

Development and evaluation of the peer support web application “uniMatchUp!”

Lisa Ollesch ¹, Jens Kohlmann¹, Maribell Steiner¹, and Daniel Bodemer ¹

Abstract: This paper describes the conception, development, and evaluation of a peer support web application for university students. The main goal of *uniMatchUp!* is to help students in finding appropriate academic support and learning groups by providing Group Awareness (GA) information about various aspects of fellow students that are useful for digital learning. The study contributes to a better understanding of the use of GA tools in the university context and reveals that active engagement with the application, in the form of contributed questions and answers, led to increased student satisfaction. During the interaction with *uniMatchUp!*, cognitive GA information (contribution quality) was considered more relevant than behavioral (amount of participation), and emotional (well-being) GA information about other students. The findings also provide potentials for improvement, which can shape the further development of *uniMatchUp!* and future applications.

Keywords: Peer support application, academic help-seeking, group awareness tools

1 Introduction

The motivation for *uniMatchUp!* was the exceptional situation caused by the COVID-19 pandemic, which led to new demands for university students. From the summer semester 2020 to the summer semester 2021, university life has largely taken place virtually at many universities, which reveals opportunities and challenges that may have an impact on university life far beyond the pandemic period. Currently, learning material is mostly provided digitally, which increases individual flexibility from home but reduces the chance of personal exchange with other appropriate fellow students when questions and problems arise. These are one of the preferred resources for support [AY11]. Relevant information about fellow students such as prior knowledge or the availability of potential learning partners can hardly be estimated – especially at the beginning of the academic career and with spatial distance. Although the original idea for *uniMatchUp!* stems from a problem situation, it also offers many opportunities for computer-supported teaching and learning in the context of higher education. The overarching goal of *uniMatchUp!* is to support students in their (partially) digital studies during the pandemic crisis and generally during their studies. The main target group of *uniMatchUp!* are university students in their first academic year. Usually during this initial study phase essential contacts are made,

¹ University of Duisburg-Essen, Media-based Knowledge Construction, Lotharstraße 65, 47057 Duisburg
lisa.ollesch@uni-due.de,  <https://orcid.org/0000-0002-3447-6176>; jens.kohlmann@stud.uni-due.de;
maribell.steiner@stud.uni-due.de; bodemer@uni-due.de,  <https://orcid.org/0000-0003-2515-683X>

which enable joint learning and mutual support and thus also may have a positive influence on learning success. Therefore, as part of the nationwide hackathon *Wir hacken das digitale Sommersemester* (#Semesterhack), a concept for the peer support web application *uniMatchUp!* has been developed to address the challenges described above and to support university students in self-regulated but socially integrated learning. This concept builds on extensive preliminary work of our research group and beyond, such as research on different types of group awareness [BD11; BJS18; OHB19], research on social embeddedness [SSB21], and research on group awareness tools for academic help-seeking [SSB19]. It was one of the winner projects within the Hackathon². Subsequently, the development of a first version of *uniMatchUp!* and its evaluation was funded by the Federal Ministry of Education and Research from September to December 2020.

Group Awareness (GA) is the central construct of the application, which is known as the perception of social contextual information in a group such as group members' knowledge, activities, or feelings [BJS18]. Particularly for the case of the university entry, research has recently linked GA tools to academic help-seeking, assuming improved decisions on potential helpers with GA information and, subsequently, higher academic success [SSB19; SSB21]. GA tools enable an improved assessment of learning partners by collecting, transforming, and presenting such contextual information, that is difficult to perceive in digital learning scenarios [BD11]. Our project pursued two GA-related goals: First, the development of an intuitively usable mobile and web-enabled application that supports university students with GA information. Second, the evaluation of how students make use of such GA information in practice. *uniMatchUp!* is designed to help students to ask targeted questions and find long-term study partners or groups. Even though there are comparable applications, which consider student characteristics in building peer support networks, such as the integrated collaborative learning environment *PeerSpace* [DLU11], to our knowledge, there is no usable application that presents cognitive, behavioral, and emotional GA information in combination to adequately support students in their peer matching and learning process.

Using GA tools for academic contexts is promising, since those tools have shown in various studies to be helpful in terms of partner selection, learning processes, and outcomes [BJS18]. GA tools can present various information, such as information about other learners' knowledge (cognitive), activities (behavioral), or emotions (emotional), which goes along with different effects [OHB19]. In particular, cognitive GA tools support grounding and partner modeling processes, which facilitates adaptation to the learning partners' skills [BD11]. Behavioral GA tools have the potential to trigger social comparison processes and increase group members' motivation to participate [KC08]. Emotional GA tools show positive effects on emotional outcomes by improving emotion understanding [EAC12]. The combination of these three types of GA information may help to better assess fellow students before their selection and thus adapt to specific characteristics of learning partners in subsequent communication processes [OHB19]. It

² <https://hochschulforumdigitalisierung.de/de/online-hackathon>

is assumed that the combined presentation of different types of GA information facilitates academic help-seeking [SSB19]. This might be particularly the case for phases of digital teaching, lacking immediate face-to-face contact. In this way, GA support potentially also has a positive impact on academic success (e.g., study satisfaction, intention to drop out, grades) [Al20; SSB21]. Furthermore, supporting such processes is seen as instrumental for improving students' social connectedness, which enables self-regulated student matching [SSB21; WWF05]. This leads to the first research questions:

- RQ1: To what extent is the interaction with a peer support application that presents three types of GA information related to an increase of (a) academic success and (b) social connectedness?

The joint presentation of different GA information can be helpful to shape students' choices based on their own preferences [SSB19]. However, the effects of cognitive, behavioral, and emotional GA information are often studied separately [OHB19]. This does not allow for conclusions about subjective preferences. In order for a peer support application to actually be adopted in everyday life, it is important to know and include the acceptance and desires of the target group or students. Therefore, three types of GA information will be integrated in the context of *uniMatchUp!* to investigate the relevance of cognitive, behavioral, and emotional GA information in the selection of fellow students [Ol20]. Based on these considerations, the following second research question is posed:

- RQ2: How relevant are cognitive, behavioral, and emotional group awareness attributes for students in the digital selection of fellow students?

Moreover, it is important to ensure that both the matching of students and the subsequent communication are as intuitive as possible. Findings on the optimal design and use of GA information in a university context are still lacking. Therefore, in the following study, different functions for private and public exchange at individual and group level are implemented. These functions are evaluated to answer the third research question:

- RQ3: How should a peer support application be designed to facilitate finding suitable learning partners and communicating with each other?

2 Concept and Implementation

uniMatchUp! is a responsive web application that can be accessed using common browsers and is programmed in Python, using a Django framework. University students can register with their university email addresses to ensure that only students of the University of Duisburg-Essen could register for the first test phase. As usernames, nicknames were chosen to reduce the barrier to entry for questions. The application is intended to support users in three scenarios: matching help-seekers with helpers for concrete questions relevant for the short term in 1) a public forum or a 2) private 1:1 exchange, as well as matching longer-term 3) learning or practice groups. These three functions and the respective implementation of GA information are described below.

2.1 Public forum

The focus of the public forum function lies on the content-related forums for each offered lecture (*Vorlesungsspezifische Foren*). In those forums, one can exchange about questions and study contents with all fellow students and thus profit from the collective knowledge of others. There are also forums for other concerns – a forum to get to know each other (*Kennenlernbörse*) and a forum for organizational concerns (*Organisationsforum*). Through this way, students can get in contact with each other and thus increase social connectedness. In the public forum, we provide additional GA information on several levels. This information should help to better assess potential learning partners and to enable the adaptation to such learning partner [BJS18, OHB19]. On contribution level, there is the possibility to upvote answers to questions (cognitive GA, *Empfehlungen*), and to rate the contribution quality of answers more fine-grained on a 5-star Likert scale (cognitive GA, *Durchschnittliche Qualität*). A sample answer and the corresponding rating options are visualized in Fig. 1, left side (no real username).

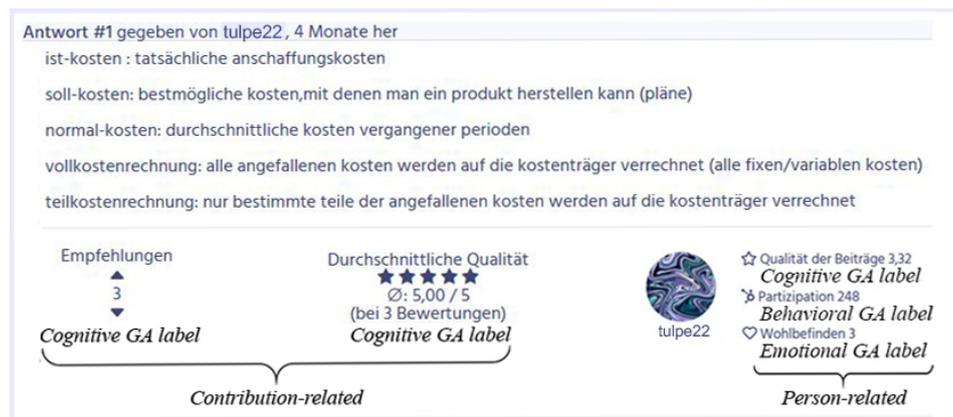


Fig. 1: Example excerpt from the forum with two cognitive GA labels on contribution level on the left and three different types of GA information on personal level on the right

Based on the contribution-related GA information, a person-related average quality value (cognitive GA, *Qualität der Beiträge*) is formed for all written answers in the forum and private help-seeking function (see section 2.2), which is displayed next to the icon of the user in the public forum but also in the respective user profile to facilitate skill assessment [see BD11]. On behavioral level, a participation counter (behavioral GA, *Partizipation*) tracks and visualizes the number of asked questions, given answers, and ratings of other users' contributions in the whole application to increase participatory motivation [KC08]. Once one of the actions is performed, the counter increases by one. Well-being in the network of the students (emotional GA, *Wohlbefinden*) is subjectively self-assessed by students on a 5-star Likert scale and can be changed at any time to trigger emotion co-regulation processes [EAC12]. In summary, all GA information on personal level is

adapted continuously, some adaptations are conditioned on interactions with the system (participation), others adaptable by the users (quality of contributions and well-being). For a sample user with assessed GA information see Fig. 1, right side.

2.2 Private help-seeking

In *uniMatchUp!* students can also post questions privately to a selection of up to three potential helpers. To do this, the users 1) specify the course topic, 2) write a question title, and an explaining question text. The help-seekers can also assign tags (keywords) to a question for better categorization. Optionally file attachments can be added. After specifying the question, a 3) selection of all students who have taken the university course is displayed along with the same three person-related GA information of the public forum (see Fig. 2). This list is randomized at all GA levels so that users with low, medium, and high proficiencies as well as new users without entries are displayed on the first page. The selection interface can be sorted by these GA attributes.

Stelle deine Frage (3/3)

Hier findest du eine Liste potenzieller Helfer:innen. Wähle 1 bis 3 Helfer:innen aus, denen du die Anfrage senden möchtest. Zusätzlich findest du hier die durchschnittliche Qualitätsbewertung, den Partizipationscore und das Wohlbefinden, um deine Auswahl zu erleichtern. Weitere Informationen findest du im Profil und auf der How to uniMatchUp!-Seite. 0 bedeutet, dass die Person noch keine Bewertungen und/oder Aktivitäten aufweist.

 Benutzername	 Qualität der Beiträge	 Partizipation	 Wohlbefinden
Duisburg_96	1	2	3
fleissigerStudi	4	159	2
ObiVanKenobi	3.32	134	4
törf	2.5	6	1
Birne_123	0	3	5
tulpe22	2.75	8	3
InfoPro42	0	1	3
Avocadopflanze3	3.15	119	5
Aloha47	3.36	99	2

1 bis 9 von 97 Einträgen

Zurück 1 2 3 4 5 ... 11 Weiter

Zurück
Frage an ausgewählte Helfer:innen stellen
Frage im Forum posten

Fig. 2: Example excerpt of the private help-seeking selection page (no real usernames)

The selected helper(s) will be notified when they receive a request. The system allows helpers to either accept the question or to reject it. If a question is accepted and answered, this question will be deleted from the other potential helpers. If the question is accepted, a chat is opened between the help-seeker and helper where they can exchange information and clarify the respective question. Once the question has been answered from the questioner's perspective and the interaction has ended, the question can be closed and will be deleted from the other potential helpers. After that, the helper's contribution quality can be rated, analogous to the quality star rating of forum answers (see Fig. 1, *Durchschnittliche Qualität*). This is offset against the other quality ratings from private help-seeking and public forum (*Qualität der Beiträge*). Resolved questions are archived, which allows users to revisit older conversations and access the documented knowledge.

2.3 Learning group search

The goal of the learning group search is to allow university students to get to know each other through a group chat and share content related to a specific course. To find an existing group or to create a new one, users can specify several attributes that include information about the desired maximum group size, expected grade, and available dates (see Fig. 3). Based on this information, *uniMatchUp!* searches for existing groups that meet the defined criteria. Furthermore, the group results are displayed according to a recommender system that suggests heterogeneous groups based on the cognitive GA quality label (i.e., users with high, moderate, and low average contribution quality; *Qualität der Beiträge*; see Fig. 1, right side). Heterogeneous grouping may be more beneficial than pure homogeneous matching to avoid clusters with students that have only low values and to encourage diversity in groups. In the overview of already existing groups, users can join as a member. For each of the displayed groups, it is possible to view the GA information about the individual group members.

Veranstaltungsauswahl
Wähle die Veranstaltung aus, für die du eine Lerngruppe suchen möchtest. Du kannst ebenfalls "veranstaltungsübergreifend" auswählen, falls du mit deiner Lerngruppe Themen aller Veranstaltungen deines Semesters besprechen möchtest.
Wähle deinen Kurs aus.

Maximale Lerngruppengröße
Wie groß soll deine Lerngruppe maximal sein?
2

Angestrebte Note
Welche Note möchtest du mit Hilfe der Lerngruppe mindestens erreichen?
1

Verfügbare Termine
Bitte kreuze an, an welchen Terminen du Zeit hättest, dich mit deiner Lerngruppe zu treffen. Den genauen Termin könnt ihr zu einem späteren Zeitpunkt gemeinsam in der Gruppe festlegen.

Montag:
 Vormittags Nachmittags Abends

Dienstag:
 Vormittags Nachmittags Abends

Mittwoch:
 Vormittags Nachmittags Abends

Donnerstag:
 Vormittags Nachmittags Abends

Freitag:
 Vormittags Nachmittags Abends

Fig. 3: Example excerpt of the creation page for a learning group

3 Study design and procedure

$N = 101$ German university students (M age = 20.14 ($SD = 3.99$, 17 – 51) years) participated in the study. Of these, 66.3% were Economics students, 14.9% were Business Education students, and 18.8% were Applied Computer Science students (University of Duisburg-Essen) in the first semester. Gender distribution was balanced with 50.5% female, 46.5% male, and 3% diverse participants.

Regarding RQ1, **GA** was assessed with an adapted version of Mock's awareness taxonomy on a 5-point Likert scale [Mo17], ranging from 1 ("does not apply at all") to 5 ("completely true"). Six items each asked for general awareness of the *self* about other students' skills and relationships (Cronbach's $\alpha = .82$; e.g., "I have an overview of the topics the course participants are familiar with.") as well as of *other* students about the self ($\alpha = .91$; e.g., "The course participants have an overview of the topics I am familiar with."), both estimated by the respective participants. Three different measures were assessed for **academic success**: Subjects were asked to indicate the 1) **grades** they expected to achieve in the respective study subjects, ranging from the usual grade levels of "1.0" to "> 4.0" as well as "I am not taking the course." An overall mean value was calculated for all courses taken across the three study programs, weighted according to the achievable credit points. To measure 2) **study satisfaction**, two subscales of the short form of the Study Satisfaction Questionnaire [WHS18] were used ($\alpha = .83$). Response options ranged from 0 ("the statement does not apply at all") to 100 ("the statement applies completely"). To measure the 3) **intention to drop out** of the study program, one item by Fellenberg and Hannover [FH06] was applied, ranging from 1 ("not at all true") to 6 ("completely true"). **Social connectedness** was measured by three subscales of the assessment of social connectedness ($\alpha = .94$) by Van Bel et al. [Va09], which were to be estimated on a 7-point scale from 1 ("strongly disagree") to 7 ("strongly agree"). To relate the variables to the interaction with *uniMatchUp!*, subjective duration of usage was asked after the interaction in hours. Moreover, the number of posed questions and answers were taken from the log data. With regard to RQ2, to indicate the **relevance of different GA types**, participants were asked to indicate how helpful (item 1), important (item 2), and steering (item 3) the five GA attributes (see Fig. 1) were during the application interaction, ranging from 1 ("not at all") to 6 ("very much"). Overall mean scores across those three items were generated. Addressing RQ3, participants were asked to assess the **likelihood of using** the whole application (item 1) as well as the public forum (item 2), private help-seeking (item 3), and learning group search (item 4) features. Response options ranged from 1 ("not at all likely") to 5 ("very likely"). Also, **usability** was tested using the User Experience Questionnaire (UEQ) [LHS08], ranging from -3 to 3, each having two opposite properties as poles (e.g., "boring" and "exciting"). According to the authors, values between -0.8 and 0.8 represent a neutral evaluation, values > 0.8 represent a positive evaluation.

To ensure equal opportunities, anyone interested could register to use the application. However, only students who were in their first year of study in one of the target subjects (Economics, Business Education, and Applied Computer Science) could participate in the post-questionnaire. The application interaction phase started on 11/26/2020 and lasted about 2 ½ weeks. The post-questionnaire was provided from 12/13/2020 to 12/23/2020. A compensation of 25 euros as well as further raffles from 25 to 75 euros were provided to ensure that we reach a sufficient number of subjects in a very short time, because the project came about during the pandemic and we therefore had to acquire at short notice. Additionally, ten out of the 101 participants declared their willingness to participate in a **qualitative follow-up survey** to substantiate their statements made in the questionnaire

described above. Sample statements are presented in the Results section to illustrate the quantitative results. Even though only the official interaction phase was relevant for the study evaluation, *uniMatchUp!* may still be used afterwards.

4 Results

To answer **RQ1**, in the first step we examined the extent to which the variables/questionnaires included in the study were related to each other (see Tab. 1).

	1	2	3	4	5	6	7	8
1. duration of use	1	.23*	.02	-.05	-.09	.18	.21*	.21*
2. questions/ answers		1	.25*	.08	-.09	.04	.16	.18
3. study satisfaction			1	-.42**	-.60**	.10	.02	.01
4. grades				1	.36**	-.09	.02	-.11
5. drop out intention					1	-.16	-.08	-.05
6. social connectedness						1	.45**	.45*
7. GA (self)							1	.64**
8. GA (other)								1

Tab. 1: Bivariate Correlations between interaction variables and those related to academic success, social connectedness, and GA. * $p < .050$, ** $p < .010$; $N = 101$, apart from grades ($N = 100$). Note that lower scores can be considered positive for grades and intention to drop out.

The results show that more active engagement with the application, in the form of questions and answers, was associated with a higher study satisfaction, confirming RQ1a. Also, the estimated overall usage time of the application was positively related to both GA dimensions, which in turn was positively related to feelings of social connectedness (see Tab. 1). Even though there is no correlation of estimated duration of use and social connectedness, we exploratory examined if an effect potentially might be mediated by GA [see SSB21]. Therefore, in the second step, two mediation analyses were conducted with GA (self) and GA (other) as mediator variables each. Although the a-path as well as b-path were significant in both mediator analyses (see Fig. 4), the indirect effects did not become significant for both the GA perspective of the *self* about other students (indirect effect $ab = .09$, 95% CI[-0.23, 0.22]) nor the GA perspective of *other* participants about the self (indirect effect $ab = .09$, 95% CI[-0.19, 0.18]), with both confidence intervals including the 0. Related to social connectedness, RQ1b is only partially supported.

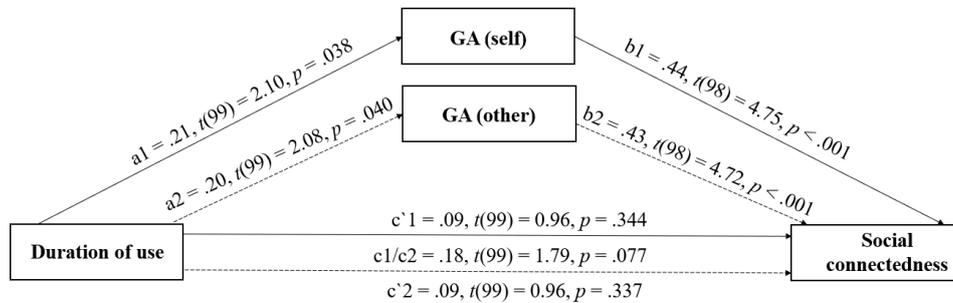


Fig. 4: Mediation paths with fully standardized parameter estimates

Concerning **RQ2**, a within-subject ANOVA with a Greenhouse-Geisser correction showed a significant difference between the relevance of GA information ($F(3.25, 325.03) = 54.22, p < .001, \eta^2_p = .35$). Bonferroni-adjusted post-hoc analysis revealed significant differences ($p < .001$) between all information labels, except of the three labels of cognitive GA information (see Tab. 2). This leads to an overall ranking of **1) cognitive GA** (“[...] The quality shows how trustworthy the user appears.”), **2) behavioral GA** (“[...] Based on participation, I see if a person is really willing to help others.”), and **3) emotional GA** (“[...] Makes it possible to consciously improve the well-being of a person.”).

GA labels	GA information	<i>M</i>	<i>SD</i>
Average quality (contribution level)	Cognitive GA	4.40	1.14
Number of upvotes (contribution level)	Cognitive GA	4.33	1.31
Quality of contributions (personal level)	Cognitive GA	4.28	1.06
Participation (personal level)	Behavioral GA	3.54	1.07
Well-being (personal level)	Emotional GA	2.63	1.25

Tab. 2: Descriptive statistics of perceived relevance of the GA information labels (scale 1 to 6)

With respect to **RQ3**, a within-subjects ANOVA with a Greenhouse-Geisser correction revealed a significant difference between the likelihood of using the three main functions public forum, private help-seeking, and learning group search ($F(1.62, 162.06) = 14.13, p < .001, \eta^2_p = .12$), see Tab. 3 (left side) for descriptive values.

Application (functions)	<i>M</i>	<i>SD</i>	UEQ subscales	<i>M</i>	<i>SD</i>
Whole application	3.91	0.91	Attractiveness	1.28	1.00
Public forum	4.88	1.53	Perspiciuity	1.04	1.24
Learning group search	4.55	1.22	Dependability	1.02	0.92
Private help-seeking	4.06	1.52	Stimulation	0.94	1.13
			Efficiency	0.86	1.06
			Novelty	0.71	1.11

Tab. 3: Descriptive statistics of likelihood of use (scale 1 to 5) and usability (scale -3 to +3)

Bonferroni-adjusted post-hoc analysis revealed slightly significant differences ($p < .050$) between all three functions with generally very high mean scores. Overall, the **whole application** performed very well, with a mean score close to 4. It was praised that “[...] interaction with other fellow students was super and, above all, better structured than in comparable communication services”. The **public forum** was the most popular function, due to the fact that “[...] by allowing everyone to potentially be involved, you always get a quick response”. The **learning group search** was the second most popular feature. Here it was stated that “[...] it helps those people who currently have no other possibility to find a learning group”, which concerns especially students who do not live in the place of the university. Even though all main functions were rated extremely positively, the private help-seeking function was the worst ranked function, which was nevertheless liked “[...] due to the possibility of finding a concrete personal caregiver”. Regarding the **UEQ questionnaire** (see Tab. 3, right side), all subscales, except of novelty, achieved a pleasing and positive evaluation. Nevertheless, the **qualitative questions** revealed several needs for improvement. The biggest shortcoming of the application is the current loading time, which was rated as “[...] the most serious thing”. Moreover, issues were seen in the clarity, since “[...] the application contains many empty spaces and sometimes bulky information”. Especially the view of the mobile version seems to need improvement, “[...] as many elements are too small and unclear”. It was also desired to be able to “[...] favor or save posts so that you don’t always have to search for them” and “[...] to mark posts that have not yet been read or to receive notifications about new posted contributions to not lose track of them”, which is not implemented in the current version of the application.

5 Discussion and conclusion

The goal of this project was to develop an application that facilitates the students’ entry into the academic life, especially in the context of COVID-19, based on the use of GA information. *uniMatchUp!* was tested with respect to potential effects on academic success as well as social connectedness (RQ1). We also examined the relevance of different GA information (RQ2) and the acceptance of the application design (RQ3). Even though only a few relationships between interaction intensity and GA with relevant dependent variables could be identified, there were positive tendencies focusing on study satisfaction as well as social connectedness. This is in line with research [A120; SSB21; WWF05] and highlights the potential of using GA tools in the study course. In addition, it must be noted that in the first semester a lot of influencing factors might have hindered more positive study results to occur – confounding variables that we could not control for all of them, such as a general wrong decision in the choice of a study program, increasing difficulty of the topics, or further supporting offers of the university. It became extremely clear that cognitive GA information seemed to be most relevant in learning partner choice, whereas emotional GA information in particular seemed to be less appropriate, at least in the form we implemented it. In general, both the individual functions and the entire application as well as its usability were evaluated very positively. However, there are also weaknesses

and need for improvements that led to the following implications: 1) The emotional GA component (well-being) should be removed or reconceptualized at the individual personal level because of its low ranking and honest assessment cannot be assured. Alternatively, an overarching assessment of togetherness at sub-forum or overall network level would be conceivable but more research is needed for finding adequate emotional GA support. 2) Caching should be refined as page load times are too high. 3) The mobile layout should be improved because the current display is not optimal. Even a native application could be discussed. 4) Notifications functions, such as email or push-up, should be implemented. 5) The basic implementation of all three core functionalities needs to be further developed.

It should be noted at this point that the sample was limited to 101 subjects, and we conducted the study in a very short time span including only three study programs. It is therefore planned to further develop and evaluate *uniMatchUp!* on the basis of the results and to expand its use. Further field and experimental designs are planned that will reveal deeper insights into the effects of single and combined GA information, with a focus on emotional GA support and effects of user anonymity vs. recognition. Such attempts are promising, as the study results indicate that university students can benefit from the use of GA information in the university context. Furthermore, our findings show that such an application and its main function are accepted and desired.

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