Analyzing the Effects and Applicability of Social Media Elements in Notification Systems in Large Interconnected Organisations

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***Abstract*—Social media has become one of the most popular means of social interaction among humans, and recent statistics suggest that more than two thirds of Internet users use social media sites. This work investigates and determines aspects of social media that can be integrated into a notification system to minimize the effects of information overload. The preliminary findings of the study showed that introducing social media elements to notifications and notification systems potentially increases the credibility of notification systems and the clarity of notification. The evaluation consisted of the following parts: user demographics and general knowledge questionnaire, the execution of predefined tasks, rating of difficulty, and information provided by the system after the execution. It was carried out online with 35 students from Graz University of Technology and high school students from different schools in Austria and Kosovo. The participants reacted positively to notifications formatted as social media posts, rating them as more trustworthy than traditional notifications. Social media elements had the effect of helping the participants with determining the difference between fake and real information. The survey results could provide the initial steps toward new use cases of Social Media applications in notifications and other disciplines that deal with users' cognitive ability to process information or disciplines where information overload is considered detrimental. This research shows potential improvements to notification systems with the use of social media elements.**

***Index Terms*—Social Media; Notifications; Large Organisations; Hashtags; Microblogs**

I. Introduction

This paper is an extension of our previous work on the applicability of social media elements in notification systems in large interconnected organisations, presented in [1].

The use of modern information and communication technologies (ICT) has increased the amount of available information and made that information easily accessible. However, this has also resulted in users experiencing information overload [2], which can be defined as the state when users are presented with large amounts of information that exceed the processing capacity of the users [3].

One of the domains for information overload are notification systems. Users receive a large amount of notifications from multiple applications on multiple devices (i.e., an application that delivers to users information that they need to know through messages, e.g., a new email has been received). Notifications allow applications such as email clients, messaging applications, calendars, and others to inform users of incoming messages from other users, upcoming events, reminders, new emails, and more without explicitly requiring user interaction with the application. Since each application has a specific notification format, the user is presented with a large amount of different information, making it hard to process and keep an overview [4].

Based on a study of 40191 randomly selected participants from different areas of work, users receive on average 44.9 notifications per day from multiple sources. Participants received notifications from 173 applications. Some of the applications were email applications (e.g., Gmail or Outlook), text messaging applications (e.g., Whatsapp or SMS applications), and voice messaging applications (e.g., Google Hangout and Skype) [5]. Findings also shown that high number of notifications, in particular from email clients and social networking applications, correlate with increased stress and the feeling of being overwhelmed. They distract users from executing current tasks and induce negative emotions [6]. Another study based on a sample of high-performing management individuals has revealed that the increase of information overload leads to more stress and negative emotions in individuals [3]. Users recognize that notifications are potentially disruptive and distracting, as they disrupt the current engagement of the user [5].

Despite the disruptive nature of notifications, users decide to use them because of their benefit in providing relevant information. In this context, notification systems can be beneficial and attempt to aggregate the previously mentioned information from different sources (e-mail clients, news portals, messaging platforms, and others) and deliver it to the user in the form of notifications [7]. In addition to providing information aggregation and notification delivery, notification systems enable notification management (e.g., selecting which applications are allowed to send notifications), reducing the need of the user to constantly interact with different applications [8]. The success

of a notification system depends on the accuracy of supporting the user with information between tasks, while simultaneously enabling utility by providing access to additional information [9]. Notification systems attempt to keep users informed by balancing the amount of valuable information provided and the disruption caused by the information. It is necessary to find means to coordinate the delivery of notifications from multiple applications across multiple devices or/and display only relevant information at a glance. By bringing together multiple sources of notifications, the user can determine the importance of a notification and reduce the level of distraction [10].

According to [9], there are three critical parameters for the creation of a successful notification system:

1) **Interruption** - is defined as an event where users have to shift their attention from the main task and switch focus to the notification. Examples of these events are receiving notifications while operating heavy machinery, where the notification should not distract the user from the main task. However, other situations, such as medical emergency alerts, require that the notification explicitly interrupts the user [11].
2) **Reaction** - is defined as the response to the stimulus provided by the notification. Some examples of user reactions are ignoring notifications, removing them from the notification list, and clicking on the notification.
3) **Comprehension** - is defined as the use of notification systems with the goal of remembering and making sense of information at a later point in time. Based on past reactions, a notification system can show notifications to users when they are more likely to read them.

While quick and correct reaction to information is important in many situations, it is also important to present the information in a comprehensible way. Notifications should display a balance between the interruption, reaction, and comprehension parameters based on situation, content and user habits and preference [9].

One of the main challenges with designing a notification system is learning when and how to display understandable and valuable messages at a glance without explicitly disturbing or distracting the user. This problem has been tackled in different disciplines. Potential practical concepts can be found on social media, especially Social Media Marketing (SMM). The goal in SMM is to present information to the user at a specific time based on previous user behavior and experiences with other similar users. The information contains social media elements and should not irritate the user but stimulate engagement with the content. This SMM information usually aims to guide the user to a social media site [12].

Social media sites have become one of the most popular means for social interaction among humans, and recent statistics suggest that more than two-thirds of internet users use social media sites [13]. One of the main reasons for its popularity is the user engagement and personalized information it provides to the users. There are also drawbacks such as the lack of security and privacy, internet addiction, frequent interruptions from other tasks, information overload, creation of information bubbles, and loss of social contacts [14].

Gamification is defined as the adoption of game technology and game design methods outside the games industry. Using game design elements in non-game contexts to motivate and increase user activity and retention has gained traction in diverse fields. Recent years have witnessed a rapid expansion of consumer software inspired by video games [15]. Motivated by gamification and its success we theorized that the reuse of elements of Social Media and SMM concepts in the field of notification systems could yield beneficial results. Concepts related to user engagement and information presentation can potentially be adopted in notification systems and other information systems to improve the flow of messages to users and improve user engagement.

Kietzmann et al. [16] identified seven main functional building blocks of social media: identity, conversations, sharing, presence, relationships, reputation, and groups. These building blocks can be identified in various social media applications, like networking sites, photo-sharing platforms, blogging platforms, video-sharing platforms, collaboration platforms, and micro-blogging platforms.

In this paper, we want to identify social media elements based on previously mentioned functional building blocks of social media and explore which of these social media elements can be adopted in a notification system. The goal is to improve user interaction and navigation, information value, information dissemination of notifications, and understanding of notifications in notification systems. Additionally, attention is also given to mitigate possible side effects of social media elements and notification systems, such as wasting time analyzing and reviewing information provided to the user through the notification system.

Based on the observations stated above, more specifically, the main research questions are:

- **RQ1**: Which elements of social media can be integrated into notification systems to display understandable and valuable notifications at a glance without explicitly disturbing the user?
- **RQ2**: Would users prefer to receive notifications with integrated social media elements like hashtags, topic keywords, source information, rating by other users, and groups information?
- **RQ3**: How do users react to notifications with additional information (hashtags, user group information, content approval/disapproval, and social media posts)?
- **RQ4**: Which emotions do users experience when receiving notifications with and without this additional information?

To this end, the remainder of this paper is organized as follows: Section II covers the literature overview and discusses current topics in social media, notification systems, and their relation and use-cases. In Section III, the methodologies used in the study and the study are explained. The results are presented in Section IV, together with a discussion of the study outcome. Finally, we conclude the work in Section V.

II. Background and Related Work

Inspired by SMM, where the integration of social media elements into marketing information has led to greater user engagement and satisfaction, we propose adopting social media elements in notification systems and notifications [12]. In analogy to gamification applying game design elements in non-game contexts [17], it is proposed to integrate social media elements in non-social media contexts. The application in notification systems aims to improve the readability of notifications and increase its information value.

The remainder of this section assesses the drawbacks and advantages of notification systems, describes social media elements, and investigates possible integration in notification systems.

A. Notification Systems

There are many different implementation versions of notification systems. The most commonly used are push notification systems for mobile phones, desktop status notification systems, browser-based notification systems, in-vehicle information systems, and others [18]. As mentioned in the previous chapter, notification systems attempt to communicate important information to users effectively without creating an unwanted intrusion into current user tasks [7]. Selecting important information for the user is a difficult task. A study of 400+ participants has shown that users are not satisfied with the notifications they receive from notification systems because they do not express the user's current interest. This leads to users ignoring most notifications from these systems [19]. Besides determining what is relevant information for the user, an essential concern in notification systems is the display of notifications without a significant interruption of users' main tasks. Visual implementations of notifications that typically are not a user's main attention priority are called secondary displays. Users willingly sacrifice brief interruptions from their primary task to view information of interest on these secondary displays [20].

There are several ways to display notification messages, and the state of the art can vary depending on the specific context in which the notifications are being used. Some common options for displaying notifications include using pop-up windows or banners on a computer or mobile device, using LED or visual indicators on hardware devices, or using in-app notifications within a mobile or web application. These technologies can be effective for alerting users to important information or events in a way that is timely and noticeable without being overly disruptive. Overall, the state of the art for displaying notification messages is constantly evolving, and there are many different technologies and approaches that can be used to effectively alert users to new information [19][20][21].

B. Social Media Elements

The above-mentioned functional building blocks of social media are umbrella terms used to cover many elements of social media observed on different social media platforms. Based on the analysis of social media sites and research on aspects of social media [12][16][22] we identified and summarized some of the most common elements. Table I displays these elements.

TABLE I
SUMMARY OF MAIN SOCIAL MEDIA ELEMENTS

Social Media Element	Description
Hashtags	A hashtag is a metadata tag type used on social networks to help users find resources with a specific theme or content [22][23]
Microblogs	Microblog services allow users to post and share short textual messages that are then propagated to an audience, which can then quickly interact with the posts and between each other [24]
Content approval/ disapproval	Social cues that send signals of social appropriateness or social acceptance of content to the content creator. Examples of these social elements are Likes, Retweets, Reactions, and more [25]
User Groups	User groups represent the extent to which users can form communities and sub-communities. The more 'social' a network becomes, the bigger the group of friends, followers, and contacts.
User-to-User Relationship	User-to-user relationships express the extent to which users can relate to each other (e.g., friendships on Facebook or Followers on Twitter) [16]
User Identity	It represents the degree to which users expose their identities on social media sites. It includes exposing information such as name, age, gender, profession, location, and other users' identifiable information [16].

Taking into account the definition of social media elements from Table I and the description of notification systems above, we have decided to exclude user identity from our research and for the review in this section. The main reason for the exclusion of this element is that it is too focused on the individual. Including user identity information in notifications displayed to the user does not improve the information on notifications. Showing this information would be redundant for the user and could not be integrated into the context of notifications without privacy concerns.

*1) **Microblogs**:* Similar to microblog posts, notifications are messages displayed to the users with the intent to share information. These messages can contain information from different applications (e.g., email subject and part of email text, new message alert). Based on the above description, it can be concluded that notifications share similarities to microblog post entries. However, unlike notifications that do not contain much additional information in their visual representation, microblog posts can contain aspects of social media, such as hashtags, group information, content approval/disapproval, and others. These elements allow the users to determine the importance and validity of a post. Aspects such as the number of individuals that have shared, liked, or approved the post, topics related to the shared post, and the type of individuals that have interacted with the post are of crucial importance to assess the value of the post and the information within [26] [27].

An example of a microblogging service is Twitter, one of the largest microblogging services with more than 300.000

posts generated daily. Twitter is classified as a social network because individuals can communicate and connect with each other to form social groups on Twitter. They form social groups by following each other or following trending hashtags and/or topics [24].

2) ***Hashtags****:* A hashtag is a metadata tag type that is used on social networks to help users find resources with a specific theme or content. The content of hashtags can be dynamically generated or user-generated and can only consist of letters, digits, and underscores. Hashtags are iconic features that enable easy retrieval of connected resources [22][23] . They are also used to construct a personal word/hashtag vector space of a user by examining the users' linguistic expression. Hashtags are inserted into the existing user word vector space using co-occurrence information and evaluated to determine whether the newly constructed vector space represents the personal linguistic expression of the individual [28]. These methods intend to represent individuals by learning about potential representations using hashtags. Different methods for learning semantic representations exist. Some of them are Word2Vec, Latent Semantic Analysis (LSA), Latent Dirichlet Allocation, and Recurrent Neural Network Language Model (RNNLM) [22]. Besides identifying and representing user characteristics, hashtags are used to connect similar resources, by assigning tags to provide contextual information [29].

Hashtag Retrieval is an information retrieval methodology which aims to retrieve relevant hashtags for a giver query from a collection of resources. Besides retrieval, an interesting topic for notifications is hashtag automatic annotation, where hashtags are generated based on content, with the goal to classify the content per topic. Automatic tag recommendation or annotation can improve the efficiency of text-based information retrieval systems. Due to the nature of hashtags it is possible to extract correlations between resources from different systems by exploring their hashtag representations [22].

3) ***Content approval/disapproval****:* There are several approaches to provide a system with the necessary user feedback information. IR systems use explicit information through user feedback or implicit information through user monitoring to determine user interests. Unobtrusive user interaction monitoring identifies content potentially interesting for users, without interfering with the user's normal work activity. Monitoring systems also leverage heuristics to deduce negative examples from observed behavior [30][31]. Providing and receiving feedback is also a fundamental component of participation in social media. In addition, the popularity of social media has enabled the use of rich user information from Facebook and other social networks to predict users' latent traits for recommendation [32]. Based on the study mentioned above, users have expressed a need for more personalization in notifications; integrating likes or dislikes into a notification system as a means of collecting feedback from the user related to notifications could be beneficial for improving the satisfaction rate of users [19].

4) ***User Groups****:* A widely discussed relationship group metric is the Dunbar Number, proposed by Robin Dunbar in 1992. He theorized that people have a cognitive limit that restricts the number of stable social relationships with other people to about 150. Social media platforms have recognized that many communities grow well beyond this number and offer tools that enable users management of memberships [33]. The assumption that the vocabulary used to discuss a topic stays similar between different user communities and does not vary significantly over time directly suggests that it is possible to compute the overlap of topics of two or more communities. This community similarity can connect communities from different social networks (e.g., Facebook), facilitate information sharing between communities, and extract community interest [34]. Furthermore, user groups and group behavior information infer social cues, including group information (e.g., number of people with the same interests who approved a notification or executed a specific action) in notifications could increase the credibility and information dissemination of notifications.

5) ***User-to-User Relationship****:* The type of relationships users form between each other determines what information exchanges between them. For example, when users form professional relationships online, the information exchanged between them will have professional content and high value, compared to friendly relationships where the information is of a different nature [16]. User relationship information could be used in notification systems to determine the character of information presented to the user.

C. Information Combination

As mentioned in [35], access to internal and external information and aggregation of different data sources is one of the main factors that increase the transparency, innovation, and productivity of large organisations. According to [36], linking information on Twitter with information from other sources like Wikipedia led to increased understanding of the information and productivity when consuming the information.

D. Privacy

The rapid growth of the Web has not only drastically changed the way people conduct activities and acquire information, but has also raised security and privacy issues for them. Users are increasingly sharing their personal information on social media platforms. These platforms publish and share user-generated data with third parties that risk exposing the privacy of individuals. Textual information is noisy, high dimensional, and unstructured. It is rich in content and could reveal many sensitive information that user does not originally expose such as demographic information and location [37].

E. Discussion

Towards our goal to determine how social media elements can enrich notifications with additional information, the section above outlined vital social media elements and investigated their application for this purpose. Table II summarizes

TABLE II
SOCIAL MEDIA ELEMENTS AND USABILITY IN NOTIFICATION SYSTEMS

Social Media Element	Usability in Notification Systems
Hashtags	Quick access to topic information; Enables instant classification of notifications by topic; Linking external information to the notification
Microblogs	Social Media Posts provide information representation ideas for notification due to their similarity; Content Sharing does not have a direct use in notifications
Content approval/disapproval	Provide a way for the user to express interest
User Groups	Provide additional information and credibility of information based on the opinion of a group of users
User-to-User Relationship	Provide different types of additional information based on relationships with different users

how social media elements could be beneficial for notification systems.

Hashtags and user group elements provide additional information, potentially enhancing the information in notifications. Integrating these elements could increase the trustworthiness of notification systems and reduce the time required for a user to evaluate the importance of notifications. Since notification systems lack a direct user feedback mechanism, integrating content approval/disapproval elements could provide it. Hashtags in Microblogging services contain information on the temporal trends of the information stream and the topology of the spread of information. This makes hashtags a suitable tool for archiving, tracking, and disseminating information [38][39]. Other applications of hashtags are advertising, indication of specific objects descriptions in posts or situations, expressing one's feelings. Interpreting the meaning of hashtags can be a means to learn potential semantic representations of words linked to hastags [28].

For microblogs, besides hashtags, our research focused on two additional features, Social Media Posts and Content Sharing. Due to the lack of applicability in notification systems, content sharing was excluded. However, considering that social media posts share similarities with notifications, we determined that formatting information in notifications similar to social media posts by including hashtags, more personalized text, and information sources could benefit notification systems.

Even though user-to-user relationships offer great insights into users' interests, knowing the user and connections are mandatory to integrate this element into a notification system. Due to the setting of our initial study, we excluded this element from the evaluation since it was necessary to track user relationships over a more extended period.

To this end, we have selected four social media elements for evaluation based on their applicability in notification systems: hashtags, user group information, content approval/disapproval, and social media posts (formatting the content of the notification as a social media post).

III. Research Study

The research study focused on providing insights and answering the previously mentioned research questions (RQ1-RQ4).

A. Study Design

To evaluate the influence of Social Media elements on notifications and notifications systems, it was necessary to conduct a user study that simulates user interaction with notifications and provides a way to display different types of notifications to participants. Measuring participant interaction with different notification types and enabling quantification of those interactions required the user study to pique participants' interest in cognitive tasks (reading and understanding articles) while showing notifications. The goal was to make the participants assume that the notifications were not part of the evaluation to receive non-biased results. Additionally, it was necessary to evaluate how well participants handled new concepts, which ones they preferred, and which ones they disliked. The evaluation consisted of the following parts: user demographics and general knowledge questionnaire, the execution of predefined tasks, rating of difficulty and information provided by the system after the execution of a task, questions for the System Usability Scale (SUS), questions for the Computer Emotion Scale (CES), Social Media Elements Importance Rating questionnaire, and a feedback questionnaire.

B. Settings and Instruments

The user study was executed online with students from the Graz University of Technology and high school students from different schools in Austria and Kosovo. It was designed as an AB study, which meant that the participants were separated into two groups (Group A and Group B). The participants were instructed to individually complete various tasks, after the execution of the tasks, they were asked to complete the previously mentioned questionnaires and specific survey questions.

1) ***General Questionnaire****:* contains questions listed in Table III that aim to identify the value and effects of additional information in notifications on the user. This questionnaire aims to provide insights to RQ1 and RQ2, by explicitly asking the participants about how they perceive SMEs in the notifications they received.

TABLE III
GENERAL QUESTIONNAIRE QUESTIONS

Question
Q1: Did you find the additional information in the notification valuable?
Q2: When I received notifications with additional information I was more confident in the notification?
Q3: Rank the additional information by importance
Q4: It was easier to understand the notification when I had additional information in the notification?
Q5: Did the notification break your concentration while executing the task?

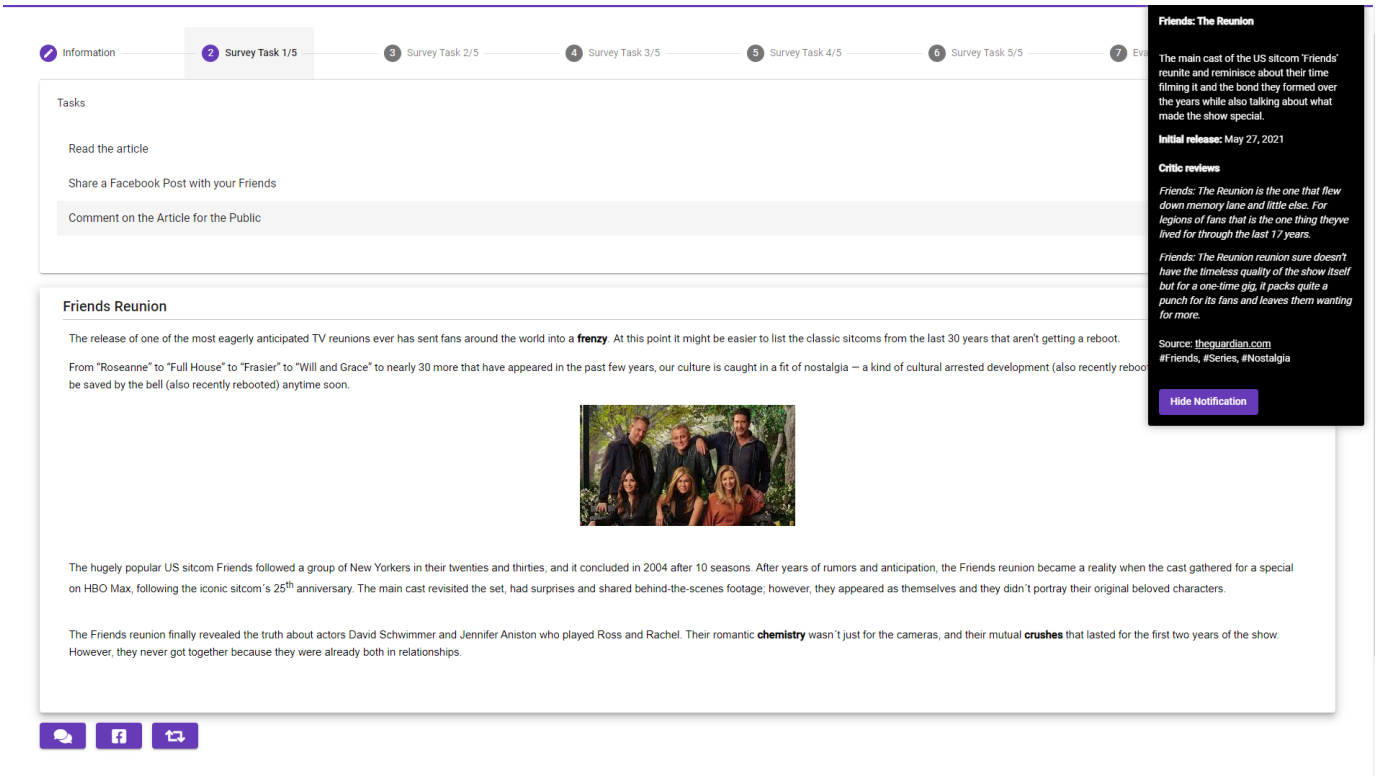

Fig. 1. Codis Survey Tool - Article Display with Notification

*2) **Article Feedback**:* contains questions listed in Table IV aimed to resolve if the users were able to determine and evaulate if the presented articles were fake or not. Since the survey was an AB survey, it is possible to use the feedback from this questionnaire to evaluate whether notifications with additional information help determine the truthfulness of articles and how users react to notifications with additional information.

TABLE IV
ARTICLE FEEDBACK QUESTIONS

Question
Q1: Do you think that the article "Friends Reunion" is Fake or Real?
Q2: Do you think that the article "Instagram for Children" is Fake or Real?
Q3: Do you think that the article "People live in a 3D-Printed House" is Fake or Real?
Q4: Do you think that the article "3 Reasons Why You Should Stop Eating Peanut Butter Cups!" is Fake or Real?
Q5: Do you think that the article "Us Bacon Reserves Hit 50 Year Low" is Fake or Real?

*3) **Computer Emotion Scale (CES)**:* The scale is used to assess the emotions of the participants, as it provides one of the most scientific ways to evaluate emotions. Anger, anxiety, happiness, and sadness are the emotions evaluated by the CES. The scale was used to answer RQ4 by determining the emotional influence of notifications on the participants, since it provides one of the most scientific ways for emotion evaluation [40].

*4) **System Usability Scale (SUS)**:* The System Usability Scale (SUS) is used to measure the ease of use (EOU) of a system. It consists of ten items designed to assess EOU on a 100-point scale. Since its creation in the 1980s, SUS has been extensively used in human–computer interaction (HCI) research and practice to evaluate information technology (IT). It consists of a ten-item attitude likert scale that gives a global view of subjective assessments of usability scale. It is used to determine whether participants would prefer to receive additional information notifications, which is directly correlated with RQ2 and RQ3. It provides a trustworthy evaluation tool for usability testing [41].

*5) **SME Importance Rating**:* to determine which SMEs in Table II were important for understanding and perceiving notifications, participants were asked to rate the importance of the elements mentioned above, from 1 (not important at all) to 5 (Very Important),

*6) **Article Classification Questionnaire**:* was used to determine if users concluded that the read article was a real article or fake news. After reading all articles and receiving notifications related to the articles, participants were asked which articles they thought were fake news articles and which were real articles.

The study was created using the CoDiS Survey Tool [42]. The CoDiS Survey Tool is a web based evaluation tool which tracks and analyses participants' behavior while presenting specific assignments, displaying custom notifications, and dis-

playing questionnaires to the participants. Figure 1 displays how the user interface of the CoDiS Survey Tool displays the articles, notifications and tasks for the participants. The user interface consists of a task view, where the participants can read the tasks related to the current article, seen in the top section of the image, above the title of the article and below the progress element. Below the article text are the user interaction buttons, that enable the user to execute article specific actions (e.g., share article on facebook, comment on article, etc.).

C. Procedure

Participants were asked to read articles mentioned in Table V and execute predefined tasks (share articles, comment on the article, and more).

TABLE V
ARTICLE TITLE AND VALIDITY

#	Title	Is Fake
1	Friends Reunion	No
2	People live in a 3D-Printed House	No
3	Instagram for Children	No
4	US Bacon Reserves Hit 50 Year Low	Yes
5	3 Reasons Why You Should Stop Eating Peanut Butter Cups!	Yes

As the participants completed these tasks, the notifications related to the articles were displayed. Notifications were displayed as part of the CoDiS Survey Tool as web elements that appear when the user starts reading an article. Depending on the user group, these notifications were either with additional information or without additional information. The additional information included hashtags, user group information, and social media post formatting. This additional information integrates all selected social media elements from the previous chapter.

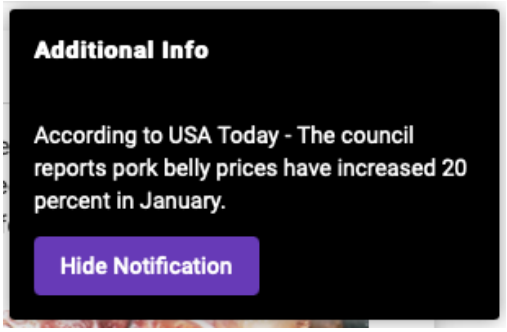

Fig. 2. Simple Notification Information Display

Figure 2 displays a standard notification instance with only the notification text and action button. While Figure 3 previews a notification with additional information.

Hashtag display is marked with the number 1 on the figure, while the number 2 marks group information (e.g., number of readers that validated and/or shared the article). The notification text source is enumerated with number 3, and the notification text is marked with the number 4.

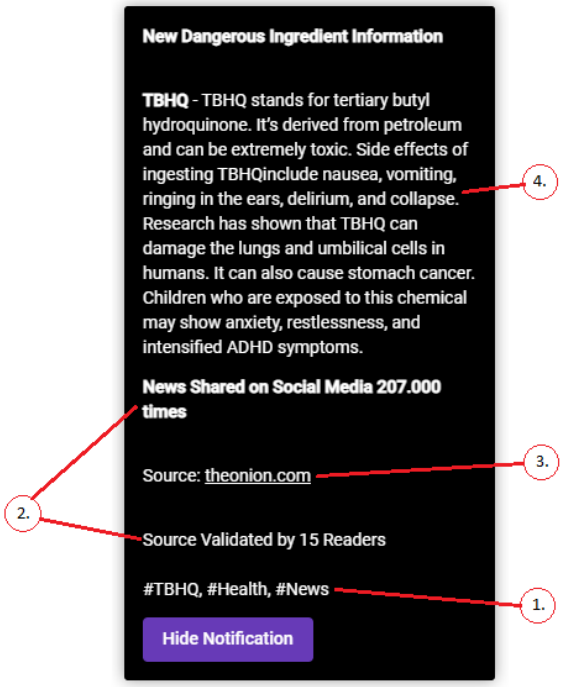

Fig. 3. Notification With Additional Information Display

D. Study Participants

The participant target groups for the study were high school and university students. In total, 215 individuals were asked to participate and only 35 completed the study. The age of the participants ranged from 15 to 34 years old, with 57.14% of the participants in the range from 15 to 20 years, 25.72 % in the range 20-25, 14.289 % in the range 25-30 and 2.85% in the range above 30 years old. Female participants made 28.57% of the total amount of participants, while male participants made 71.43%. As stated previously, the study was designed as an AB study, which is why the participants were divided into two groups (Group A and Group B). The purpose of this division is to reduce bias between users. Both groups received the first article with additional information notifications. The purpose of this was to create a control article and familiarize the users with this type of notifications. Group A received simple notifications on even-numbered articles, while group B received them on odd-numbered articles. After the participants finished reading the articles and the article-related tasks, they had to complete an evaluation.

IV. Findings and Discussion

Analyzing the answers to the questions presented in Table III, we have concluded that the participants find the notifications easier to understand and share the thought that they have more credibility when presented with additional information.

The additional information in notifications has increased the value of notifications to the user based on answers to Q1 from Table III. As seen in Table VI, 85.71% confirmed

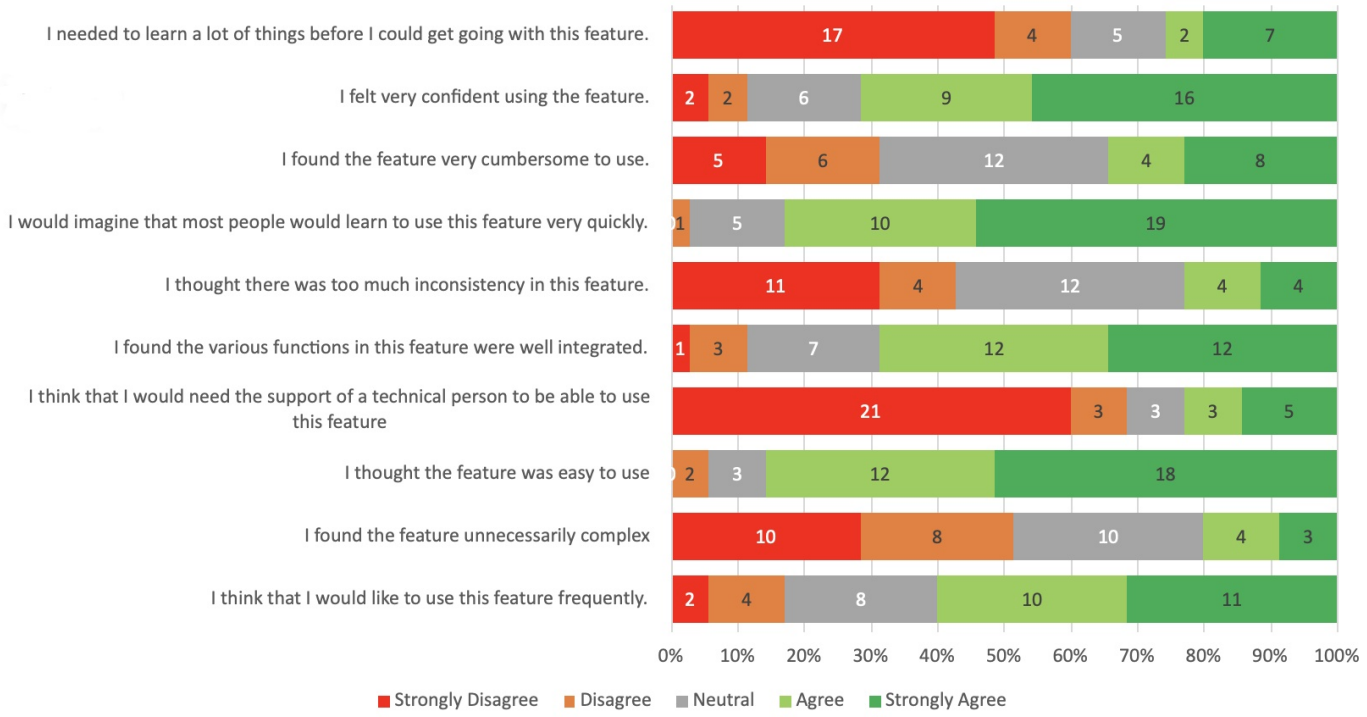

Fig. 4. System Usability Scale Detailed Results

TABLE VI
TABLE III QUESTIONNAIRE RESULTS

Question	Yes	No
Did you find the additional information in the notification valuable?	30 (85.71%)	5 (14.29%)
When I received notifications with additional information I was more confident in the notification?	21 (60.00%)	14 (40.00%)
It was easier to understand the notification when I had additional information in the notification?	27 (77.14%)	8 (22.86%)
Did the notification break your concentration while executing the task?	21 (60.00%)	14 (40.00%)

the premise that additional information is valuable to notifications. The participants had more confidence in notifications with additional information in comparison to standard notifications. Table VI shows that 60% of the participants voted that additional information increases the confidence of the notifications. Based on Q3 from Table III 77.14% of the participants stated that they find it easier to understand notifications with additional information. With 60% of the participants answering with "Yes" to Q5 of Table III, we can confirm that the notifications break user concentration, which validates the results of previous research [3][5].

According to [9], the success of notification systems is dependent on the information they convey to the user. The survey participants agree with this as shown in Table VII. It reveals that users are predominantly concerned with the content and source of notifications. It implies that adding additional information to validate the content and source increases their value to users. The results in Table VII also validate our proposal that formatting notifications as social media posts could improve the information presented to the user since the content was formatted to be similar to a social media post. Contrary to our research, the group information (e.g., "22 readers validated text") was not ranked as highly important by the participants.

As seen in Figure 4, the distribution of SUS answers reveals that most of the users agree or strongly agree with questions Q2, Q4, Q6, Q8, and Q10 of the SUS [41] while disagreeing or strongly disagreeing with the rest of the questions. It is also visible that questions related to the negative rating of the system contain a significant portion of neutral answers, compared to questions focused on positive system ratings. These results indicate that the participants have formulated a positive opinion about notifications with additional information and that they would use a system with this feature, while not explicitly agreeing that there are negative aspects in such a system.

Due to the large number of neutral answers, the average rating of the SUS scale is 69.78. This is slightly above the limit of 68 set by [41] as the value that is the minimum for a usable system. Based on the SUS results, we can infer that users would prefer to use a social media notification system.

The result of the CES is shown in Table VIII, the table contains a list of feelings a participant has experienced. The CES shows that the users were happy most of the time executing tasks and receiving notifications, while none of the

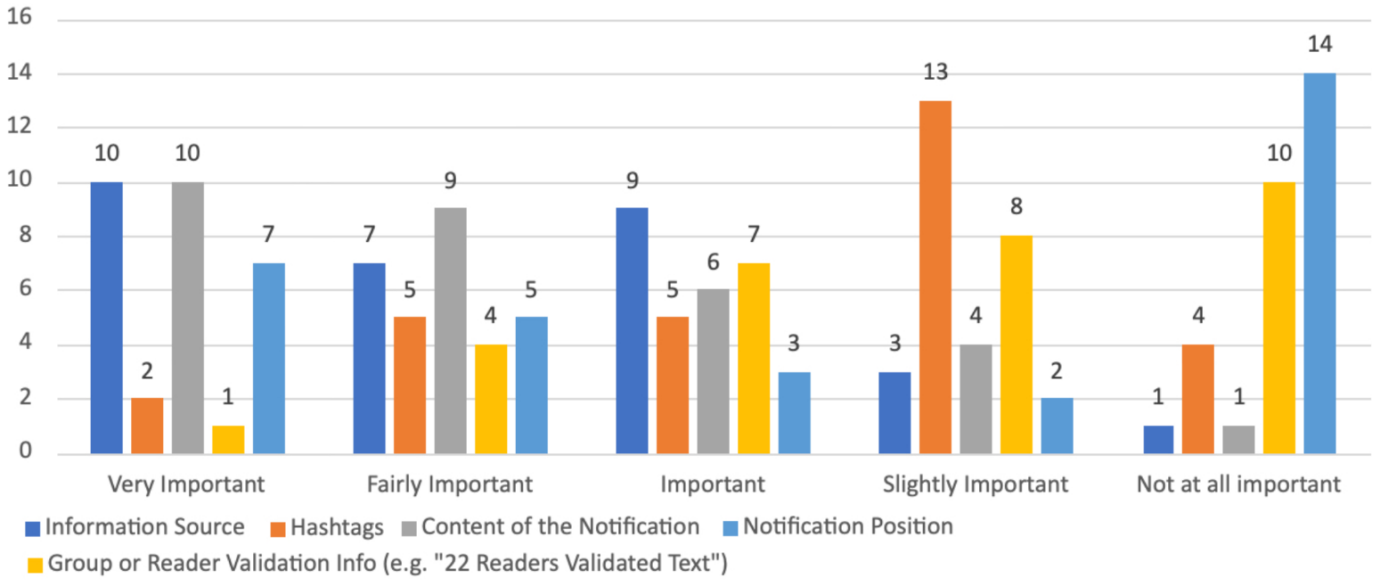

Fig. 5. Notification Element Ranking

TABLE VII
ADDITIONAL INFORMATION RANKING BY IMPORTANCE

Additional Information	Very Important	Not at all important
Information Source	10 (33.33%)	1 (3.33%)
Hashtags	2 (6.67%)	4 (13.33%)
Content of the Notification	10 (33.33%)	1 (3.33%)
Group or Reader Validation Info (e.g., "22 Readers Validated Text")	1 (3.33%)	10 (33.33%)
Notification Position	7 (23.33%)	14 (46.67%)

TABLE IX
ARTICLE VALIDITY EVALUATION RESULTS

Article Name	Fake News	Real Article
Friends Reunion	2 (6.90%)	27 (93.10%)
Instagram for Children	13 (44.83%)	16 (55.17%)
People live in a 3D-Printed House	15 (51.72%)	14 (48.28%)
3 Reasons Why You Should Stop Eating Peanut Butter Cups!	14 (48.28%)	15 (51.72%)
Us Bacon Reserves Hit 50 Year Low	13 (44.83%)	16 (55.17%)

time experiencing sadness, anxiety, and anger. According to Table VIII, the emotion anxiety has the lowest score because most users rated it with "none of the time" followed by sadness and anger.

TABLE VIII
PERCENTAGE AN ANSWERS HAS BEEN SELECTED ON THE COMPUTER EMOTION SCALE

	None of the Time	Some of the Time	Most of the Time	All of the Time
Happiness	20.95%	31.43%	24.76%	22.86%
Sadness	68.57%	24.29%	4.29%	2.86%
Anxiety	69.29%	18.57%	8.57%	3.57%
Anger	65.71%	21.90%	7.62%	4.76%

The best-rated emotion was "Happiness" where the majority of the users answered with either "Some of the Time", "Most of the Time" or "All of the Time". These results do not correlate with previous studies, where users experienced negative emotions and stress while receiving notifications [6].

As part of the evaluations, the participants had to determine which articles were fake and which were real. The results of this evaluation are presented in Table IX. Besides the first article ("Friends reunion"), the participants could not distinguish fake from real. Only 57.93% of the cases were the articles correctly classified. Participants who received notifications with additional information classified articles with a 6.61% greater accuracy. As stated in Section III the participants were asked to rate the importance of the additional information, Figure 5 describes the result of the importance classification. The source of the information and the content of the notification were the elements that were rated as very important, while the position of the notification was classified as not at all important. Hashtags and group information were elements that were rated as important, leaning more towards slightly important than fairly important. In conclusion, the users appreciated information sources and content of notifications more than the position of notifications or user group validation information, while hashtags received a neutral rating.

Due to the inability to track the usage of notifications over a longer period, we could not evaluate all social media elements.

V. Conclusion

This work investigates and determines aspects of social media that can be integrated into a notification system to minimize the effects of information overload. With an empha-

sis on SME applications in notification systems, this research study concludes by demonstrating the potential of social media aspects in several fields. The preliminary analysis shows how the selected social media elements might enhance user satisfaction and the significance of information in notification systems. Additionally, it is observable that the additional SME information does not enhance the effects of information overload, but improves the perception and understanding of notifications. Based on the SUS it was determined that a system that uses SME for the enhancement of notifications is considered a s a usable system. Not all SMEs' use cases were investigated due to time restrictions and the limited number of SMEs considered. Additional SMEs, other media and devices for notification display could be considered for review in future work. Future research may also examine how users respond over time to messages that provide additional information. This could allow us to evaluate the SME studied and other SMEs that were unable to participate in this study more effectively. This may allow for a better evaluation of the analyzed SME and additional SMEs that could not be part of this study. Tracking user reactions for longer periods to different combinations of SMEs in notifications could lead to a novel approach to the use of SMEs within notification systems. The survey results could provide the initial steps toward new use cases of Social Media applications in notifications and other disciplines that deal with users' cognitive ability to process information or disciplines where information overload is considered detrimental. In conclusion, there are several advantages to integrating social media elements into notification systems. Using social media elements for notifications can help to ensure that important information is disseminated quickly and widely. This can be especially useful in emergencies, where time is of the essence. This research shows potential improvements to notification systems with the use of SME.

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