



Usability Evaluation of NOW Interactions

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Abstract. This paper presents the results of two user studies on the suitability of NOW Interactions, a novel, push notification based mobile communication technique designed to lower the threshold for responding to information inquiries by combining a reminder, a request, and a response into one interaction, for future integration into medical diaries and health apps, through evaluating adherence, user experience, and user acceptance. Both studies comprised quantitative usability tests, interviews, and TWEETS engagement evaluations.

Main findings show a 71% adherence rate to initial notifications that increased to 98% for subsequent notifications. Participants reported on particularly valuing the direct response feature of NOW Interactions, generating a positive experience. Furthermore, feedback indicated acceptance of NOW Interactions, especially when envisioned incorporated into essential medical diary apps. Based on the findings from the present user studies, the potential of NOW Interactions for integration into medical diaries and health apps is strengthened.

Keywords: NOW Interactions · Self-report · Push notifications · Quantitative usability test · Adherence · User experience · acceptance

1 Introduction

Effective communication is at the heart of healthcare delivery, affecting diagnosis, treatment, and aftercare. As technology becomes integral to health settings, its role in self-reported data collection, like medical diaries, has grown exponentially. While traditional, paper-based methods continue to be used, digital solutions offer advantages such as real-time data capture, ease of access, and increased user engagement. It is necessary to understand that simply adding a technological layer does not inherently enhance efficacy. An app's success extends beyond its technical functionality, it is heavily influenced by how people experience its use. Even feature-rich apps can under perform if users find them burdensome or challenging. The User Interface (UI) of digital health apps bridges users and technology and has the potential to significantly shape patient experiences. A well-designed UI provides an engaging and intuitive experience, encouraging consistent engagement with digital health apps, leading to adherence to prescribed routines. Such adherence is central to treatment successful [3] with the user experience (UX) of healthcare technology playing a crucial role.

NOW Interactions [2] is a push notification based communication technique designed to simplify self-reported health data collection by merging reminder, request, and response into a single, streamlined interaction. The interactions are designed to make responding to a notification easier than dismissing it. Smooth interactions are crucial in self-reporting, as they minimise the challenges encountered in providing accurate data. Any problems when providing data can compromise assessment and validity, potentially compromising health outcomes. Individuals' ability and willingness to participate in self-reporting is directly related to the effort required, with increased effort leading to decreased task completion [6, 7]. This issue ties into the overarching challenge of *respondent burden* which refers to the difficulty, stress, and time commitment associated with the process of self-reporting. Contributing factors include contact frequency, respondent effort, and the stress while responding [4]. Given its impact on adherence and response rates, addressing respondent burden is crucial in digital health [7]. Optimising UIs and interactions is a practical approach to addressing respondent burden. By reducing the effort required when providing health data, it is possible to enhance ease of use and encourage users to engage in self-reporting. However, even with user-friendly designs, capturing a person's attention consistently remains a challenge. Mobile reminders and push notifications have emerged as powerful tools for capturing attention [13]. In healthcare, they encourage people to engage in health related activities, from adhering to medication schedules [5] to completing questionnaires or make diary entries [11]. However, people nowadays face many distractions, from real-world interruptions to a multitude personal device notifications. These frequent demands on a person's attention, coupled with the potential for cognitive overload, can cause important requests to be overlooked or prematurely dismissed. Poorly timed or designed notifications disrupt and lead to negative UX, even causing users to disable these important alerts [8]. Failure to answer notifications in a healthcare settings can have severe consequences for patient health and well-being.

In this paper, we evaluate the efficacy of NOW Interactions in capturing user's attention and facilitating low threshold data provision. To assess its fit for a self-report diary context, it is essential to gauge users' adherence to this type of interactions and their overall perception of it. We examine if NOW Interactions are perceived as beneficial aids, instead of intrusive alerts, while maintaining a balance between utility and UX. The two user studies evaluate adherence, UX, and user acceptance, employing methods including quantitative usability testing, semi-structured interviews, and engagement evaluations using the TWente Engagement with Ehealth Technologies Scale (TWEETS) [9].

The following sections provide more background on NOW Interactions, outline the studies and their methods, present the results, and discuss the findings.

2 Background

The concept of NOW Interactions was developed to make the collection of selfreported health data through health apps more accessible and less intrusive, especially recognising the unique challenges experienced by individuals with health conditions [2]. Utilising the triggering power of push notifications, NOW Interactions integrates interactable elements directly into the notification, seamlessly blending the reminder, request, and

response options into one cohesive interaction. This persuades users to share brief pieces of health data without opening an app, minimising interruptions to ongoing activities.

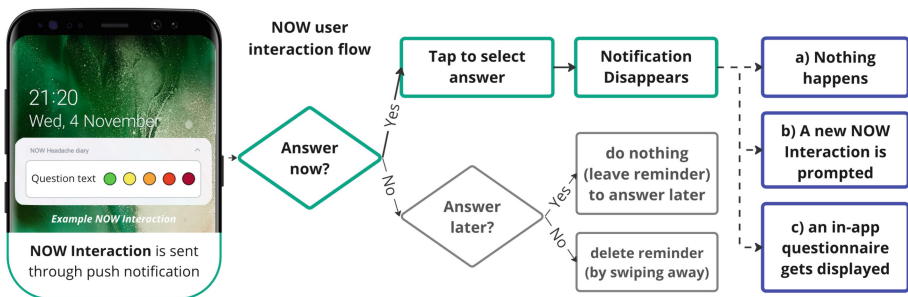


Fig. 1. Reacting to NOW Interactions from a user perspective.

From the user's perspective, a NOW Interaction appears as a push notification that promptly displays the inquiry with relevant answer options. Once an answer is selected, the notification vanishes, registering the chosen response. Subsequently, either no further action is taken, another NOW Interaction is triggered, or the user is redirected to an in-app location, see Figure 1. This design encourages users to engage with the notification rather than dismiss it.

2.1 Design Foundation

NOW Interactions is based on insights from Fogg's Behaviour Model [6], which explains human behaviour. This model identifies three core elements: motivation, ability, and triggers. To successfully engage someone into performing a task, they must have a desire to do it (motivation), the capability to do it (ability), and be reminded to do it (triggers) [6]. NOW Interactions targets the ability element by focusing on the exact moment where the user makes the decision about whether or not to act on a request. Simplifying this decision moment, by allowing data to be provided at the same time as the trigger has drawn the attention, makes the notification more meaningful as it presents a direct, concrete request instead of being just a reminder. By reducing the need to take further action or navigate through potentially complex in-app interfaces, NOW Interactions minimises user effort and simplifies the interaction process. The difference between traditional self-report and NOW Interactions is visualised in Fig. 2.

The design of NOW Interactions considers the cognitive process individuals go through when answering questions. Once their attention is captured by a trigger, respondents usually read, comprehend, retrieve from memory, judge, and then match their answer to available options [1, 15]. By streamlining these steps, NOW Interactions minimises disruptions, enhancing the likelihood of accurate and genuine reporting.

Swift interactions can enhance user engagement. Studies indicate that if a UI's response time remains below 0.1 seconds, a person's flow of thought remains uninterrupted [12]. NOW Interactions reduces the typical delay associated with opening apps, maintaining the user's focus and lowering the likelihood of task abandonment. Building

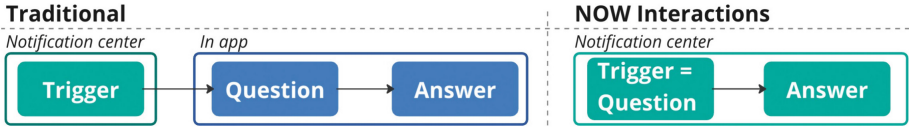


Fig. 2. Comparison of traditional and NOW Interactions responses.

on this efficiency, the design of NOW Interactions is also inspired by microinteractions [14]. These single use-case interactions, break tasks into manageable segments, preventing users from feeling overwhelmed. By presenting a single inquiry at a time, NOW Interactions ensures a smooth continuation of tasks, even if users face interruptions.

In essence, NOW Interactions facilitates a low threshold interaction, streamlining the answering process for minimal disruption and effort.

2.2 Preceding Feasibility Study

Given that existing platforms do not readily accommodate such notifications as envisioned by NOW Interactions, creating the prototype presented a unique set of challenges. To address these, a feasibility study was conducted, as detailed in [2], to identify challenges with the prototype and to gauge the potential of the overarching NOW Interactions concept.

The results of the study led to improving the NOW Interactions prototype for the user studies presented in this paper. Key takeaways on the concept of NOW Interactions included participants' appreciation of direct engagement via notifications without app opening and a positive reception to receiving consecutive questions. While the feasibility of NOW Interactions was established, the study underscored the necessity for more comprehensive research, especially concerning user adherence, acceptance, and experience over extended usage periods.

2.3 The NOW Interactions Prototype

The core functionality of the NOW Interactions prototype evaluated in the user studies presented in this paper is to send interactive notifications at preset times, recording and saving users' responses. The notifications appear in the device's notification centre, where users can respond directly from the notification without needing to open the accompanying app.

The prototype comprises three primary elements: an administrative dashboard, a backend integrated with a database, and a native Android app.



Fig. 3. Different type of icons used in NOW Interactions.

- *Administrative dashboard*: Used for customising notifications and logic, making it a versatile tool capable of adapting to diverse research scenarios.
- *Backend and database*: Provide the infrastructure to manage user interactions, store response data, and facilitate communication between the Android app and the administrative dashboard.
- *Android app*: Delivers NOW Interactions directly to users' notification centre. The app also provides a simple interface that shows a diary view of all answered questions, allowing users to track their responses over time.

The prototype's design prioritises flexibility in data collecting, allowing for custom questions, answer icons, and response evaluation logic. The prototype triggers tailored follow-up questions or actions, ensuring relevant interactions, avoiding unnecessary questioning, and optimising UX through efficient information exchange. For research purposes, the prototype also incorporates an in-app survey feature. This links the data from the NOW Interactions with survey data regarding engagement evaluations while maintaining participant anonymity.

Designing the actual notifications was challenging due to space constraints, with room only for a succinct question and up to five icon-represented answer options. Figure 3 showcases various icon sets used during the current studies.

3 User Studies

To evaluate NOW Interactions, two user studies were carried out. The first study involved a group-defined scenario focusing on post-school sleep and energy levels, while the second simulated a headache diary. Both studies employed quantitative usability evaluation, engagement evaluation, and semi-structured interviews to examine NOW Interactions on:

1. *Adherence*: Gauging consistent user engagement.
2. *User Experience*: Assessing satisfaction and ease of interactions.
3. *User Acceptance*: Evaluating users' perceived value and acceptance.

3.1 The Two Studies

The *first study* was conducted with high school students enrolled in information technology and media production. These students played an active role in shaping the study, contributing to the prototype's content, determining the scenario, adjusting the frequency and timing of notifications, and aiding in the design

of questions and icons. They wanted to focus on tracking post-school energy levels and sleep patterns. Of these students, 11 participated in the quantitative usability study.

The *second study* involved teachers from various primary and secondary schools. They were introduced to NOW Interactions with a predefined medical headache diary scenario. Six teachers participated in the quantitative usability study. For an overview of both studies, see Table 1.

When designing these two user studies, deliberate choices were made regarding incentives, participant selection, and study duration. These were rooted in our aim to

Table 1. Overview of the Studies.

	Students	Teachers
<i>Duration</i>	1 week	2 weeks
<i>Scenario</i>	Group-defined scenario focusing on post-school sleep and energy levels.	Headache diary, tracking occurrences, severity, and whether medicine was taken.
<i>Participants & Method</i>	38 high school students in IT and media were introduced to NOW Interactions during a workshop. 11 students qualified for the digital user test, receiving 14-22 tailored inquiries throughout the week.	During an interaction design workshop, 13 teachers were introduced to NOW Interactions. 6 qualified for the user test, receiving 41-82 inquiries over two weeks.
<i>TWEETS + interview</i>	8 students answered to TWEETS, 6 participated in semi-structured interview	5 teachers answered to TWEETS, 1 participated in semi-structured interview

capture genuine user adherence, cater to the unique characteristics and challenges of each participant group, and obtain meaningful results. The rationale behind these choices is further outlined in Table 2.

3.2 Inclusion and Consent

To be included in the study, participants were required to: 1) express a willingness to participate, including providing written, informed consent, 2) have access to an Android device, and 3) successfully install the prototype.

All participants provided informed consent, permitting the use of their data solely for testing and improving the NOW Interactions prototype. The research obtained approval from the university's system for risk and compliance for processing of personal data in research¹.

Table 2. Study Design Rationale.

Rationale Aspect	Details
<i>Incentives</i>	No incentives offered in order to measure genuine adherence without external motivators. Relevant question content was used to naturally engage participants.
<i>Participant selection</i>	Cohort Teachers were targeted due to their high-stress profession, aligning with the headache diary simulation. Cohort students for their tech-savviness and busy lives. Non-patients chosen to avoid potential stress on medical conditions, and bypass medical ethics committee concerns. <i>Note that our selection of participants was constrained due to the Covid-19 pandemic.</i>
<i>Study duration</i>	1 & 2 week durations were selected to observe potential variances in user engagement. Chose 1 & 2 week durations to align with participant comfort while ensuring significant engagement. Distinct durations offer potential to observe differences in usage decline and adherence consistency.

¹ RETTE: <https://rette.app.uib.no>.

3.3 Usability Testing Methods

Usability testing provides insights into user-technology interactions, helping to highlight areas of improvement. In medical contexts, addressing usability issues before advancing to clinical trials ensures that design-related issues don't overshadow medical assessments. This proactive approach allows patient feedback to focus on medical efficacy and therapeutic value, bypassing basic usability issues. In the two studies the following methods were used:

- *Quantitative usability evaluation*: Objective assessment of user behaviour by collecting specific performance metrics as users engage with the technology.
- *Engagement evaluation*: TWEETS [10], a tailored measure of engagement among users of eHealth technologies defines engagement as a combination of behaviour, cognition, and affect, using nine items. Responses are collected on a 5-point Likert scale, ranging from strong disagreement to strong agreement.
- *Semi-structured Interviews*: Interviews using a mix of open-ended and specific questions, allowing the exploration of set topics while capturing unique participant experiences and perspectives.

3.4 Data Collection and Analysis

The usability testing methods were deployed to gather data on adherence, user experience, and user acceptance.

Participants initially engaged with NOW Interactions within predefined scenarios, with data from these interactions collected in real-time. Analysis of these patterns offered insights into adherence, and engagement levels, and identified instances of dropout, offering a view of engagement over time. TWEETS items were translated to Norwegian and adapted to gauge potential for the future use of NOW Interactions. These adapted items were presented as a conventional questionnaire within the NOW Interactions prototype. The semi-structured interviews involved participants in discussing their experiences and insights on NOW Interactions. The interviews covered usability feedback, design perspectives, and challenges encountered. While certain topics were predefined to ensure consistency, the flexible nature of the interviews allowed for spontaneous insights to gauge participants' likelihood and willingness to use NOW Interactions in future scenarios. Table 3 shows the collected data.

- *Usage metrics analysis*: Inspecting data logs for patterns in interaction frequency, signs of dropouts, and engagement consistency were extracted from data logs, followed by an inter-study comparison.
- *TWEETS analysis*: Each item's mean response was calculated to ascertain participant consensus.
- *Semi-structured interviews analysis*: Transcribed audio recordings underwent thematic coding for comprehensive evaluation.

Table 3. Data Overview.

Core Aspect	Usage Metrics	Interview data	TWEETS data
<i>Adherence</i>	Data includes user responses, time-stamps, insights into interaction frequency, total logs, and drop-outs, etc.	Covers aspects related to user commitment, consistent interaction, and reasons for usage lapses.	Examines user perceptions of integrating such interactions into their daily routines.
<i>User Experience</i>	Usage metrics offer indirect insights into UX.	Discusses functionality, feedback on the notifications, user preferences (likes/dislikes), and challenges.	Focuses on ease of use and overall satisfaction.
<i>User Acceptance</i>	Usage metrics provide indirect insights into user acceptance.	Delves into perceived utility, potential to adopt to this way of reporting, potential integration into daily routines.	Gauges desire for future use of NOW Interactions and perceived benefits.

4 Results

From the digital user test, usage metrics were collected for eleven students and six teachers. Following this, eight students and five teachers provided feedback through the in-app TWEETS survey. Eight students and one teacher further participated in the follow-up semi-structured interview, sharing more insights into their experiences with NOW Interactions.

4.1 Quantitative Usability Test

A total of 522 NOW Interactions were sent across both studies: 330 to teachers and 192 to students. Out of these, 402 notifications (77%) received responses (Table 4 provides a detailed breakdown). It can be noted that there is significant difference between answering rates between the Initial NOW Interactions and the *secondary NOW Interactions* as shown in Table 4. While 71% of the initial notifications received responses (283 out of 400), secondary notifications captured a 98% response rate (119 out of 122). 62% of the secondary interactions was responded to within 5 seconds of the initial notification (Fig. 4c).

Figures 4a and 4b illustrate the students' and teachers' responses over a week and two weeks, respectively. In both figures, each line represents one participant. Among the teachers, we noticed a distinct case of early dropout: one teacher stopped responding on day 6, having been consistent until then (see Fig. 4b). The remaining five teachers displayed consistent engagement, averaging 49 entries each. There was only one day where one of the participants did not log any entry. Among the students, ten maintained consistent engagement until the study's last (half) day. However, one student dropped in at day 5 to respond to two NOW Notifications (Fig. 4a).

Table 4. Overview of NOW notifications sent and answered.

	Initial NOW notification			Secondary NOW notification			Total		
	sent	answered	%	sent	answered	%	sent	answered	%
Teachers (6)	246	181	74 %	84	81	96 %	330	262	78 %
Students (11)	154	102	66 %	38	38	100 %	192	140	72 %
Total	400	283	71 %	122	119	98 %	522	402	77 %

4.2 TWEETS Survey

Based on the TWEETS evaluation scores, both student and teacher groups found the NOW Interactions to be user-friendly, easy to use, and potentially adherable. Every item received an average score between 4 and 5, reflecting a general consensus of agreement to strong agreement. The high scores across both groups suggest that the NOW Interactions were generally well-received, with only minor variances between the two cohorts. The items that received the highest scores were ‘If it was important for me to use a medical diary, this type of communication could become part of my daily routine’ and ‘This type of communication made it easy for me to answer the questions.’, both achieving a score of 4.62. The scores on these items suggest participants’ readiness to integrate NOW Interactions into their daily routines in a medical context and that they are perceived as a straightforward and effortless mode of communication.

4.3 Semi-structured Interviews

The insights from the semi-structured interviews showed the participants’ perceptions, preferences, and concerns regarding NOW Interactions. These insights are grouped and presented by thematic areas:

General Feedback on NOW Interactions: NOW Interactions was received positively and the consensus was it was serving as a timely reminder that encouraged regular participation. Participants praised the system for its efficiency, simplicity, and promptness. Nonetheless, there were some concerns. Among these were notifications sometimes getting lost among other alerts and a wish for more detailed response options for specific questions. The size of the icons was also pointed out by two participants as being somewhat small.

Technical Aspects: Some participants reported challenges with notifications while their phones were in power-saving mode. They hinted at irregularities in notification delivery, with notifications arriving late or seemingly not at all.

Question design: Participants indicated mostly focusing on the icons, instead of the question text. The icons were perceived as self-explanatory and helpful in quickly recognising the question’s context, although a few prioritised reading the text. The energy icons and colour differentiation received notably positive feedback. Icons used in the studies are shown in Fig. 3.

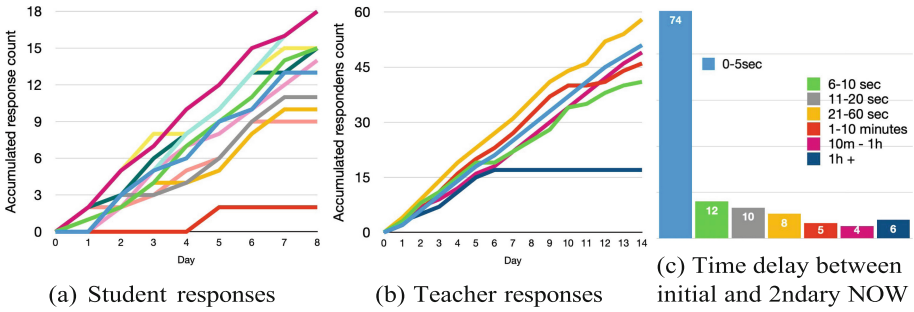


Fig. 4. User response frequency and time delays for secondary NOW Interactions.

Flow of Secondary NOW Interactions: All participants reported being comfortable with responding to two consecutive NOW notifications, did not find the experience overwhelming, and felt that the flow was quite manageable. This aligns with the notably high response rates observed earlier, where 98% of the secondary interactions were answered, as seen in 4. Most felt the second notification was delivered timely, however, though some reported occasional delivery delays. Seven participants indicated that managing up to 3 to 5 consecutive interactions could be feasible.

Disruption and Intrusiveness: Participants perceived NOW as minimally disruptive and non-intrusive. Its simplicity compared to other alternatives was emphasised by both the teacher and a student as a key feature. The ability to respond without going through opening an app made the process more pleasant and efficient. Both the teacher and a student highlighted that while the notifications were noticeable, they were not intrusive. Other students reported having their phones on silent mode, thus not finding the notifications bothersome. The participants reported that even though they responded to NOW Interactions over an extended period of time, they did not give much conscious thought to the process. One student specifically mentioned that they have a tendency to discontinue participation in similar studies but chose to stay engaged in this one.

5 Discussion

Determining the potential of NOW Interactions to seamlessly integrate into daily routines, especially within medical diaries, relies heavily on users consistently and easily engaging with them.

In NOW Interactions, *adherence* can be seen from two perspectives: 1) adherence to the initial NOW Interaction, and 2) adherence to the following communication in the form of secondary NOW Interactions. During our studies, initial notifications received a response in 71% of the cases. Once a user responds to the primary notification, they typically engage with the subsequent notifications, as illustrated by a 98% follow-up adherence rate. This trend was supported by interview feedback, where eight of the nine participants indicated they felt they could manage 3-5 sequential notifications. This leads to an interesting consideration, *Could NOW Interactions be used for longer sequences or complete questionnaires?*

While the teacher cohort had a clear case of dropout, the student cohort showed one student (student 4 in Fig. 4a) only having activity in the middle of the study. This might be related to irregularities reported in notification delivery, especially when phones are in power-saving mode, and can impact consistent user engagement. The irregularities might originate from our app installation process which was facilitated through a testing mediator app, bypassing the conventional Play Store listing requirements. Consequently, this decision could result in our app's notifications being down prioritised when in power-saving mode. Addressing this issue could increase response rates to initial NOW Interactions. Both students and teachers provided insights indicating their willingness to incorporate NOW Interactions into their daily routines, especially when linked to a critical medical diary apps, underscoring *user acceptance*. Comments from the interviews also showed a clear preference towards NOW Interactions compared to other methods. Participants particularly praised the direct response feature without the necessity to open an app, indicating an enhanced *UX*. The consistent engagement of users with secondary NOW notifications reflects their acceptance of NOW Interactions as a communication technique.

The feedback was largely positive, yet it is essential to note that students actively contributed to the study's design. Their participation in shaping the scenario's theme, notification timing, and designing elements, could have fostered a sense of ownership, potentially leading to favourable views on NOW Interactions. That said, this active engagement can be seen as reflective of the intrinsic motivation typical of actual medical diary users.

For upcoming tests, we plan to expand our participant pool, previously limited by Covid-19 measures. We will also lengthen the testing phase and further explore the potential of consecutive NOW Interactions. Currently, we are evaluating feedback from health professionals on NOW Interactions' effectiveness and relevance, with many expressing significant interest in its prospective uses.

6 Conclusion

In this paper we presented two usability studies on the efficacy of NOW Interactions, a novel communication method designed to lower the threshold for responding to information inquiries by combining a reminder, a request, and a response into one interaction. Results were promising with a 98% response rate to secondary interactions, highlighting user engagement.

Participants reported on particularly valuing the direct response feature and indicated willingness to incorporate NOW Interactions into their daily routines when linked to medical diary apps. While the study did spotlight areas for improvement, notably concerns with notification delivery in power-saving mode, the overarching sentiment was positive.

The usability studies presented in this paper are the first to assess NOW Interactions and suggest it holds considerable potential for improving user adherence and experience for medical diaries. Future studies will focus on developing a more stable prototype, delving deeper into its capabilities, and exploring its applicability in broader sectors, including education.

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