How Students Weight Different Types of Group Awareness Attributes in Wiki Articles: A Mixed-Methods Approach

Lisa Ollesch, Sven Heimbuch, Hannah Krajewski, Cora Weisenberger, and Daniel Bodemer
lisa.ollesch@uni-due.de, sven.heimbuch@uni-due.de, hannah.krajewski@stud.uni-due.de,
cora.weisenberger@stud.uni-due.de, bodemer@uni-due.de
University Duisburg-Essen

Abstract: Group awareness (GA) tools can visualize different types of group attributes. Studies often focus on the representation of one attribute, although social media environments such as wikis may benefit from GA combinations. In our studies, we examined the importance of cognitive (knowledge), behavioral (participation), and emotional (friendliness) GA information in wiki article selections, which allows initial predictions about how individuals deal with combined GA information. A quantitative analysis using choice-based conjoint analysis ($N = 104$) showed that the visualization of friendliness is weighted higher than participation in wiki groups. GA assessments are moreover slightly related to personal characteristics like the learning motivation, the tendency towards social comparisons, and the need for affect. The additional qualitative analysis ($N = 19$) revealed a higher effect of visualized emotional deficits on perceived group problems than cognitive and behavioral deficits, underlining the need for a stronger investigation and support of emotional GA.

Keywords: Group awareness information, wikis, choice-based conjoint analysis, interviews

Background

In comparison to other knowledge construction platforms evaluated in educational contexts, social media environments like wikis offer much potential for the beneficial occurrence of controversies and socio-cognitive conflicts (Kimmerle, Moskaliuk, Oeberst, & Cress, 2015). However, collaborative learning through social media is also associated with challenges (Kirschner & Erkens, 2013). These involve the lack of participation motivation due to responsibility diffusion in large groups ("behavioral challenge"), the inability to deal with cognitively relevant content due to information overload ("cognitive challenge"), and the lack of group feelings due to missing emotional cues ("emotional challenge"). All of these challenges may hinder effective group performances or even lead to people not participating in collaboration processes at all. This highlights the need for specific support measures (Ollesch, Heimbuch, & Bodemer, 2019). To support social media or wiki communities in addressing the aforementioned challenges and make more people engage in wiki article editing, the use of so-called *Group Awareness Tools* (GATs) is very promising. Those tools provide information about specific properties of group members, e.g., regarding their participation, knowledge, or feelings (Janssen & Bodemer, 2013) and therefore enhance the person's existing GA. GA information can be collected in different ways (from objective to subjective measures) and is very commonly visualized as bar chart (e. g., Kimmerle & Cress, 2008). So far, the visualization of cognitive (very common: knowledge bar chart based on knowledge test), behavioral (very common: participation bar chart based on amount of contributions), and emotional (so far rarely evaluated: friendliness bar chart based on sentiment analysis of contributions) *Group Awareness* (GA) information has mostly been investigated in isolation (cf., Janssen & Bodemer, 2013). Cognitive GATs have shown to facilitate the navigation and selection of meaningful content in wikis (thereby addressing the "cognitive challenge", Heimbuch & Bodemer, 2017). Moreover, behavioral GATs serve as a source of motivation for (equal) participation through the visualization of collaborators' activities (thereby addressing the "behavioral challenge", Kimmerle & Cress, 2008). Last but not least, emotional GATs, even though only systematically investigated in online contexts with smaller groups and not in social media contexts yet, facilitate the joint emotion regulation in the relational space of interactions (thereby addressing the "emotional challenge", Eligio, Ainsworth, & Crook, 2012).

Research questions and hypotheses

Based on the already existing separate but complementary findings, we strongly assume that the joint visualization of several GA attributes could be accompanied by advantages for group processes and outcomes, especially on larger learning platforms as the mentioned challenges cannot be addressed with one type of GA information alone (Ollesch et al., 2019). However, more research on GA combination effects needs to be done to reveal combined effects (Janssen & Bodemer, 2013). As a first step, taking widely used wiki platforms as an example, we aim to

investigate how cognitive, behavioral, and emotional GA information are weighted when selecting a wiki article or group as the decision for a wiki article includes the decision for a certain group constellation of editors. This serves as an important indicator of how people refer to GA information in its combined representation. This helps to test our assumption about the importance of all three attributes in the improvement of existing wiki designs. We focus on the group aspects knowledge, participation, and friendliness. The first two aspects are very common used GA attributes. Emotional or friendliness awareness has rarely been explored (cf., Eligio et al., 2012) but previous interviews with our students showed that it is a desirable attribute to visualize. Besides, when several types of GA information are externally presented, personal characteristics likely influence the subjective importance of GA attributes in wiki article or group decisions (Heimbuch & Bodemer, 2017). Here, we focus on the influence of the current learning motivation, the tendency towards social comparisons, the need for cognition, and the need for affect. Our research questions are as follows: *RQ1)* How important are cognitive (knowledge level), behavioral (participation level), and emotional (friendliness level) GA attributes in a collaborative wiki learning environment when choosing for wiki groups/wiki articles to be edited? *RQ2)* How do characteristics of learners influence the subjective importance or weighting of GA information in this selection process? To answer RQ1 and RQ2, students were asked to choose their preferred wiki group from a set of hypothetical wiki articles with different levels of knowledge, participation, and friendliness awareness information (see Figure 1).

Learning motivation

One relevant characteristic is the *current learning motivation*, which is seen as a prerequisite for collaborative learning (Kirschner & Erkens, 2013). Individuals with high motivation are more likely to select learning partners with high competencies or knowledge than individuals with low motivation (French, 1956). Moreover, learners with high motivation are willing to contribute more to a wiki collaboration than people with low motivation (Ebner, Kickmeier-Rust, & Holzinger, 2008), which should also influence the decision for more active wiki groups to avoid frustrations (Capdeferro & Romero, 2012). Especially when people have high interest in successful task accomplishment and consider the task to be challenging, the amount of knowledge and participation will potentially be more important than the friendliness of group members' contributions. Therefore, this hypothesis is set up: *H1)* Learners with high learning motivation tend to decide for wiki articles visualizing *a)* high group knowledge and participation, whereas *b)* high group friendliness becomes less important.

Social comparison processes

In addition to the motivation of learners, the *tendency towards social comparisons* influences the learning partner choice (Neugebauer, Ray, & Sassenberg, 2016). GATs promote social comparisons by presenting information about the group, e.g., by making learners aware of the group members' knowledge. People with higher tendency towards social comparisons are more interested in information that allows comparisons and in using it in interaction with others (Neugebauer et al., 2016). Even if all GA attributes could trigger social comparison processes, it should be noted that when selecting a new wiki group or article, individuals do not yet have their own participation level or friendliness score, at most expectations, since those GA attributes are based on contributions after the selection process. However, knowledge is a GA attribute, which can be and is very often assessed in advance, e.g., via knowledge test (Janssen & Bodemer, 2013). For this reason, the social comparison effects should especially occur in the importance of knowledge when selecting a wiki article. Since both upward and downward comparisons are possible, it cannot be said per se that a higher amount of knowledge will be more important. But when the motive behind the comparison process is self-improvement, this should lead to the choice for better learning partners (Ray, Neugebauer, & Sassenberg, 2017): *H2a)* Learners with high tendency towards social comparisons attach more importance on group knowledge than on group participation and friendliness when deciding for a wiki article. *b)* Moreover, when these learners score high in the motive self-improvement, they tend to decide for wiki articles with high group knowledge.

Need for cognition and affect

The construct *need for cognition* (NFC) is a personality trait that has become relevant in many fields of research. It is assumed that NFC influences decision-making behavior (Nair & Ramnarayan, 2000). Individuals with high NFC (rational-oriented cognitive styles) tend to process the information they receive in a decision-making scenario reflectively and rather prefer cognitive-demanding features (Carbonell & Brand, 2018), comparable with high group knowledge. Contrary to the NFC, the *need for affect* (NFA) is a personality variable that describes how individuals deal with emotion-triggering situations. It is defined as general motivation to approach or avoid such situations (Bartsch, Appel, & Storch, 2010). High NFA includes the desire to experience and understand the emotions of oneself and others (Bartsch et al., 2010), which also suggests that the amount of emotional GA information in the form of friendliness is weighted more heavily. On the basis of these findings, we hypothesize

the following: *H3a)* Learners with high NFC tend to decide for wiki articles visualizing high group knowledge, whereas *b)* learners with high NFA tend to decide for wiki articles visualizing high group friendliness.

Experimental studies

This paper is a first step in investigating the importance of different GA information in collaborative wiki learning. Choice-based conjoint analysis (study 1) is applied to determine how people value different types of GA information based on personal characteristics (answering RQ1, RQ2, H1 to H3). As ad-on for RQ1, qualitative interviews (study 2) are applied. Our main aims are to help researchers and practitioners getting a big picture of GA combination influences on (wiki) decision-making and help them to select the appropriate support measures.

Study 1

Method: Choice-based conjoint analysis

A sample of $N = 104$ participants (64 females, students of the University Duisburg-Essen) with a mean age of $M = 21.26$ ($SD = 2.52$) took part in laboratory study 1. To determine the relative importance values of the GA attributes in wiki article selections, we employed choice-based conjoint (CBC) tasks. CBC analysis provides the opportunity to model realistic decision-making situations. Participants make discrete decisions for one of several alternatives which differ in the qualities or levels of different attributes. After that, the relative importance of these attributes and the estimated utility value of their levels can be calculated by means of Hierarchical Bayesian analyses using Sawtooth Software. Every CBC task consisted of four articles with the three GA attributes knowledge, participation, and friendliness (randomized arrangement of bar charts) and three levels per attribute (low, medium, and high), see Figure 1. Higher relative attribute importance values do not necessarily mean that a higher attribute level (e.g., higher knowledge) is preferred, but that changes in the levels have a higher effect on the selection preferences. Therefore, CBC also provides the utility values of the attribute levels, here low, medium, and high, from which the relative importance values of the GA attributes are composed (highest level−lowest level of the same GA attribute divided by total range across all attributes). Subjects were provided with a wiki scenario in which they should imagine that they have to work together with other people on a wiki article. The whole wiki article as well as individual contributions would be evaluated and also serve as test preparation on the hypothetical topic. The respondents should imagine that the respective wiki articles involve different group constellations each as well as topics about which they have an assessed medium knowledge, so neither particularly much nor particularly little knowledge to allow upwards and downwards comparisons. Prior to testing, subjects were informed about the meaning of the GA attributes, e.g., the high quality of knowledge in article 1 meant that the wiki group members are extraordinarily knowledgeable about the topic. The visualization of the participation presented the mean frequency of contributions, whereas friendliness presented the friendliness level of the group members' contributions in the wiki. The subjects should imagine that, based on their group preferences, actual groups would subsequently be formed that fit together particularly well. Subjects were then confronted with 17 of those successive CBC tasks, always visualizing different levels of the three attributes.
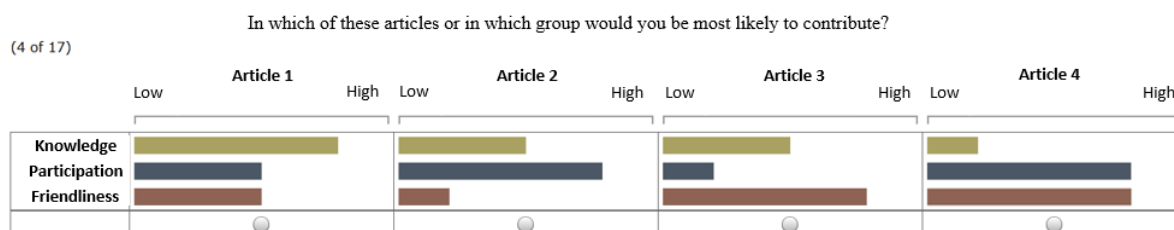

Figure 1. An excerpt of the CBC paradigm.

To assess the current learning motivation, the Questionnaire on Current Motivation by Rheinberg, Vollmeyer, and Burns (2001) (QCM, 18 items answered on a 7-point Likert scale) was completed by the participants right after the provided scenario. The factors challenge ($\alpha = .63$, 4 items) and interest ($\alpha = .81$, 5 items) were used for calculations because they become particularly relevant in self-regulated learning (Rheinberg et al., 2001). The tendency towards social comparison was surveyed by the validated German translation of the Iowa-Netherlands Comparison Orientation Measure (COM, Jonas & Huguet, 2008) ($\alpha = .80$, 11 items answered on a 7-point Likert scale). Moreover, the social comparison motive self-improvement was surveyed by the Strategic Social Comparison Motives Measure (SSCMM, Ray et al., 2017) ($\alpha = .79$, 4 items answered on a 5-point Likert scale). To measure the NFC, the NFC subscale of the Rational-Experiential Inventory by Keller,

Bohner, and Erb (2000) (α = .90, 14 items answered on a 7-point Likert scale) was used. The NFA was measured with the NFA measure by Appel, Gnambs, and Maio (2012) (α = .84, 10 items answered on a 7-point Likert scale).

Results and discussion

The following applies to all calculations: Extreme values were filtered out if they were at least three interquartile distances away from the upper or lower quartile. To answer RQ1, the mean relative importance values of the GA attributes knowledge, participation, and friendliness were considered, for descriptive values see Figure 2. These results show that in general all three attributes seem to be important in wiki decision-making based on the similar descriptive values of the relative importance values. This goes in line with theoretical assumptions by Ollesch and colleagues (2019) as well as Janssen and Bodemer (2013) and stresses the potential for providing combined GAT designs in order to fulfil different learners' needs. Despite similar values, a repeated-measure analysis of variance showed significant differences in the importance of the different types of GA information ($F(1.86, 191.63)$ = 3.39, p = .039, η^2 = .03). The following post-hoc analysis revealed significant differences between the importance of friendliness and participation (p_{tukey} = .033), but there were no significant differences between friendliness and knowledge (p_{tukey} = .764) as well as knowledge and participation (p_{tukey} = .164). The GA information friendliness proved to be significantly more important than participation, which means that visualized differences of the GA attribute friendliness had a greater impact on the decision probability for wiki groups or wiki articles to be edited. This is interesting as emotional GA information is under-represented in current research in comparison to cognitive and behavioral GA information (Ghadirian, Ayub, Silong, Bakar, & Hosseinzadeh, 2016), even though individuals seem to care about this type of information (slightly on a descriptive basis) the most.
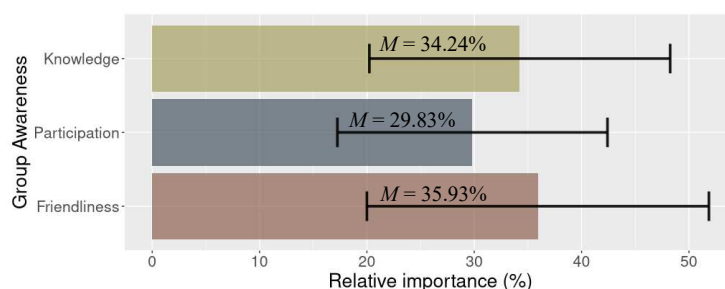

Figure 2. Relative importance values of the GA attributes. Whiskers represent standard deviations.

The descriptive values for the utility values of the (zero-centered and interval-scaled) GA attribute levels show that in all cases high levels were more preferred in comparison to low levels: low knowledge M = -52.64 (SD = 32.42), medium knowledge M = 22.94 (SD = 14.33), and high knowledge M = 28.84 (SD = 34.17); low participation M = -50.22 (SD = 25.76), medium participation M = 16.91 (SD = 11.27%), and high participation M = 34.12 (SD = 18.06); low friendliness M = -63.65 (SD = 29.37), medium friendliness M = 21.23 (SD = 13.67), and high friendliness M = 42.43 (SD = 21.32). Except of H2a, which refers to the general relative importance values of the GA attributes (see Figure 2), all hypotheses address the preferences for high levels of the respective GA information. Therefore, in the first step, simple linear regressions were performed with the scores of the relative importance values of the GA attributes as criterion. In the second step, the scores for the preferences of the high levels of the respective GA attributes were examined in the same way to see if the direction of the effects were hypothesis-confirming. Predictors were the personal characteristics of H1 to H3.

Hypotheses 1: With respect to H1a, we found significant positive relationships between the QCM dimension challenge and the relative importance of knowledge ($F(1, 102)$ = 12.38, p = .001, β = .33, ω^2 = .10). Moreover, students who found the task from the scenario challenging preferred to collaborate with wiki groups that have a high level of knowledge when editing wiki articles ($F(1, 101)$ = 4.44, p = .038, β = .21, ω^2 = .03), supporting H1a. For the QCM dimension interest, however, neither the relationship with the relative importance of knowledge ($F(1, 102)$ = 1.56, p = .214, β = .12, ω^2 = .01) nor with high knowledge articles ($F(1, 100)$ = 1.38, p = .244, β = .12, ω^2 = .004) turned out to be significant, which does not support H1a. We also found no significant relationships between the QCM dimension challenge and the relative importance of participation ($F(1, 102)$ = 0.06, p = .814, β = -.02, ω^2 = -.01) as well as high participation articles ($F(1, 100)$ = 0.90, p = .346, β = .09, ω^2 = -.001). Students with high interest did not weight participation in general ($F(1, 102)$ = 0.67, p = .416, β = -.08, ω^2 = -.003) and more concrete also not high participation articles higher ($F(1, 100)$ = 0.19, p = .667, β = .04, ω^2 = -.01), which does not support H1a. With respect to H1b, we found significant negative relationships between the QCM dimension challenge and the relative importance of friendliness ($F(1, 102)$ = 8.08, p = .005, β = -.27, ω^2 = -.06). Students who found the task from the scenario challenging tended to avoid wiki groups that

have a high level of friendliness when editing articles ($F(1, 102) = 6.91$, $p = .010$, $\beta = -.25$, $\omega^2 = .05$), supporting H1b. For the QCM dimension interest, however, neither the relationship with the relative importance of friendliness ($F(1, 102) = 0.20$, $p = .654$, $\beta = -.04$, $\omega^2 = -.01$) nor with articles visualizing very friendly contributions of other group members ($F(1, 102) = 0.39$; $p = .533$; $\beta = -.06$; $\omega^2 = -.01$) turned out to be significant, which does not support H1b. To sum up, the expected relationships could be shown between the QCM dimension challenge and knowledge as well as friendliness but not for the QCM dimension interest. Regarding the GA attribute participation, no significant relationships could be shown at all. H1 is only partially supported.

      Hypotheses 2: With respect to H2a, students with higher tendency towards social comparisons showed a significant stronger weighting of the GA attribute knowledge ($F(1, 101) = 4.85$, $p = .030$, $\beta = .21$, $\omega^2 = .04$), which supports H2a. Even though effect sizes illustrate the right direction, H2b is not securely supported as the motive self-improvement was not significantly related to the preference for high knowledge wiki articles ($F(1, 98) = 1.59$, $p = .211$, $\beta = .13$, $\omega^2 = .01$). Moreover, the relative importance values of participation ($F(1, 101) = 1.30$, $p = .257$, $\beta = -.11$, $\omega^2 = .003$) and friendliness ($F(1, 101) = 1.02$, $p = .315$, $\beta = -.10$, $\omega^2 < .001$) were not significantly related with the tendency towards social comparisons in this setting and therefore weaker than the relationship with knowledge, which supports H2a.

      Hypotheses 3: With respect to H3a, even though expected descriptive trends were given, already no significant relationships could be shown between the NFC and the relative importance of knowledge ($F(1, 102) = 0.28$, $p = .595$, $\beta = -.05$, $\omega^2 = -.01$) as well as high knowledge articles ($F(1, 101) = 1.76$, $p = .187$, $\beta = .13$, $\omega^2 = .01$). H3a is therefore not securely supported. Missing significant results regarding the NFC (H3b) could be explained by the use of a scenario instead of a real collaboration situation. Thus, for the students with high NFC, it may not have been salient enough whether they would benefit from articles with high knowledgeable group members. We originally expected that high knowledge would imply that cognitive activity has to be put into group discussions, which is in line with high NFC. However, people with high NFC also tend to be less affected by cognitively demanding problems, like a low group knowledge level, than people with lower NFC (Cacioppo, Petty, Feinstein, & Jarvis, 1996). This may have led to the fact that the influence of the NFC on the GA attribute knowledge was not as great as expected, because it could not only be satisfied in group constellations with high knowledge. However, the analysis revealed that the NFA has a significant effect on the relative importance of friendliness ($F(1, 102) = 4.17$, $p = .044$, $\beta = .20$, $\omega^2 = .03$) and that students with high NFA tended to prefer articles with visualized high friendliness ($F(1, 102) = 6.40$, $p = .013$, $\beta = .24$, $\omega^2 = .05$). H3b is supported.

      Although it has to be noted that in all cases the explained variances were rather low, these results give first impressions about how individuals with different personal characteristics would deal with combined GA information in real collaborations, assuming that importance is an indicator of increased interaction. People with high NFA might ignore cognitive and behavioral GA information in a wiki learning environment because they rather care about the regulation of emotional aspects. More potential influencing variables need to be identified in future studies. Before we discuss our results in more detail, an additional qualitative approach is introduced in the following. This approach serves to examine the motives behind this decision-making as well as perceived problems of learners when a GAT indicates a deficit in one of those three GA attributes.

Study 2

Method: Qualitative interviews

After the termination of study 1, a supplementary qualitative study was conducted amongst 19 students (*s01* to *s19*) who had not participated in study 1 with a mean age of $M = 21.74$ ($SD = 3.48$); seven were male and 12 were female. The aim of this study was to support the quantitative study and find out why certain decisions were made in Study 1. The face-to-face interviews were transcribed and analyzed using the software MAXQDA 2018. The participants were introduced to the scenario in the same way as in study 1, in which an intermediate knowledge level was specified. In contrast to study 1, regarding their most important GA attribute, the interviewees were also asked whether their assessment would change if they had a different level of knowledge (high or low knowledge). Moreover, they were asked to talk about the problems they see in wiki articles visualizing one GA deficit (cognitive, behavioral, or emotional deficit) to delve deeper into potential causes for preferences. Article 4 in Figure 1 visualizes the shown cognitive or knowledge deficit (knowledge low but rest high) among the potential wiki group members. Two analogous article constellations with emotional (friendliness) and behavioral (participation) GA deficits were provided, three in total. Based on the interview data, we (two coders, $\kappa = .90$) categorized the named problems associated with a deficit in one of the GA information as follows: A cognitive problem was characterized by a participant's *contribution that is not part of the topic* or is of *poor quality, missing solutions of socio-cognitive conflicts, slow cognitive progression,* and *missing cognitive outputs. Low well-being, interpersonal conflicts, feeling of stress* or *frustration, low tolerance of mistakes/knowledge gaps,* and *low*

acceptance of other opinions were classified as components of emotional problems. Behavioral problems were understood as *low participation motivation, unequal workload, slow work pace,* and *missing behavioral outputs.*

Results and discussion

Concerning to RQ1, eight interviewees each chose friendliness and participation as their most important attribute, while only three interviewees chose knowledge. Individuals who preferred friendliness mostly stated as a reason that it was important for effective group cooperation and outcome to get along well within the group. Individuals who preferred participation stated as a reason that motivation to contribute was important to get the chance for a good outcome. Individuals who preferred knowledge stated as a reason that the average knowledge in the group is the basis for processes and outcomes and that you cannot move forward without an adequate level of knowledge among the group members. Of the 19 respondents, six said their importance assessment would change with a different knowledge level. Five of those had previously chosen friendliness as their most important attribute, one had previously chosen participation. Except for one person, all students indicated that they would rather prefer the GA attribute knowledge for changing knowledge levels. An exemplary statement is provided in the following, given by a subject with a self-improvement motive: "With a low level of knowledge, *knowledge is most important to me because I have the hope that I will then learn more.* Then I would be willing to accept smaller losses in friendliness. If my knowledge is high, then friendliness is more important to me than knowledge" (s11).

To sum up, similar to study 1, study 2 highlighted the importance of the GA attribute friendliness. However, the qualitative interviews showed that knowledge seems to be less important than participation, which is not compliant with the descriptive values from the CBC analysis but in our opinion less meaningful due to the small sample size. It could also be shown that the importance of the knowledge is very dependent on knowledge levels since some interviewees would rather pay attention to knowledge if they had a low level of knowledge. Nevertheless, with medium knowledge, there was a preference for friendliness and participation information, which is also underlined by the number of assessed problems based on different group deficits. Table 1 shows the frequencies and example statements for problems mentioned for cognitive, emotional, and behavioral deficits.

Table 1: The perceived impact of cognitive, emotional, and behavioral group deficits on different problems

N = 19	Cognitive problems	Emotional problems	Behavioral problems	Problems each deficit
Cognitive deficit	17 (89.47%) "One problem could be that the quality of the finished product does not correspond to what the task was." (s18, *poor quality*)	4 (21.05%) "If there is someone who has higher knowledge than the low group average, interpersonal conflicts can arise because this person can reveal that the input of others contains bad information." (s17, *interpersonal conflicts*)	6 (31.58%) "If you don't know that much, you may only progress slowly in fulfilling your tasks." (s14, *slow work pace*)	27
Emotional deficit	14 (73.68%) "Unresolved disagreements could arise based on the low level of knowledge, in which both parties permanently stick to their opinions." (s04, *missing solution of socio-cognitive conflicts*)	19 (100%) "This can lead to other people showing rage when you don't know something." (s19, *low tolerance of mistakes/knowledge gaps*)	7 (36.84%) "The division of labor will be unequal." (s10, *unequal workload*)	40
Behavioral deficit	14 (73.68%) "You'll probably have to wait until you get an answer when you ask a question. That will be difficult." (s11, *slow cognitive progressing*)	9 (47.37%) "Since difficulties and conflicts can arise, they can distract from the actual work, so that there is a lack of time, this can lead to everything becoming very stressful in the end." (s13, *stress*)	15 (78.95%) "This has a negative effect on your own participation motivation. (s07, *low participation motivation*)	38

According to interviewees a visualized emotional deficit in a group has the largest effect on different problem types (40 mentioned problems). This underlines the results of study 1 as well as current research, which

suggests that relational issues significantly influence interaction, task engagement, and learning (e.g., Näykki, Järvelä, Kirschner, & Järvenoja, 2014), highlighting the need for a stronger support of emotional GA.

Overall discussion

Even though wikis offer many learning potentials (Kimmerle et al., 2015), these are not fully exploited. We assumed that the support through combined GA information could be useful as different types of GA information tackle different challenges (Ollesch et al., 2019). Therefore, it is important to understand how people deal with GA combinations and whether all three GA attributes are actually used for wiki decisions. We have addressed this goal in two studies to investigate the perceived importance of knowledge, participation, and friendliness awareness information for guiding students' wiki article decisions. This was an important first step as they are often considered separately in CSCL environments (Janssen & Bodemer, 2013). Moreover, with study 1, we contributed to understand how users' characteristics influence the way decisions are made.

Regarding RQ1, all types of information seem to be relevant, which highlights the need for a holistic perspective in the development of GATs to improve the design of already existing wikis and similar platforms. Our study results support the assumption that it makes sense to visualize more types of GA information if the preferences of users have not been captured beforehand by the respective researchers, instructional designers, or teachers. This would help to facilitate navigation in wiki or similar learning communities as GA combinations could offer every learner or student to choose the "right group". A person focusing on knowledge might use this attribute to be more efficient in his or her tasks and a person who thinks friendliness is important can choose a group that stresses him the least. Common denominator of both studies was the importance of emotional GA information in the form of friendliness. These results suggest that especially emotional processes should be supported even more in wiki or other social media environments as some students care a lot about this information. However, it has to be investigated how this emotional GA support should exactly look like as current emotional GA research focuses on smaller groups (e.g., Eligio et al., 2012) and a friendliness bar chart (e.g., based on sentiment analysis of contributions) is just one possible operationalization. Regarding RQ2, the first indication for interpersonal differences in study 1 were the high standard deviations of the relative importance values and attribute levels. Further, linear regression analysis revealed slight relationships of all personal variables and the relative importance values of the GA attributes as well as their high levels, except of NFC and the motive for self-improvement. Even if the influence of the motive self-improvement (H2b) was not statistically verified in study 1, the qualitative interviews could show that a small amount of personal knowledge triggers self-improvement motives, leading to the preference for high knowledgeable groups (e.g., statement of s11), which goes in line with literature (Ray et al., 2017). The learning motivation (factor challenge), the tendency towards social comparisons, and the NFA seem to be relevant to distinguish different types of preferences. These findings about personal influences could be used for developing adaptive GA visualizations fitting to personal characteristics. e.g., a person with high NFA might be more motivated by having the option to choose articles with high friendliness.

Even if the results are promising, providing GA can also lead to the "rich-get-richer" principle, e.g., when those topics which were indicated as friendly get more and more people for collaboration, whereas those topics with a lower friendliness level people will not pay attention to. Concrete task instructions could counteract this but more studies that relate GA information and decision-making need to be conducted in order to better understand this phenomenon as well as the dangers of "filter bubbles" when providing personalized GA information. Moreover, the present scenario has exemplary addressed the wiki context and students. Nevertheless, these results are not only specific to wikis and are therefore transferable to other CSCL contexts. Future studies should consider different types of (wiki) users with real and varying knowledge levels as well as different learning topics as those aspects can significantly determine whether someone will contribute something or not. We are already conducting systematic studies that go beyond the importance of different GA attributes and examine the interaction effects of different types of GA information (e.g., two-factor between design with knowledge and participation as well as knowledge and friendliness) on real learning processes.

Based on these studies, providing wiki communities with GA combinations could help to reduce information diversity and provide users with better tools to make easier decisions for wiki articles, leading to the facilitation of their usage in teaching scenarios and to more people participating in wiki writing processes. New GA applications could on the one hand focus on providing GA information individuals put importance on or would like to have visualized, e.g., friendliness, which would improve user experience. On the other hand, they could also ensure that potentially distracting information is not visualized to draw attention to GA information relevant to the task completion, e.g., knowledge. With this mixed-methods approach, we clarify that it is time to bring the often separate GAT findings together as each type of GA information seems to have a value for different types of learners or students. Friendliness awareness should be considered and explored more closely in future design attempts for new support measures as it is not yet clear which kind of emotional support is most helpful

for certain contexts. However, we believe, that not only designers of online learning environments could benefit from these findings. Knowing about students' importance weightings and providing personalized GA can be helpful for teachers in the support of traditional learning to create matching groups dependent on the teaching objectives (e.g., based on similar or heterogeneous preferences) and maintain a pleasant learning atmosphere.

References

Appel, M., Gnambs, T., & Maio, G. R. (2012). A short measure of the need for affect. *Journal of Personality Assessment*, *94*(4), 418–426.

Bartsch, A., Appel, M., & Storch, D. (2010). Predicting emotions and meta-emotions at the movies: The role of the need for affect in audiences' experience of horror and drama. *Communication Research*, *37*(2), 167–190.

Cacioppo, J. T., Petty, R. E., Feinstein, J. A., & Jarvis, W. B. G. (1996). Dispositional differences in cognitive motivation: The life and times of individuals varying in need for cognition. *Psychological Bulletin*, *119*(2), 197–253.

Capdeferro, N., & Romero, M. (2012). Are online learners frustrated with collaborative learning experiences?. *The International Review of Research in Open and Distributed Learning*, *13*(2), 26–44.

Carbonell, G., & Brand, M. (2018). Choosing a physician on social media: Comments and ratings of users are more important than the qualification of a physician. *International Journal of Human–Computer Interaction*, *34*(2), 117–128.

Ebner, M., Kickmeier-Rust, M., & Holzinger, A. (2008). Utilizing wiki-systems in higher education classes: A chance for universal access? *Universal Access in the Information Society*, *7*(4), 199–207.

Eligio, U. X., Ainsworth, S. E., & Crook, C. K. (2012). Emotion understanding and performance during computer-supported collaboration. *Computers in Human Behavior*, *28*(6), 2046–2054.

French, J. R. P. (1956). A formal theory of social power. *Psychological Review*, *63*(3), 181–194.

Ghadirian, H., Ayub, A. F. M., Silong, A. D., Abu Bakar, K. B., & Hosseinzadeh, M. (2016). Group awareness in computer-supported collaborative learning environments. *International Education Studies*, *9*(2), 120–131.

Heimbuch, S., & Bodemer, D. (2017). Controversy awareness on evidence-led discussions as guidance for students in wiki-based learning. *The Internet and Higher Education*, *33*, 1–14.

Janssen, J., & Bodemer, D. (2013). Coordinated computer-supported collaborative learning: Awareness and awareness tools. *Educational Psychologist*, *48*(1), 40–55.

Jonas, K. J., & Huguet, P. (2008). What day is today? A social–psychological investigation into the process of time orientation. *Personality and Social Psychology Bulletin*, *34*(3), 353–365.

Keller, J., Bohner, G., & Erb, H.-P. (2000). Intuitive and heuristic judgment formation–Different processes? *Zeitschrift für Sozialpsychologie*, *31*(2), 87–101.

Kimmerle, J., & Cress, U. (2008). Group awareness and self-presentation in computer-supported information exchange. *International Journal of Computer-Supported Collaborative Learning*, *3*(1), 85–97.

Kimmerle, J., Moskaliuk, J., Oeberst, A., & Cress, U. (2015). Learning and collective knowledge construction with social media: A process-oriented perspective. *Educational Psychologist*, *50*(2), 120–137.

Kirschner, P. A., & Erkens, G. (2013). Toward a framework for CSCL research. *Educational Psychologist*, *48*(1), 1–8.

Nair, U. K., & Ramnarayan, S. (2000). Individual differences in need for cognition and complex problem solving. *Journal of Research in Personality*, *34*, 305–328.

Näykki, P., Järvelä, S., Kirschner, P. A., & Järvenoja, H. (2014). Socio-emotional conflict in collaborative learning—A process-oriented case study in a higher education context. *International Journal of Educational Research*, *68*, 1–14.

Neugebauer, J., Ray, D. G., & Sassenberg, K. (2016). When being worse helps: The influence of upward social comparisons and knowledge awareness on learner engagement and learning in peer-to-peer knowledge exchange. *Learning and Instruction*, *44*, 41–52.

Ollesch, L., Heimbuch, S., & Bodemer, D. (2019). Towards an integrated framework of group awareness support for collaborative learning in social media. In M. Chang, H.-J. So, L.-H. Wong, F.-Y. Yu, & J. L. Shih (Eds.), *Proceedings of the 27th International Conference on Computers in Education* (pp. 121-130). Taiwan: Asia-Pacific Society for Computers in Education.

Ray, D. G., Neugebauer, J., & Sassenberg, K. (2017). Learners' habitual social comparisons can hinder effective learning partner choice. *Learning and Individual Differences*, *58*, 83–89.

Rheinberg, F., Vollmeyer, R., & Burns, B. D. (2001). QCM: A Questionnaire to assess current motivation in learning situations. *Diagnostica*, *47*(2), 57–66.