, expert or lead users in Virtual Product User Communities are also often part of the product support team or a professional in the related field, which means they are more likely to have the expertise and experience to provide helpful contributions (Wasko & Faraj, 2005). Swarts (2015) found that users find it helpful if a post is related to a real-life situation. Contributions, where the user relates to their situation and experience, are viewed as more helpful than contributions that repeat already-known information (Skalicky, 2013; Swarts, 2015). Overall, studies have shown that expert users are more likely to positively contribute to a successful discussion thread because they tend to be more comprehensive in their answers and have the experience to support them. However, it is worth investigating whether the solutions that are helpful and agreed on come from expert users only or does it also come from non-expert users. It is also worth studying whether expert users always contribute to a discussion thread positively or not.

Demonstration of Critical Thinking Ability

Critical thinking is useful not only for forming a solution but also to evaluate it as well. Studies on critical thinking or cognitive engagement in online forums mainly focus on discussions in online learning communities (An et al., 2008; Beckman & Weber, 2016; Maurino, 2006; Newman et al., 1997; Zhu, 2006). The findings indicate that higher levels of critical thinking such as resolving disagreements, comparing to experience, and referring to literature are rarely done in an online discussion (Maurino, 2006; Zhu, 2006).

However, as mentioned in the previous section, experience-based information is often perceived as more useful to users in an online network (Skalicky, 2013; Swarts, 2015) as factual information can be searched by users themselves in official user guides or manuals instead of going to a user forum. Meanwhile, Beckman and Weber (2016) found that users used numerous outside knowledge, but often repeated information or post confusing statements. To study whether Computer-Mediated-Communication allows students to demonstrate critical thinking abilities, Newman et al. (1997) developed a content analysis scoring system based on the study by Garrison (1992) and Henri (1991). They found that the virtual platform helped students engage in linking ideas and relating them to their experiences.

Overall, there have been findings that critical thinking in virtual platforms has enabled users to also refer to outside knowledge and their experiences, which has been found to be more helpful. Virtual platforms also allow users to link ideas that can help in finding an agreed solution. However, these studies mostly focused on online learning platforms and the capability of the platform in demonstrating these abilities virtually. There is still a gap in how users demonstrate critical thinking abilities in Virtual Product User Communities and whether using critical thinking methods contributes to successful problem-solving within the discussion threads.

Conclusion

The success of a discussion in a Virtual Product User Community largely relies on the characteristics of the thread and of the posts. Having a smaller group of participants tends to lead to a discussion is more coherent and communication to be more intense between users. Additionally, having an expert user to lead users to an agreement, while also still having diversity in user roles and opinions, can enrich a discussion to find a feasible solution. Meanwhile, the quality of the posts relies on the expertise of a user and the presence of a higher-level of critical thinking. A successful discussion means that the participants are engaging in problem-solving actively and critically.

There are still gaps in research of reaching a consensus in online forums. Most studies on problem-solving focuses on virtual learning communities (Chen & Chiu, 2008, Hou et al., 2008, Khlaif et al., 2017, Kwon et al. 2017) while there is a lack of research on Virtual Product User Communities. Additionally, most studies on problem-solving does not focus on the end result of the discussion itself. This may be because successful problem-solving is dependent on the quality of knowledge contribution and the amount of knowledge sharing, including other variables such as motivations. Therefore, studying factors that affect knowledge contribution and knowledge sharing means indirectly studying what leads to a successful discussion thread. However, as Gritsenko (2016) mentioned in his study, some discussion threads do not end in an agreement, and there is still a gap as to what kind of threads or posts leads to an absence of an end result. In addition, research on the quality of discussion threads and posts is mainly quantitative in nature, focusing on quantitative variables such as group size or post length (Lee et al., 2014). Additionally, there is a gap in research on whether having a high social status and high critical thinking level affects post-quality and problem-solving success. Therefore, it is important to study the effect of qualitative thread and post characteristics on problem-solving outcome in Virtual Product User Communities.

Methodology

To study how participant social status and type of contribution affect success of discussions in product user forums, two product user forums were analysed and compared with each other. The product user forums in question are the Adobe XD support forum and the Figma support forum. These two product user forums were chosen because the products themselves serve a similar purpose (creating UX prototypes of applications and websites). Two different forums were chosen in order to avoid bias in the sample and to replicate studies done on user support forums in the past (Li & Cox, 2016). The difference between the products lead to a difference in the content of the discussion thread and the participant characteristics. A qualitative research method was used to analyse the discussion threads in these two forums.

Data Collection

The data was selected using purposive sampling. The posts in the discussion threads are the units of analysis of the study. For a comprehensive study, fifty discussion threads were included in the sample. Similar to the study conducted by Gritsenko (2016) and Li and Cox (2016), discussion threads that were included have sufficient number of posts, which are threads consisting of five to thirty posts. The fifty threads were selected in the order that they appeared in the forum while sorting the forum by “latest”. This means that these forums were updated recently and reflected the current topics that were being discussed in the respective platforms. In this sample, the threads range from having 6 to 216 posts, but the mean length of threads is 21.34 posts. The earliest post in this thread was made on December 13th, 2017, and the latest was made on June 2nd, 2023. In total there are 1067 posts included in this sample.

Some threads were excluded to fit the topic of the study. Only threads that focus on solving issues or asking questions were included. Discussion threads with the topic of feature recommendations, announcements, or complaints were excluded. In addition, for the sake of comprehension only posts that are written fully in English were included. Some posts in a foreign language were translated using the

embedded translator in the software, as other users were replying to them in English. However, some posts in a foreign language were not able to be translated using the embedded translator, so they were excluded from the sample. Additionally, discussion threads with the above criterion were included regardless of if it is marked as solved or not, as Gritsenko (2016) found that discussions do not always end in an agreed solution even if it is marked as solved.

Aside from the posts in the discussion threads, features of the forums themselves were observed to give context to the analysis. The Adobe XD Support Forum was observed to include titles to distinguish the level of participation a user has had in the forum. The feature “marked as correct” were often used to also highlight announcements, not only possible solutions. Meanwhile, the Figma Support Forum did not have any titles or reputation features. In the Figma Support Forum, only original posters were seen using the feature to “marked as solution”.

Table 1*Codebook for Thread-level Analysis*

Categories	Sub-categories			Definition
Group Size (Gritsenko, 2016)	Active	Small	Group	Contains less than ten participants who are all active in the discussion, actively inquiring or giving suggestions (Gritsenko, 2016).
	Partially	Active	Small Group	Contains less than ten participants and at the start only some are actively participating, but later more active people are joining in on the discussion (Gritsenko, 2016).
	Active	Large	Group	Contains more than ten participants (Gritsenko, 2016) who are all active in the discussion.
	Partially	Active	Large Group	Contains more than ten participants and only some are participating throughout the discussion (Gritsenko, 2016).
Lead user presence	Visible	Lead	User Presence	A user who is actively engaging in the discussion, provides suggestions and feedback, is visible in the thread.
	No	Visible	Lead User Presence	No user is actively engaging and leading the discussion and provides suggestions and feedback.
User Role Diversity	Diverse User Roles			There are at least three knowledge-sharers (Wang et al., 2015) within the discussion thread.
	Homogenous		User Roles	One user role, typically inquirer, dominates the discussion thread.
Opinion Diversity	Diverse Opinions			More than two opposing beliefs (Gritsenko, 2016), being shared between the inquirers and the experts.
	Uniform Opinion			Only one opinion or belief is being shared between the inquirers and between the experts.
Question (Zhu, 2006)	Seeking information			Question with a direct and correct answer, less complicated to solve (usually starts with “what”).
	Starting discussion			Question with no direct and correct answer, more complicated to solve.
End Agreement	Agreement Reached			Thread ends with all users agreeing in an opinion or a proposed solution.
	No Agreement Reached			Thread does not end, and some user still disagree on the prevailing opinion or proposed solution.
Solved	Problem Solved			Initial problem statement is solved, and all inquirers are satisfied with the solution.
	Problem Unsolved			Initial problem statement is not solved, and not all inquirers are satisfied with the solution.

Data Analysis

The posts in the discussion threads were analysed using qualitative content analysis. A qualitative content analysis is appropriate as it is a method that can help to analyse and interpret the latent variables in the posts (Graneheim & Lundman, 2003). A direct approach to content analysis was used, where research findings and theory were used for the initial codes (Hsieh & Shannon, 2005). Aside from content analysis, observable elements of a post and a thread (upvotes or likes, number of views, marked as correct or marked as solution) were noted. Content analysis and observations were done both on a thread-level and post-level.

Thread Level Analysis

As described in the theoretical framework, certain approaches that users undertake in discussions can influence how helpful a thread can be. The things that were categorized on a thread-level are group size, presence of lead user, diversity in thread, type of initial question being asked, whether an agreement is reached or not, and whether the problem is solved successfully (see **Table 1**). The types of group size are adapted from Gritsenko (2016), while the types of initial question are adapted from Zhu (2006).

Observations will also be done for the threads. Surface-level characteristics will be taken note such as number of posts, number of views, how long has the thread been open, and whether thread is marked as solved or not.

Post-level Analysis

To categorize the individual posts, six categories and their meaning were adapted from the Analytical Framework for Cognitive Engagement by Zhu (2006) and the Critical Thinking Analysis Protocols from Newman et al. (1997). Codes from the Analytical Framework for Cognitive Engagement by Zhu (2006) categorizes the posts into the approaches participants take in cognitive engagement, while the Critical Thinking Analysis Protocols from Newman et al. (1997) categorizes contributions into the ones helpful to critical thinking and ones distracting from critical thinking. Aside from these codes, codes that indicate the

social status of the users were included, as according to research findings social status plays a role in reaching a consensus (Mavriqi et al., 2016; Mavriqi et al. 2018). Finally, posts were categorized based on their perceived helpfulness. An initial coding scheme is created based on these codes (see **Table 2**).

A standard coding rule was implemented to ensure the posts were categorized in the same manner. Every post was required to be categorized based on user status and relevance. For posts that offer possible solutions, they were also required to be categorized based on novelty, informativeness, and justification. However, some posts that were not offering possible solutions were also coded by informativeness when applicable. The categories of synthesizing, critical assessment, and perceived helpfulness were only used when it was present in a post.

Aside from content analysis, certain surface-level post characteristics were observed. The number of post likes were noted as it is an interface element that can show how helpful users find a thread to be. Lastly, if a user has a badge or title distinguishing their reputation from others, it was noted to be compared with the results of the content analysis.

Table 2*Codebook for Post-level Analysis*

Categories	Sub-categories	Definition
User Status	Expert User	These users tend to be more solution-oriented (Kwon et al., 2017), innovative, eager to help (Grosse et al., 2018), refer to outside knowledge (Wasko & Faraj, 2005), and less ambiguous.
	Non-expert User	Users who are more problem-oriented, elaborating the problem more than contributing to finding a solution. These users also often post complaints.
Relevance (Newman et al., 1997)	Relevant	Statements are important to the main topic of the discussion.
	Irrelevant	Statement is outside of the scope of discussion.
Novelty (Newman et al., 1997)	New information and ideas	Information or ideas that have not been mentioned in the previous posts in the discussion thread.
	Repeating previous statements	Information or ideas have been mentioned in the previous posts.
Informative (Newman et al., 1997, Zhu, 2006)	External relevant material	User draws on personal experiences or refers to related outside material to add more information that may solve the problem or question.
	Ambiguous post	User does not include any additional information that is needed to analyze or solve the problem.
Synthesizing (Newman et al., 1997; Zhu, 2006)	Linking ideas and interpreting	Statements are linked, summarized, and interpreted to create a better solution.
Critical assessment (Zhu, 2006)	Agreeing without making an inference	User agrees to the previous statement without additional comments or forming an interpretation.
	Agreeing with inference	User agrees to the previous statement with additional comments or forming an interpretation.
	Disagreeing without making an inference	User disagrees with the previous statement without additional comments or forming an interpretation.
	Disagreeing with inference	User disagrees with the previous statement with additional comments or forming an interpretation.
Justification (Newman et al., 1997; Zhu, 2006)	Justifying solution	User provides factual proof or examples as to why a solution would be viable.
	No Justification	User does not provide factual proof for their judgment or solution.
Perceived helpfulness	Helpful	User expresses that their problem is solved, express appreciation, and thanks the other users.
	Unhelpful	User expresses that the problem persists or indicates that the proposed opinion or suggestion is not applicable to them.

Reliability

Due to the subjective nature of content analysis, both codebooks were tested for reliability. To ensure reliability, another coder coded 15 percent (8 threads consisting of a total of 172 posts) of the corpus using the initial coding scheme. The Krippendorff's Cu-Alpha of the thread-level codebook is 0.682, while the Krippendorff's Cu-Alpha of the post-level codebook is 0.836, which means both of the reliability is sufficient.

Ethical considerations

Ethical considerations were taken into account when analysing the posts in the discussion threads. There are users in the forum who use their real name and photo to identify themselves in the forums. For the sake of anonymity, their names and pictures were not included in the corpus of this study. The individual posts were numbered instead to be distinguished from one another. This study has been approved before data collection was started by the BMS Ethics Committee.

Results

The result of the content analysis showed that thread characteristics and post characteristics are related to the success of a thread. Thread characteristics that were expected to positively influence the outcome of a thread were more present in threads that are successful. Threads are considered successful when the problem is solved for every participant and every participant agreed to the same proposed solution. Additionally, post characteristics that were expected to be desired in a post were more present in helpful posts. However, some positive characteristics were also found in unsuccessful threads and unhelpful posts. The findings of this study will be further discussed below.

Thread Outcome

Most threads as expected were unsuccessful threads, which are threads that are not solved, without an end agreement, or both. Out of the 50 threads analysed, 38 of them were categorized as unsuccessful and only 12 of them were categorized as successful. Additionally, between the two forums, the Adobe XD Support Forum has slightly more unsuccessful threads, while the Figma Support Forum has slightly more successful threads (see **Table 3**).

Table 3

Code-document Analysis of Thread Outcome between Adobe XD Threads and Figma Threads

	Adobe XD Threads	Figma Threads	Total
Successful Thread	4 (8%)	8 (16%)	12 (24%)
Unsuccessful Thread	21 (42%)	17 (34%)	38 (76%)
Total	25	25	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

There were more unsuccessful threads than successful ones because the criteria of a thread being both solved and with an end agreement were mostly not met. Some threads were found to lack an end agreement even when the problem is solved (see **Table 4**). When the main issue of a thread is solved, the solution available might not be fully agreed upon because some users determine the solution to be a temporary one. This is the case for threads discussing a known bug, where participants might agree on a workaround to counter a bug, but it is only a temporary fix while waiting for the bug to be fixed. Meanwhile, an end agreement in a thread does not always indicate that users agreed on a solution. There are threads where users all had the same complaint or agreed that an issue is a bug that needs to be fixed.

Table 4

Code Co-Occurrence between Thread Resolution with Thread End Agreement

	Agreement Reached	No Agreement Reached	Total
Problem Solved	12 (24%)	4 (8%)	16 (32%)
Problem Unsolved	2 (4%)	32 (64%)	34 (68%)
Total	14	36	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

Most threads ended up not being solved or without an end agreement due to a lack of feedback from users reporting on the issue. The users who reported having a problem rarely gave feedback in text form on whether a proposed solution was helpful or not, so it is unclear whether the problem persists for them. Some may use the upvote button or the like button to indicate a solution as helpful. However, the information on who upvoted or liked is not visible, therefore it could be a user who reported the problem, but it could also be a user who is only viewing the thread. Additionally, many users often added a post afterward saying the issue is still present for them long after the early posts have indicated that their

problem is solved. Therefore, the reason why threads are not categorized as successful is that it often ends with open questions or a lack of feedback from the inquirers.

There is also a discrepancy between the threads that were categorized as successful and with threads that were marked as solved. Out of 12 successful threads, only 6 of them were marked as solved. Similarly, 17 threads out of 38 unsuccessful threads were marked as solved. Forum design is the reason for this discrepancy. In the Adobe XD Support Forum, the function to mark a post as the solution is often used not only to mark possible solutions but also to highlight a post. Adobe employees often used this to highlight to incoming participants that the issue is being investigated or to direct users to submit a support ticket instead. Meanwhile, in the Figma Support Forum, the users who first posted the issue can mark a post as the solution to signal incoming users that the issue was solved. However, since users rarely give feedback on whether their issue persists or not, some threads that were solved did not get marked as solved.

Thread Characteristics

Group Size and Activity Levels

Table 5*Code-document Analysis of Thread Outcome with Group Sizes and Activity Levels*

	Adobe XD		Figma		Total
	No. of Threads	Range No. of Participants	No. of Threads	Range No. of Participants	
Active Large Group	4 (8%)	15 – 48	0 (0%)	0	4 (8%)
Partially Active Large Group	5 (10%)	11 – 26	9 (18%)	11 – 36	14 (28%)
Active Small Group	7 (14%)	2 – 9	12 (24%)	2 – 9	19 (38%)
Partially Active Small Group	9 (18%)	3 – 10	4 (8%)	9 – 10	13 (26%)
Total	25		25		50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

From the 50 threads analysed, most of them consisted of a small group of participants. The number of participants in the threads in the sample ranged from 3 to 48 participants. Meanwhile, the length of a thread (including the question post) ranged from 6 to 216 posts. The two forums have an equal number of threads with a large group of participants and threads with a small group of participants. Both forums also have an equal number of active threads and partially active threads (see **Table 5**). The two platforms host varying amounts of group sizes and activity levels.

Partially active groups were found to produce more unsuccessful threads. These threads involved users who joined the thread later, often searching if anyone has found a solution or giving feedback that the solution provided did not work for them. Incoming users who still have a related unsolved problem will not be able to interact with the early participants, since they tend to not be active in the thread anymore. This makes it hard for users to reach an agreement or for a solution to be found.

Table 6

Code Co-occurrence between Group Size and Activity Level with Thread Resolution and Thread End Agreement

	Problem Solved	Problem Unsolved	Agreement Reached	No Agreement Reached
Active Large Group	0 (0%)	4 (8%)	0 (0%)	4 (8%)
Active Small Group	11 (22%)	8 (16%)	12 (24%)	7 (14%)
Partially Active Large Group	1 (2%)	13 (26%)	1 (2%)	13 (26%)
Partially Active Small Group	4 (8%)	9 (18%)	1 (2%)	12 (24%)
Total	16	34	14	36

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

Meanwhile, no active large groups were found to be successful. Threads with a large number of active participants often consisted of users talking about a prevalent issue found in the software, especially issues related to a known bug that users are waiting to be fixed or issues pertaining to a missing function. This leads to users actively trying out and suggesting workarounds, or users posting complaints repeatedly towards the end of the thread. The content of these posts makes the thread unlikely to be successful, as not all users agree that the workaround is a solution, and the complaints are more problem-oriented than solution-oriented. This is why all threads with an active large group in the sample have an unsolved problem and no end agreement (see **Table 6**).

Most of the successful threads consisted of an active small group. In an active group with a small number of participants, the discussion is more focused, and the users actively provide feedback on whether a provided solution is helpful or not. These threads are also not long compared to other threads, ranging from 6 to 23 replies. However, when looking at the group size and activity levels of successful and

unsuccessful threads, there is nearly an equal number of unsuccessful threads with an active small group (see **Table 7**). Thus, the success of a thread does not only depend on the group size and activity level.

Table 7

Code Co-occurrence Table between Group Size and Activity Level with Thread Outcome

	Successful Thread	Unsuccessful Thread	Total
Active Large Group	0 (0%)	4 (8%)	4 (8%)
Active Small Group	10 (20%)	9 (18%)	19 (38%)
Partially Active Large Group	1 (2%)	13 (26%)	14 (28%)
Partially Active Small Group	1 (2%)	12(24%)	13 (26%)
Total	12	38	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

Composition of Lead Users and Non-Lead Users

Most of the threads have a visible lead user as one of the participants. Out of the 50 threads analysed, there are only 13 threads with no visible lead user presence (see **Table 8**). Threads that do not have a visible lead user presence often consist of users who are reporting that they have an issue and looking for other users who may know a solution to this issue. The Figma Support Forum has slightly more threads without a visible lead user presence. The forum design of the Figma Support Forum compared to the Adobe XD Support Forum causes possible lead users to be less visible, as users who are not Figma employees do not have a special title or badge given to them, even if they often give helpful contributions in the forum.

Table 8

Code-Document Table of Lead User Presence in Adobe XD Threads and Figma Threads

	Adobe XD Threads	Figma Threads	Totals
No Visible Lead User Presence	5 (10%)	8 (16%)	13 (26%)
Visible Lead User Presence	20 (40%)	17 (34%)	37 (74%)
Totals	25	25	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

The majority of successful threads do have a visible lead user presence. With an experienced lead user available and leading the conversation, non-lead users can receive reliable feedback. A proposed solution that stems from experience and facts is seen as trustworthy, thus leading users to agree to it. However, there are also many threads with a visible lead user presence that turned out to be unsuccessful (see **Table 9**). This can be caused due to there being a large number of unsuccessful threads in this sample. Additionally, a lead user does not always provide a positive contribution. Some employees in the thread often repeat suggestions and questions, even if non-lead users do not find them helpful. In conclusion, having a visible lead user thread does not always make a thread successful, as it depends on the quality of the contribution that the lead user provides.

Table 9*Code Co-occurrence Table between Lead User Presence and Thread Outcome*

	Successful Thread	Unsuccessful Thread	Total
No Visible Lead User Presence	2 (4%)	11 (22%)	13 (26%)
Visible Lead User Presence	10 (20%)	27 (54%)	37 (74%)
Total	12	38	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

From the findings, the diversity of user roles does not have the expected effect on thread outcome. In this study, there are more successful threads where the composition of user roles is more homogenous than diverse. In these threads, there are less than three lead users contributing. As previously mentioned, the large number of unsuccessful threads in this sample could be the cause of this finding. This is especially true as there are also many threads with homogenous user roles that are unsuccessful (see **Table 10**). In this sample, there are also more threads with a small group of participants than threads, leading to fewer lead users in each thread.

Table 10*Code Co-occurrence Table between User Role Diversity and Thread Outcome*

	Successful Thread	Unsuccessful Thread	Total
Diverse User Role	4 (8%)	17 (34%)	21 (42%)
Homogenous User Role	8 (16%)	21 (42%)	29 (58%)
Total	12	38	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

However, having fewer lead users can also be more beneficial for a thread, as there can be fewer conflicting opinions which result in users reaching an agreement easier. When looking at the code co-occurrence between user role diversity and opinion diversity, threads with a diverse user role mostly have diverse opinions as well, while a thread with a homogenous user role composition has a uniform opinion (see **Table 11**). This means both variables are connected to each other.

Table 11

Code Co-occurrence Table between User Role Diversity and Opinion Diversity

	Diverse User Roles	Homogenous User Roles	Total
Diverse Opinion	20 (40%)	4 (8%)	24 (48%)
Uniform Opinion	1 (2%)	25 (50%)	26 (52%)
Total	21	29	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

Opinion Diversity

Threads with a uniform opinion were found to be more successful than threads with a diverse opinion. Having a uniform opinion can lead to a thread having a positive outcome, as there is less chance of conflicting opinions, leading to users reaching an agreement easier. This is also the reason that threads with diverse opinions are more unsuccessful in this sample. However, there is nearly an equal number of threads with a uniform opinion that has an unsuccessful outcome (see **Table 12**). The opinion that is being propagated in a thread influence whether a thread becomes successful. If the opinion that is being spread is mostly negative, finding a solution and reaching an agreement would be difficult. Therefore, while threads with a uniform opinion are more successful in this sample, a thread also depends on other factors for it to be solved and have an end agreement.

Table 12

Code Co-occurrence Table between Opinion Diversity and Thread Outcome

	Successful Thread	Unsuccessful Thread	Total
Diverse Opinion	4 (8%)	20 (40%)	24 (48%)
Uniform Opinion	8 (16%)	18 (36%)	26 (52%)
Total	12	38	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

Type of Question

The topics of the analysed threads were mostly to start discussions. Out of 50 threads, 29 of the threads have topics where the original poster would like to start a discussion about their issue (see **Table 13**). There are more threads where the intention is to start a discussion rather than to seek information in the Figma Support Forum. Meanwhile, in the Adobe XD Forum, there is nearly an equal number of threads where the original poster is seeking information or starting a discussion.

Table 13

Code-Document Table of Type of Question between Adobe XD Threads and Figma Threads

	Adobe XD Threads	Figma Threads	Totals
Seeking information	13 (26%)	8 (16%)	21 (42%)
Starting discussion	12 (24%)	17 (34%)	29 (58%)
Totals	25	25	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

When looking at the successful threads in this study, most of them were threads that started a discussion. Out of 12 successful threads, 8 of them are threads that start discussions (see **Table 14**). However, when looking at the unsuccessful threads, most of them were also threads that started a discussion. When analysing the topics of these threads, successful threads that start a discussion mainly discussed how to work with existing functionalities, while unsuccessful threads focused on functions that stopped working. Discussions on bugs were found to be less productive, as the longer the bug is unfixed, the more users are using the thread as a place to complain and vent. Therefore, a thread is more likely to be successful if the topic is a discussion on how to work with the software to achieve the goal of the users.

Table 14

Code Co-occurrence Table between Type of Question with Thread Outcome

	Successful Thread	Unsuccessful Thread	Total
Seeking information	4 (8%)	17 (34%)	21 (42%)
Starting discussion	8 (16%)	21 (42%)	29 (58%)
Total	12	38	50

Note. The percentages in brackets represent the percentage of the data relative to the total number of threads = 50.

In conclusion, thread characteristics alone do not determine a thread outcome. An active small group is more successful than larger groups and partially active groups. However, there is also a nearly equal amount of active small groups that were unsuccessful. Threads with a visible lead user were also more successful, but it depends on the quality of the contribution of these lead users. While diversity is usually more beneficial in a discussion, threads with a less diverse composition of user roles and more uniform opinions are more successful. A more uniform opinion can lead a group to reach an agreement

easier. However, this depends on whether the opinion is a positive contribution toward finding a solution. Lastly, threads that are focused on creating a discussion were more successful than threads that are only used to seek information. However, if the discussion topic is about bugs or issues until the bug is fixed it is unlikely for the users to agree on a solution that is not permanent. Therefore, thread characteristics are dependent on the post characteristics for it to be a positive aspect.

Post Characteristics

Post Helpfulness

Overall, there are more unhelpful posts than helpful posts in the sample. 1067 posts were analysed, but only 107 of them were considered to be a positive or negative contribution. Contributions were only considered to be positive or negative when there is a post following them, indicating whether the user found them to be helpful or not. Out of 107 posts that were offering possible solutions, 66 of them were perceived as unhelpful while 41 of them were perceived as helpful (see **Table 15**). The Adobe XD Support forum had more contributions that received feedback. This is due to Adobe XD having longer threads in the sample than Figma threads. However, when comparing the contributions within the forums, the Figma Support Forum had more positive contributions than negative ones, while the Adobe XD Support Forum had more negative contributions than positive ones. Therefore, Figma Support Forum users found the forum more helpful than Adobe XD Support Forum users found theirs.

Table 15

Code-Document Table of Post Helpfulness between Adobe XD Threads and Figma Threads

	Example	Adobe XD Threads	Figma Threads	Totals
Negative Contribution	"Sorry that you're experiencing issues while using type tool in XD. We have seen this issue in past where after updating the graphic card driver the issue got fixed. We would suggest checking the latest update to your graphic card driver. If that doesn't help, please try to identify text box which might be corrupted. Would you mind telling us if it's happening with every file or with a specific file? Thanks"	53 (49.53%)	13 (12.15%)	66 (61.68 %)
Positive Contribution	"You should use variants if you want to smart animate between your designs. Select the component and click add variant on the top toolbar. You can then add prototype connections between the three variants."	22 (20.56%)	19 (17.76%)	41 (38.32%)
Totals		75	32	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

When inspecting the content of the negative contributions, most of them are employees responding to bug reports from users. The employees would do a standard troubleshooting process such as asking the user for their software version and their PC specifications or suggesting the users to restart their computer. If the issue is a known bug, the employees would suggest filing a ticket to the support or assure the users that the developers are working to fix the bug. Users often found these suggestions unhelpful and repetitive. This is why the most frequent words are words such as “thanks”, “team” (referring to internal employees), or “issue” (see **Figure 3**).

it is natural that most of the users who post there are non-expert users than expert users. Meanwhile, expert users in these threads were mostly employees or experienced users who were voluntarily helping non-expert users in the threads. As a result, their posts would be much lesser than non-expert users.

Despite being fewer in numbers, most contributions came from expert users. However, the findings indicate that expert users made more negative contributions than positive contributions. Since most of the topics of the threads surrounded bugs and issues, posts by experts were less likely to be found helpful. A lot of expert users in these threads are employees, who followed a standard trouble-shooting process that often is redundant and unhelpful for users. On the other hand, expert users who were not employees also often asked the same questions as the employees or posted workarounds that only worked as temporary solutions for non-expert users. However, expert users still provided more positive contributions than non-expert users. In these posts, most of the expert users were non-employees who adopted a more solution-oriented approach to solving the problems instead of only exploring the problem.

Interestingly, non-expert users provided more positive contributions than negative contributions. The ratio of positive contribution to negative contribution is 5:2 for non-expert users (see **Table 16**). In these posts, non-expert users often found a workaround or were able to identify the problem after trial and error. Their positive contributions would also have detailed steps. After finding a solution to a niche problem using first-hand experience, other non-expert users would find these solutions helpful. In conclusion, expert users made more negative contributions in this sample as most of them consisted of employees who create posts that were more repetitive and problem-oriented. Meanwhile, posts with a solution-oriented approach from expert users or non-expert users were found to be more helpful.

Table 16*Code Co-occurrence Table between User Status and Post Helpfulness*

	Example	Positive Contribution	Negative Contribution	Total
Expert User	“You also commented that Adobe Xd freezing after update. As have been suggested in other conversions try to make clean installation”	36 (33.64%)	64 (59.81%)	100 (93,46%)
Non-expert User	“Found a great solution. Select the art you want to export -> hit Ctrl + G to group the art work -> Export as SVG -> Open in Illustrator -> Release to Layers (Sequence) There might be a couple things that didn't come across 100% but my result gave me 95% of what I needed”	5 (4.67%)	2 (1.87%)	7 (6.54%)
Total		41	66	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

Post Relevance

For posts that offered suggestions or solutions, nearly all of them were relevant to the problem discussed in the threads. Posts were categorized as relevant if they are relevant in finding the solution to the problem. The majority of both positive and negative contributions were found to be relevant to the topic. There were a few outliers where three positive contributions were irrelevant, but this is due to a thread discussion diverting away from the topic towards the end (see **Table 17**). Therefore, even though a solution or suggestion may be relevant, users would not always find it to be helpful. However, an irrelevant suggestion would not be helpful in finding the solution to the main problem.

Table 17

Code Co-occurrence Table between Post Relevance and Post Helpfulness

	Positive Contribution	Negative Contribution	Total
Irrelevant	3 (2.80%)	0 (0%)	3 (2.80%)
Relevant	38 (35.51%)	66 (61.68%)	104 (97.20%)
Total	41	66	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

When looking at the relation between post relevance and user status, non-expert users were found to have more irrelevant posts than expert users. Non-expert users were found in this sample to be more likely to post complaints than expert users. Therefore, non-expert users were more likely to make posts that are irrelevant in finding the solution to the issue (see **Table 18**).

Table 18

Code Co-occurrence Table between User Status and Post Relevance

	Expert User	Non-expert User	Total
Irrelevant	22 (2.06%)	65 (6.10%)	87 (8.15%)
Relevant	337 (31.56%)	643 (60.31%)	980 (91.80%)
Total	359	708	1067

Note. The percentages in brackets represent the percentage of the data relative to the total number of posts = 1067.

Post Novelty

The novelty of a post is important as repetitive posts are often unhelpful to users, especially if the solution suggested is not applicable. In this study, there are more repetitive posts than novel posts. When

looking at the individual forums, the Adobe XD Support Forum has a higher ratio of repetitive posts to novel posts while the Figma Support Forum has a lower ratio of repetitive posts to novel posts (see **Table 19**). In the Adobe XD Support Forum, employees were more active in responding to threads. The posts of these employees would often have a standard format, which other users would find repetitive. On the other hand, there were fewer posts from employees in the Figma Support Forum. A lot of suggestions in the Figma threads often come from experienced users who helped other users voluntarily. Their suggestions would be less standardized, making them more novel to other users.

Table 19

Code-Document Table of Post Novelty between Adobe XD Threads and Figma Threads

	Adobe XD Threads	Figma Threads	Totals
New information and ideas	211 (19.77%)	149 (13.97%)	360 (33.76%)
Repeating previous statement	245 (22.96%)	140 (13.11%)	385 (35.05%)
Totals	456	289	745

Note. The percentages in brackets represent the percentage of the data relative to the total number of posts = 1067.

Aside from employees, non-expert users were found to post repetitive posts more often than expert users. These repetitive posts were caused by users posting that they have the same problem as the original poster without providing any new information. Oftentimes, they also post repetitive complaints when an issue from the software itself is taking too long to fix. Meanwhile, expert users post more new information instead of repeating them (see **Table 20**). Expert users would often bring in new information that non-expert users would not know yet, since expert users tend to be more experienced and solution-oriented than non-expert users. Therefore, expert users would create more novel posts than non-expert users, due to their approach to solving a problem and their experience.

Table 20*Code Co-occurrence Table between Post Novelty and User Status*

	Expert User	Non-expert User	Total
New information and ideas	186 (17.43%)	175 (16.39%)	361 (33.86%)
Repeating previous statement	128 (11.99%)	257 (24.08%)	385 (36.10%)
Total	314	432	746

Note. The percentages in brackets represent the percentage of the data relative to the total number of posts = 1067.

While there are more posts overall that repeat information, most contributions contain novel information and ideas. Since most contributions were novel, they were found to be both helpful and unhelpful (see **Table 21**). Novel posts were more found to be helpful as they often contain new suggestions that the users have not tried yet. However, depending on the quality of the suggestion, the contribution might not necessarily be considered helpful. Additionally, every first form of contribution in a thread is considered novel. But even though a user would be the first to suggest it, it is not always helpful to the users asking for help. Overall, novel posts were found to be the most helpful in the sample, but their helpfulness depends on the quality of the suggestion offered.

Table 21*Code Co-occurrence Table between Post Novelty and Post Helpfulness*

	Positive Contribution	Negative Contribution	Total
New information and ideas	32 (29.91%)	43 (40.19%)	75 (70.09%)
Repeating previous statement	9 (8.41%)	23 (21.50%)	32 (29.91%)
Total	66	41	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

Post Informativeness

Informative posts are expected to be more helpful than ambiguous ones, as it would contain information that would enrich the problem-solving process or help in exploring the problem. Most posts where users give suggestions or elaborate on their problems in the sample consist of external relevant material. There are 644 posts with external relevant material while there are 112 ambiguous posts in this sample. Expert users often used personal experience and links to external sources to add more information to their suggestions. Their personal experience would be in the form of steps that users can follow, and they would also use links to other threads with a similar topic that has been solved or links to video tutorials. Meanwhile, non-expert users also added personal experiences to elaborate on their issues, while also adding more visual information such as screenshots or screen recordings.

Table 22

Code-Document Table of Post Informativeness between Adobe XD Threads and Figma Threads

	Example	Adobe XD Threads	Figma Threads	Totals
Ambiguous post	"Menu } Object } Remove fill, Mac: Opt + /, Windows: Alt + /"	64 (5.99%)	48 (4.50%)	112 (10.51%)
External relevant material	"There isn't an hour tracker per se, but you can check the version history to get an overview/estimate as it does multiple save points while you're working. You can find version history on the top nav of your file, right by the name of the file."	406 (38.07%)	238 (22.33%)	644 (60.36%)
Totals		470	286	756

Note. The percentages in brackets represent the percentage of the data relative to the total number of posts = 1067.

While most positive contributions in the sample were informative, most negative contributions were also informative. There are positive contributions that were ambiguous, but these posts talked about an irrelevant issue. Among posts that gave suggestions with external relevant material, most of them were negative (see **Table 23**). This could be caused by the existence of a large number of negative contributions and a large number of informative posts in the sample, but the helpfulness of a post still depends on the perception of the inquirers. Including personal experience or external links does not guarantee that a post becomes useful to the user. Users often post their issues in these forums because their issues are very specific, often influenced by factors such as their machine specifications, app version, or the files they are working with. Therefore, the personal experience of others or links that lead to general tutorials or user manuals may not always be helpful. However, this is also the reason why informative posts that elaborate

on the issue of the user are also important, as they can help expert users to find a tailored solution for them. Overall, informative posts are more helpful than ambiguous posts, but their helpfulness depends on whether the inquirers find their solution to be applicable or not.

Table 23

Code Co-occurrence Table between Post Informativeness and Post Helpfulness

	Example	Positive Contribution	Negative Contribution	Total
Ambiguous post	<p>“Can I ask you to give more details about this: “Must I redo all links again then or they follow from the “linkdrawing” I made in the Prototype Tab”. Thanks. IMHO, “No”. Also I share info about Hyperlinks. May be you mean this? [LINK]”</p>	3 (2.80%)	5 (4.67%)	8 (7.48%)
External relevant material	<p>“Figma team, please fix this! Solution: a temporary fix I found was to ☒ 1.Outline the stroke 2.Go into edit mode 3.Delete any criss-cross lines by selecting them and hitting delete 4.(optional) Merge the two shapes back together and flatten”</p>	38 (35.51%)	61 (57.01%)	99 (92.52%)
Total		41	66	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

Synthesizing Information

Problem-solving in these support forum threads is a collaborative process, so linking the information and ideas given by other users can result in an effective and agreed solution. In this sample, users do not link information often. Out of 1067 posts, there were only 40 posts where users link ideas and information that were stated in the thread. Expert users were observed to draw from their own experience or look at outside sources more often than trying to link the information that is available within the threads. Similarly, non-expert users focused on their own experience and elaborated more on the problem they faced personally. As a result, posts with suggestions and solutions seldom refer to previously stated information or ideas. Among the suggestions that did, most of them were negative contributions (see **Table 24**). The content of the negative contributions suggested users try out a previously mentioned solution, so while the user referred to previously stated ideas it was more repetitive. Meanwhile, in the content of the positive contributions, the user linked previously stated information to draw up a conclusion on their own. Therefore, their suggestion would be more novel than redundant.

Table 24

Code Co-occurrence Table between Synthesizing and Post Helpfulness

	Example	Positive Contribution	Negative Contribution	Total
Linking ideas and information	"Thank you for reaching out. As rightly explained by [user] on how to remove the links permanently. You may also check out this article: [link] which contains the visuals of the steps shared by him."	1 (4.67%)	5 (0.93%)	6 (5.61%)

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

Critical Assessment

When there are several suggestions and information being shared in a thread, it is important to critically assess them. In this sample, users seldom made critical assessments. Out of 1067 posts, there were only 36 posts that made critical assessments (see **Table 25**). On these posts, users most often agree or disagree with inference. Users often agree on feedback that other users gave and often disagree about workarounds to a bug.

Table 25

Code-Document Table of Critical Assessment between Adobe XD Threads and Figma Threads

	Example	Adobe XD Threads	Figma Threads	Totals
Agreeing with inference	"I agree with you. I just realised zoom doesn't work on Chrome too so after some digging it looks it is a MacOS issue not the XD as I thought."	7 (0.66%)	9 (0.84%)	16 (1.50%)
Agreeing without inference	"yeah, correct"	0 (0%)	3 (0.28%)	3 (0.28%)
Disagreeing with inference	"It is totally untenable/unworkable to have to name top-level frames identically to get prototyping working correctly. I shouldn't have to conform my system for naming top-level frames to get prototyping to work correctly."	10 (0.94%)	5 (0.47%)	15 (1.41%)
Disagreeing without inference	"Yeah... that's not the correct answer.."	2 (0.19%)	0 (0%)	2 (0.19%)
Totals		19	17	36

Note. The percentages in brackets represent the percentage of the data relative to the total number of posts = 1067.

Rather than making assessments, expert users often repeated statements or shared their personal experiences rather than making assessments of previously shared information. On the other hand, non-expert users often tried out a suggestion rather than assessing them, remarking on them as helpful or not. Therefore, users more often post about their own experience, repeat previous statements, and remark on a solution as helpful or not rather than critically assessing them.

Justification

Suggestions are best supported not only with personal experience but also facts for them to be reliable. In this sample, most of the positive contributions were justified by the users (see **Table 26**). These users often justify their solution with facts on how the functions in the software work. When the suggestion is justified, users would be able to understand the rationale behind the suggestion and follow the suggestion better. However, there were more negative contributions that were justified than ones that were not justified. Most of the negative contributions that were justified came from employees sharing that an issue was fixed by the development team, but non-expert users would then remark that the issue was not yet fixed for them. Therefore, justified solutions were often viewed as more helpful and detailed, but the content of the suggestion and the opinion of the non-expert users decide whether a solution is applicable or not.

In conclusion, the helpfulness of posts not only depends on the post characteristics but also the content of the post and the perception of the inquirer. Most of the positive contributions came from expert users, but non-expert users also shared helpful solutions after finding one through trial-and-error. Relevant posts can be helpful or unhelpful depending on whether the content is a viable solution. In addition, novel posts were more helpful as the information would bring something new to the discussion. However, repetitive posts can be just as helpful if the shared solution has been proven to be of help.

Linking previously stated ideas or information can help in enriching the discussion, as instead of being repetitive, users can make up a conclusion that might be useful information to other users. Lastly, justifying a solution with factual information can help support the suggestion, while making the solution easier to follow by non-expert users.

Table 26

Code Co-occurrence Table between Justification and Post Helpfulness

	Example	Positive Contribution	Negative Contribution	Total
Justifying Solution	"There isn't an hour tracker per se, but you can check the version history to get an overview/estimate as it does multiple save points while you're working. You can find version history on the top nav of your file, right by the name of the file."	24 (22.43%)	33 (30.84%)	57 (53.27%)
No Justification	"We are sorry to hear you are experiencing issues while using text tool in XD. In past we have seen the issue got resolved after upadting the operating system. We would request you to please check if you have any latest updates available for your operating system."	17 (15.89%)	33 (30.84%)	50 (46.73%)
Total		41	66	107

Note. The percentages in brackets represent the percentage of the data relative to the total number of contributions = 107.

Discussion

The purpose of this study was to identify the effect of thread characteristics and post characteristics on the success of a thread. It is important to define the effects of these characteristics to be able to design a forum that is conducive to creating helpful discussions. The results indicated that the effect of thread characteristics is dependent on the post characteristics. Most of the threads in this study were categorized as unsuccessful, and most of the posts in this study were categorized as unhelpful. Thread characteristics that were expected to have a positive effect were also present on unsuccessful threads and vice versa. This shows that even with positive thread characteristics, the quality of the posts decides whether the thread becomes successful or not. Therefore, this section will first discuss the findings on the effect of thread characteristics on thread outcome, and then the findings on the effect of post characteristics on post helpfulness.

Effect of Thread Characteristics on Thread Outcome

The findings on the effect of group size on the success of a thread is aligned with previous research. Most successful threads have an active small group, with less than ten participants. These active small groups contained intense interactions that allowed more depth (Wang et al., 2015) and faster spread of opinion (Mavriqi et al., 2016; Wang et al., 2015). However, there were also a near equal amount of unsuccessful active small groups. Even though it is easy for active small groups to reach an agreement, the users may agree collectively on a complaint rather than a solution. All active large groups were found to be unsuccessful. In line with previous research, as the group becomes larger the thread becomes harder to coordinate (De Almeida et al., 2014). Additionally, as users become more desperate, they would start posting repetitive complaints, which leads to too many messages (Lertwachara & Erickson, 2013). Meanwhile, partially active groups would mostly have an unsuccessful discussion, as users who would join later would not be able to get information from earlier participants. Thus, maintaining an active small

group in thread discussions is the most ideal, but group size and activity levels would not be the only defining factor for a successful thread.

The effects of a visible lead user did not align with what was expected. Non-expert users actively joined threads whether there was already an expert user or not, simply to share their issues. This was not in line with the finding by Ye et al. (2015). The results also showed that having a visible lead user in a thread does not guarantee a successful outcome. While most of the successful threads in this study had a visible lead user, most unsuccessful threads also had a visible lead user. Therefore, the value of having a visible lead user depends on the quality of their contribution. This is especially true since a lot of expert users in this study often repeat previous statements or mimic the way support employees behaved. These users may provide redundant contributions to earn a reputation (Lertwachara & Erickson, 2013; Wasko & Faraj, 2005). Earning a reputation was only possible in the Adobe XD Support Forum, where users earn titles based on their activity. Incidentally, most threads in the Adobe XD Support Forum did have a visible lead user, so these expert users may be non-expert users who were motivated in earning social capital (Wasko & Faraj, 2005; Yan et al., 2019). Meanwhile, a lot of expert users in the Figma support forum participated voluntarily despite there being no social incentives, which is in line with the finding by Lertwachara & Erickson (2013). The Figma threads also had more successful threads, which means the expert users in Figma provided more helpful contributions. In conclusion, having a lead user can only be beneficial if these users are actual experts who provide helpful suggestions. Having social incentives can also be a detriment to the quality of a thread instead of enhancing it.

Unlike previous research, the diversity of user roles and opinions did not have the expected effect on thread outcome. Previous research indicated that perceived diversity is beneficial for solving complex technical problems (De Almeida et al., 2014) and can lead to successful problem-solving (Wang et al., 2015). However, despite most threads having complex issues to solve, most successful threads had homogenous user roles and a uniform opinion. Having fewer lead users can lead to there being fewer

opinions being spread, leading to a more cohesive thread that can reach an agreement. However, the success of a thread still depends on the quality of the opinion these few expert users spread. Otherwise, the users might agree on having the same complaint rather than agreeing on a solution.

The success of a thread also depends on the topic being discussed. Topics that are more complex and require a discussion were found to be more successful. Even though these topics are more complex, they engaged the participants in a more in-depth discussion. However, most of the unsuccessful threads also have complex topics that start a discussion. The specific topics of these discussions affect the outcome of the thread, as complex bugs would often lead to a heated discussion if they were not fixed quickly, while topics relating to how users should work with the software are less likely to be unproductive.

Effect of Post Characteristics on Post Helpfulness

The thread characteristics depend on the quality of the suggestion being spread by expert users. Therefore, it is important to also look at the characteristics of a helpful post in these support forum threads. Most post characteristics depend on the information that is being shared, and the experience of the users. The suggestions or facts that were shared are not always correct and suggestions may work differently for each user. However, certain post characteristics were found to help enhance the quality of a post.

The findings highlighted that expert users were not always helpful. Their behaviour matched the description from the literature, as the same expert users could be found in multiple threads and reply to a lot of posts (Lee et al., 2014; Yang et al., 2021). This is the case for employees who are managing these forums. These employees often repeat previously stated information, as they often do not experience the issues directly, so users find their contribution less helpful (Skalicky, 2013; Swarts, 2015). However, solution-oriented suggestions, which were often more helpful (Kwon et al., 2017), came from both expert users and non-expert users. These users often share solutions they found from trial-and-error or personal

experience, which is less redundant and more innovative (Grosse et al., 2018). Nevertheless, non-expert users were also found to be users who shared ambiguous and irrelevant statements the most. Therefore, both expert users and non-expert users can both be helpful, but expert users who are employees are more likely to be repetitive.

Even if a suggestion is novel, it might not always be helpful. Literature suggests that personal experience was found to be more helpful than repetitive information (Skalicky, 2013; Swarts, 2015), but since the issues that occur in these threads can be caused by variables that are unique to each user, the experience of one user might not always be the same for others. Therefore, a novel suggestion based on experience may not always be helpful, and still depends on the quality of the suggestion.

Despite the quality of a post being integral to the perceived helpfulness, users rarely did critical assessments. Unfortunately, in line with literature, this study found that users rarely critically assess or link information (Maurino, 2006; Zhu, 2006), making the opinion being shared left unchecked. Even if users found that a solution did not work for them, there was no attempt in resolving the disagreement. Most users did justify their suggestions with information taken from the user manual or the software itself. However, while justification makes a suggestion more credible, it did not guarantee the helpfulness of a post. No matter their status, every user needs to be critical and thorough to create a productive discussion.

Limitations

This study is a qualitative exploratory study, so there are limitations to the methodology used. As mentioned previously, most of the threads in the sample were unsuccessful due to one user adding a post much later than the creation of the thread to remark that the problem was not solved for them. The threads in this study were selected through sorting the threads by “latest” (recently updated or active threads), so it is more likely for these kinds of threads to be the one selected. To ensure the likelihood for

there to be equal amounts of successful and unsuccessful threads, another sorting method can be used in these forum platforms to allow a sampling method that does not follow a chronological order. Alternatively, a scraper can be used to randomly choose threads that fill the criteria of the study.

Some codes also require more rigid definition to distinguish one from another. In the case of the categories “justification” and “informative”, it was often difficult to distinguish between a fact and personal experience in the context of Virtual Product User Communities. These categories were adapted from a study conducted on virtual learning communities, where a fact can be more easily distinguished from a personal anecdote. Meanwhile, in Virtual Product User Communities, a post describing steps to follow can be both a fact and personal experience. More examples of posts should be studied to differentiate between a personal anecdote and factual information about the product or service. Additionally, for the category “group size”, it was difficult to differentiate between an active group and a partially active group. The threads in this study consisted of conversations between different groups of users having separate short conversations at different points in time. Therefore, it is difficult to distinguish a thread where all users are considered active, from a thread where only a few users are active in the beginning. A stricter definition is required to define activity levels on a thread-level.

Future Recommendations

Based on the findings of this study, there are some considerations for future research. Since a lot of expert users in this study made unhelpful posts more than helpful ones, it would be of interest for there to be more research on expert users in the context of Virtual Product User Communities. Future research could consider doing content analysis on contributions in user support forums and patterns or characteristics that distinguish an expert opinion from a non-expert opinion. Additionally, this study highlighted that the helpfulness of posts and success of threads heavily relies on the quality of the posts. Future research could aim to develop possible qualitative characteristic of high-quality posts by doing a

more inductive content analysis by finding similar concepts and patterns in posts that are considered helpful or by doing interviews with users of user support forums.

Implications

This study presented contributions to user support forum research. Firstly, the study filled a gap in research on the characteristics of a successful user support forum. Previous studies were done on opinion convergence and knowledge construction in Virtual Product User Communities but not on thread outcome. Secondly, in this study, a distinction is created between successful threads and unsuccessful threads. This study elaborates that a successful thread is a thread where the problem in discussion is solved for everyone, and every participant agrees to the same proposed solution. Thirdly, this study demonstrated the use of qualitative variables to identify the characteristics that affect thread outcome. Studies on user support forum mostly focused on quantitative variables to determine post quality and used social network analysis to study opinion convergence. However, this study used qualitative content analysis to investigate the characteristics affecting thread outcome. Lastly, this research showed that critical thinking activities are not only relevant in virtual learning communities but also in Virtual Product User Communities. The results showed that critical thinking activities are useful in promoting successful problem-solving in the context of an IT support forum.

The research also presented practical implications for customer support and forum designers. For companies hosting user support forums, a clear site directory should be in place to prevent users from posting the same issues. Threads should be categorized clearly so users can easily find a thread that addresses their problem and get their issue solved faster. These threads can then be more easily searched, so users are encouraged to explore possible solutions before posting a complaint. The feature to “marked as solved” should be used accurately, so users can quickly find the solution that has been proven to work. There should also be a clear guide, either through placeholder text or tooltip, that details to users all the

information that needs to be included to ensure that an issue can be reproduced by the developers. This prevents customer support or other users having to ask the same questions to every user who did not provide the required information. Additionally, there should be strict rules in place so users would not spam complaints that derail the discussion. Customer support employees should also be more communicative in reporting back updates to prevent users from resorting to complaints to gain attention.

Conclusion

Even though the success of a thread is largely dependent on the content of the posts and the expertise of the users, some identified characteristics can make a thread more likely to be successful. Having a small active group of users with an experienced lead user helps the discussion to be more focused and efficient. However, this depends on the topic as difficult topics such as a bug can easily make a thread become bigger. In addition, with a small group, it is important that the posts are of high quality. Expert users should critically assess the existing information and offered solutions instead of merely repeating what others have said. Meanwhile, non-expert users should refrain from posting repetitive complaints, and try to include as much information about the problem as they can. With a coordinated effort, a forum can be a pleasant environment for customer support.

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Appendix

Literature Log Search

Date	Where did I search	Search string	Number of hits/relevancy
04/12/2023	Scopus	KEY (<i>user*</i> OR <i>"online community"</i> OR <i>product*</i>) AND KEY (<i>problem*</i> OR <i>"end result"</i> OR <i>solution*</i>)	113.661 hits, too broad and too many unrelated papers
04/12/2023	Scopus	KEY (<i>user*</i> OR <i>"online community"</i> OR <i>"virtual community"</i> OR <i>"product user"</i> OR <i>"user forum"</i>) AND KEY (<i>"problem solving"</i> OR <i>"end result"</i> OR <i>solution*</i>)	13.210 hits, still too broad and too many unrelated papers
04/12/2023	Scopus	KEY (<i>"online community"</i> OR <i>"virtual community"</i> OR <i>"product user"</i> OR <i>"user forum"</i>) AND KEY (<i>"problem solving"</i> OR <i>"end result"</i> OR <i>solution*</i>) AND KEY (<i>social*</i> OR <i>"group communication"</i>)	46 hits, more related but more academic forums than IT support forums
4-13-23	Scopus	KEY (<i>"virtual product user"</i> OR <i>"user forum"</i> OR <i>"IT support"</i> OR <i>"online community"</i> OR <i>"virtual community"</i>) AND KEY (<i>"problem solving"</i> OR <i>"collaborative problem solving"</i>) AND KEY (<i>social*</i>)	29 hits, much more related but more or less same results as previous search string