

# The Influence of Participation and Activity Level in an Online Community on Academic Elective Intentions for STEM

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## ABSTRACT

Online Communities allow individuals to interact, get to know and exchange with similar others. Especially when there are no offline-groups available, online communities can be useful for locating others who share specialized interests. For girls, who are interested in STEM (science, technology, engineering, and mathematics), an online community could be an option to meet other girls and women who are interested in STEM. That way girls (1) meet role models and similar others and (2) can identify with the social group of STEM-girls. However, belonging to an online community might not be enough. Research has shown that active involvement is important in order to incorporate the social identity of the group into one's own identity and to benefit from being a group member. To test this assumption, we conducted a study with female high school students who were members of an online community for girls interested in STEM (training group, N = 231) or who were interested and applied to become a member of the community but had to wait another year (control group, N = 186). We found that the more actively members participated within the online community, the more they identified with the group. We further found that for members, who identified strongly with the group, the academic elective intentions for STEM increased significantly over the study period of ten months whereas the academic elective intentions for STEM decreased for members who identified less with the group as well as for members of the control group.

## Keywords

Online community, STEM, group identification, participation, academic elective intentions

## INTRODUCTION

Due to low participation rates of females in science, technology, engineering, and mathematics (STEM) in

Germany we set up an online community (CyberMentor) for girls interested in STEM and women vocationally engaged in those fields. By setting up this community we wanted to address two main reasons why many girls avoid STEM: stereotypes about careers in STEM and missing role models. Studies show that stereotypes exist about men being talented in mathematics and natural sciences and women being untalented in those fields [7, 10]. To change such stereotypes, CyberMentor provides role models that serve as converse examples. Within the community, girls meet females engaged in STEM vocational fields and other girls with similar interests. In our program, not only the adults but also the girls are recognized as role models, which is especially advantageous since same age role models are as important and can be as influential as older role models [4, 12]. To foster interaction among girls, we set up an online community platform offering profile pages, discussion forums, personal messages, and a chat room. In conversations with other community members, participants get to know STEM from a different perspective and learn about the opportunities these fields offer.

The aim of this study was to find out if a higher participation rate of CyberMentor participants within the community platform predicts a higher level of group identification. Since research indicates that the strength of identification with a group can affect (positive) outcomes of group membership, we were further interested if community members who reported a higher level of group identification also showed higher academic elective intentions for STEM.

After this introductory section we will present the theoretical background and the hypotheses of our study. Next the method will be described, followed by the results. We will close this paper with a discussion and comments on future research.

## THEORETICAL BACKGROUND AND HYPOTHESES

Groups make up an important part of a person's social identity. The social identity theory [21, 22] proposes that the self (or identity) of an individual is composed of the personal identity and several social identities. While the



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personal identity is determined by individual aspects like taste or intellectual capabilities, the social identity refers to the person as a group member. Tajfel [21] defines social identity as “*that part of an individual’s self-concept which derives from his knowledge of his membership of a social group (or groups) together with the value and emotional significance attached to that membership*” (p. 63). Thus, groups – or more precisely, the identification with groups – are important for shaping identities. When it comes to groups, one popular theory is the social identity theory mentioned above. It views group membership as a psychological state leading to collective representation of who one is and how one should behave [14]. Henry, Arrow, and Carini [13] mentioned that the social identity theory refers primarily to people’s identification with broad social categories such as gender or race and designed a model that defines group identification more detailed. In their definition, group identification has three sources: cognitive (social categorization), affective (interpersonal attraction), and behavioral (interdependence). They view the cognitive process of self-categorization as a member of the group – which is also central in the social identity theory – as one source of group identification. Another source is the interpersonal attraction. If members are attracted to one another, they may prefer to spend more time together which means that they interact more. Interaction then strengthens self-identification as a member. As a third source of group identification they consider behavioral interdependence. Flippen, Hornstein, Siegal, & Weitzman [9] found interdependence to be a stronger basis for in-group formation than similarity and Sherif and Sherif [19] argued that interdependent interaction is crucial to intra-group attraction.

Henry et al. [13] emphasize that group identification occurs in interacting groups, whereas in the social identity theory, group interaction is omitted [16]. According to Henry et al. [13] group identification is more related to intra-group processes as compared to in-group versus out-group distinction. In their view it is important “*how members identify with each other and with their own group without regard to out-group members. Out-groups may influence group identification but are not necessary to it*” [13, p. 562]. Finally Henry and her colleagues [13] see group identification as a continuous variable, whereas social identity was seen as a dichotomy in its early conception: one was either a member of a category or not [23].

Irrespective of the group identification definition one refers to, groups are important for individuals, as ‘belonging’ and feeling that one is a member of a group of others who share similar interest and goals is an important interpersonal need [3]. However – not everyone finds suitable groups for special interests. Due to small numbers of females engaged in science, technology, engineering, and mathematics (STEM) in Germany, respective groups rarely exist and girls who are interested in STEM do not find others to exchange and to identify with. Yet, if “*there is no equivalent ‘offline’ group, membership and participation in*

*a relevant virtual group can become an important part of one’s social life and can have powerful effects on one’s sense of self and identity*” [17, p. 204]. McKenna & Bargh [18] found for example that participation in an online community for people with stigmatized sexual identities or political ideologies had positive effects on their self-esteem. As predicted, participation in these virtual groups’ facilitated people’s coping with their marginalized identities. The authors report further that for those who participated more actively in the online community, compared to those lurking (reading but no posting), the importance of the group identity was substantially greater. Active members found the group itself and interaction with other members of the group to be more important to them. Ethier & Deaux [8] report similar results studying an offline group of Hispanic first-year university students. They also report that the identification with the own ethnic group was positively related to active involvement in Hispanic cultural groups. Deaux [6] thus argues that identifying with a social category might not be enough and that the role of involvement in the group is an important factor concerning group identification. This equates to the group identification model developed by Henry and colleagues [13], stating that categorization as a group member is one source of group identification (cognitive), but not the only one: interpersonal attraction (affective) and interdependent interaction (behavioral) are important sources of group identification as well.

According to these theoretical thoughts and previous research results, we assume that a greater participation rate in the CyberMentor community leads to higher identification with the group.

H1: *Greater participation in the CyberMentor online community leads to higher identification with the group.*

However, which advantages are linked to a greater participation in the online community and thus the hypothesized higher identification with the group? Research has shown that identification with the group is an important mediator for positive outcomes of group membership. McKenna & Bargh [18] reported that those online community members who identified stronger with the stigmatized group showed an increased level of self-acceptance and greater likelihood of disclosing the concealed identity to family or friends. Studying an offline group, Bat-Chava [2] found no general relationship between the identification with the group of deaf persons and self-esteem. An increase in self-esteem was only found for those who reported a high level of group identification. These results indicate that it is not enough to see oneself as a member of a group in order to benefit from the group membership. The level of how strongly one identifies with the respective group seems to be important concerning the outcome of being a member of this group. In order to test this we wanted to find out if girls interested in STEM, who identify stronger with the online group, benefit more from being a member of the CyberMentor online community as compared to members who identify less with the group or a

control group. Greater benefit in the case of the CyberMentor community is associated with greater academic elective intents for STEM. To test this assumption we hypothesize:

H2: *Community members with high group identification benefit more in terms of academic elective intents for STEM than community members with low group identification or members of a control group.*

## **METHOD**

The study was conducted within the CyberMentor online community. CyberMentor is an e-mentoring-program designed for female high school students interested in science, technology, engineering and mathematics (STEM). For one school year mentees communicate via e-mail with female mentors engaged in STEM vocational fields. Additionally to the e-mail exchange with the personal mentor, a community platform offers getting to know other members. Participants can fill out profile pages and write personal messages to other community members; a discussion forum and a chat room allow discussions about STEM and other topics. Within the platform the students get to know other girls interested in science and technology, with whom they can exchange about science topics as well as “girly”-topics. That way, they experience that it is normal for girls to be interested in STEM.

### **Design and Participants**

The study was conducted during the CyberMentor season from September 2006 till June 2007. Testing the first hypothesis – that greater participation within the community platform would lead to higher identification with the group – we only considered CyberMentor members as subjects. Online questionnaires were distributed to all student members ( $N = 231$ ) before the start of the mentoring season (measuring point 1) and after ten months (measuring point 2). The questionnaires included several scales. In this paper we will only report those scales that are relevant for this study. To test hypothesis 1 we had data from 147 mentees who participated in the CyberMentor program and who filled out the group identification scale (at measuring point 2).

To test the second hypothesis – that community members with high group identification would benefit more in terms of academic elective intents for STEM than community members with low group identification or members of a control group – we used a median split to divide the participants of the first study in two groups; community members with high group identification ( $N = 75$ ) and community members with low group identification ( $N = 72$ ), and compared them with a control group ( $N = 186$ ) that included girls who were interested in the program but were not allowed to participate in that season. The control group was asked to participate in the evaluation; those who filled out both of the questionnaires were assured to be

chosen as participants the next CyberMentor season<sup>1</sup>. Since there were no 13 graders in the control group (they would not have been able to participate the next year since grade 13 is the last year in the German high school), we excluded the 13 graders of the training group for testing the second hypothesis. 71 members of the high ‘group identification’ group, 63 members of the low ‘group identification’ group, and 125 members of the control group filled out the relevant scales for the second hypothesis.

Since the age was not available for many control group members, only the participants’ grades will be reported. In the control group 16 students attended grade six, 30 students were in grade seven, 30 in grade eight, 12 in grade nine, 18 students were in grade ten, 12 in grade eleven, and 7 in grade twelve. In the training group 4 students attended grade six, 19 students were in grade seven, 27 in grade eight, 16 in grade nine, 25 students in grade ten, 27 in grade eleven, 16 in grade twelve, and 9 in grade thirteen. Participation in the program and the study was voluntary and required parental permission.

### **Measurement Tools**

Online community participation: To measure the online community participation we considered the number of discussion board posts each study participant wrote. The number of posts ranged from zero to 614 ( $M = 28.63$ ,  $SD = 71.37$ ). Research results show that uneven participation rates of online community members are common. One usually finds a few members that contribute a lot and many members that contribute little or none [see also 20]. In order to use this variable as an independent variable for our regression model we categorized the variable into five groups from zero posts to many posts: (1) zero posts,  $N = 95$ , (2) 1 to 4 posts,  $N = 36$ , (3) 5 to 16 posts,  $N = 32$ , (4) 17 to 54 posts,  $N = 35$ , and (5) 55 or more posts,  $N = 33$ .

Group identification: The group identification (GI) was measured with a translated version of Henry et al.’s [13] group identification scale. The nine items were reformulated to refer to identification with the CyberMentor group. Example items were “I am happy to be a member of the CyberMentor group,” “I see myself as quite similar to other members of the group.” Responses were made on a 6-point Likert-scale with the anchors 1 ‘disagree completely’ to 6 ‘agree completely’. Cronbach coefficient  $\alpha$  was .90.

Academic elective intents for STEM: The student’s academic elective intents for STEM were assessed with a 4-item scale developed by Ziegler and Stoeger [25]. The study’s participants indicated how well they could picture themselves choosing science, technology, engineering, and mathematics (STEM) as a university course of study, attending a discussion or a class in STEM, and pursuing a career in this field. All items began with the phrase “I can picture myself...” Sample items were “I can picture myself

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<sup>1</sup> Note: Before the start of the program, applicants were chosen randomly for the training or the control group.

majoring in a subject related to the field of STEM,” “I can picture myself attending a public discussion on a topic in the field of STEM.” Responses were made on a 6-point Likert-scale as described above. Cronbach coefficient  $\alpha$  was .84 at measuring point 1 and .87 at measuring point 2.

## RESULTS

The results will be reported in two steps. First, using the data about the online community participation and the group identification, the first hypothesis (*Greater participation in the CyberMentor online community leads to higher identification with the group*) will be examined. This involves computing a linear regression analysis. In a further step, we will use the data raised with the questionnaires, to examine the second hypothesis (*Community members with high group identification benefit more in terms of academic elective intents for STEM than community members with low group identification or members of a control group*). This involves computing an analysis of variance in repeated measurements, using group membership (high group identification vs. low group identification vs. control group) as the independent variable.

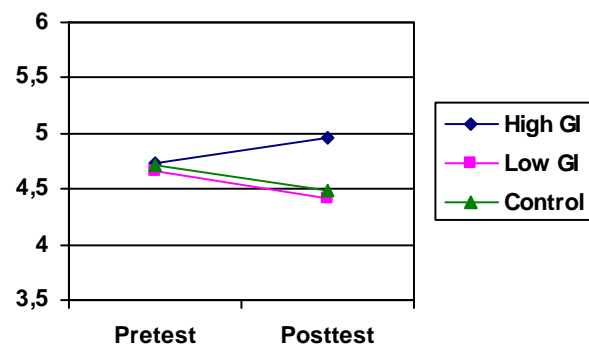
**Hypothesis 1:** Greater participation in the CyberMentor online community leads to higher identification with the group.

In order to examine this hypothesis, a linear regression analysis was conducted, using the participation within the discussion board as the independent variable and the group identification as the dependent variable. The independent variable *participation within the discussion board* ( $\beta = .37$ ,  $t(146) = 4.76$ ,  $p < .001$ ) proved to be a statistically meaningful predictor of group identification. The model explains 13% of the total variance. The hypothesis *Greater participation in the CyberMentor online community leads to higher identification with the group* can therefore be confirmed.

**Hypothesis 2:** Community members with high group identification benefit more in terms of academic elective intents for STEM than community members with low group identification or members of a control group.

Examining the second hypothesis, we used a 3 (condition: high group identification vs. low group identification vs. control group) x 2 (time: pretest vs. posttest) mixed design. For the analysis the first factor, condition, was the between-subjects factor, and time was the within-subjects factor. The number of participants in each cell was 71 in the high group identification group, 63 in the low group identification group, and 125 in the control group. For the dependent variable ‘academic elective intents for STEM’ the 3 x 2 repeated measures analyses of variance (ANOVA) of the pretest and posttest data showed no significant main effect ( $F(1,256) = 2.46$ ,  $p > .10$ ). The academic elective intents averaged for all did not change much from pre- to posttest. But – as supposed – a significant interaction between condition and time was found ( $F(2,255) = 8.70$ ,  $p < .001$ ). For community

members with a high group identity, academic elective intents for STEM increased from pretest ( $M = 4.74$ ,  $SD = 0.82$ ) to posttest ( $M = 4.96$ ,  $SD = 0.93$ ,  $t(70) = 2.43$ ,  $p < .05$ ). For community members with a low group identification however, the academic elective intents for STEM decreased from pretest ( $M = 4.67$ ,  $SD = 1.03$ ) to posttest ( $M = 4.42$ ,  $SD = 1.11$ ,  $t(62) = -2.13$ ,  $p < .05$ ). For the control group there was also a significant decrease from pretest ( $M = 4.71$ ,  $SD = 0.91$ ) to posttest ( $M = 4.49$ ,  $SD = 0.98$ ,  $t(124) = 2.43$ ,  $p < .01$ ). The results are also shown in figure 1.



**Figure 1:** Pretest and posttest means of the academic elective intents for STEM for the three groups: high group identification, low group identification, and control group.

In order to examine the differences between groups (high GI, low GI, control) at the pretest and the posttest, we applied an Oneway Analysis of Variance (ANOVA). An  $\alpha$ -adjustment was conducted and the significance level was fixed at  $.05/3 = .017$ . For the academic elective intents for STEM, the test revealed no significant difference between the groups at the pretest ( $F(2,256) = 0.10$ ,  $p > .10$ ), but there was a meaningful difference at the posttest ( $F(2,256) = 6.46$ ,  $p < .003$ ). A *post hoc* test (Tamhane) on the three groups did not find differences between any two groups at the pretest; but it confirmed differences at the posttest between the groups *High Group Identification* and *Low Group Identification* ( $p < .017$ ) as well as between *High Group Identification* and the *Control Group* ( $p < .017$ ). No significant difference was found between *Low Group Identification* and the *Control Group* ( $p > .10$ ). The hypothesis *Community members with high group identification benefit more in terms of academic elective intents for STEM than community members with low group identification or members of a control group* can thus be confirmed.

## DISCUSSION

In a first step, we examined if active participation in an online community predicts identification with the group. The hypothesis *Greater participation in the CyberMentor online community leads to higher identification with the group* was tested within the CyberMentor online community, a virtual group for female middle and high school students interested in STEM. We found the

expected prediction between active participation within the community (measured by the number of discussion board posts) and the level of group identification (measured with Henry et al.'s group identification scale [13]). The more active community members participated in the online community, the higher they identified with the group. These findings are in harmony with the group identification model proposed by Henry and her colleagues [13]: interdependent interaction causes in-group formation, a necessary backdrop for attraction to a group and categorization of oneself as a member. Ethier and Deaux [8] state that group involvement in a new context should be considered as an important factor concerning whether an individual experiences an increased salience in the new environment. In other words, active involvement and participation within the group are important for a high level of group identification. Our study underpins these theoretical approaches. The more a community member was actively involved in the online community, the more she identified with the group. Similar results have also been reported for offline groups [8] as well as for virtual groups [18].

For this study we set the focus on the online community participation and how it affects group identification. However, our program offered more than 'only' a community platform. Other aspects like a *good relationship to the personal e-mail-mentor* or *participation in supplementary offline activities* might also affect the level of group identification. To test this, we added those two variables<sup>2</sup> to our regression model. Besides the variable *participation within the discussion board* ( $\beta = .19, t(122) = 2.26, p < .05$ ) the *relationship to the mentor* ( $\beta = .36, t(122) = 4.60, p < .001$ ) as well as the *participation in supplementary offline activities* ( $\beta = .28, t(122) = 3.39, p < .01$ ) proved to be statistically meaningful predictors of group identification<sup>3</sup>. The model with those three independent variables explains 30% of the total variance as compared to 12% when the *participation in the discussion board* was the only independent variable. This shows that there are factors that influence group identification besides online participation. If there is the possibility to offer such extra activities, one should thus consider doing this.

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<sup>2</sup> The relationship to the mentor was measured at measure point 2 with three self-constructed items. An example item is „I got along well with my mentor“. Responses were made on a 6-point Likert-scale with the same anchors as the other scales described above. Cronbach coefficient  $\alpha$  was .80. Besides the personal mentors and the community platform, nine offline activities (offline meeting, trips to mentor's workplaces, etc.) had been offered to the community members during the period of the study. For each member the number of offline activity attendances has been recorded ( $min = 0, max = 7, M = .59, SD = 1.27$ ).

<sup>3</sup> Note: The number of participants in this study is  $N = 122$  since not all of the 147 community members that filled out the group identification scale, filled out the relationship-scale.

Examining the second hypothesis - *Community members with high group identification show greater academic elective intents for STEM than community members with low group identification or members of a control group* - we showed that the academic elective intents for STEM increased only for those community members, who identified strongly with the group. While the academic elective intents were about equal for all three groups (high GI, low GI, and control) to start out with, it decreased significantly over the period of the study (ten months) for those members who identified less with the group as well as for the control group. Knowing that girls' interest in STEM drops from about the age of eleven till they finish high school [e.g. 15, 24], it is not surprising that we found a decrease in academic elective intents for STEM within the control group. It is surprising though that a similar decrease was found for some of the program participants. Just offering a virtual group to identify with might therefore not be enough - just as stated by Ethier and Deaux [8]. Moreover it is important that members get actively involved in online activities such as talks in the discussion board. An explanation of the phenomenon - that active participation is an important mediator of group identification, which in turn is important for positive outcomes of group memberships - could be found in Gollwitzers' self-completion theory [11]. The theory states that people seek to make important aspects of their identity into a 'social reality'. This happens when others acknowledge and validate one's identity. In our case, active participation in the online community causes others to notice one's identity as a girl who is interested in STEM. Being recognized by others, so Gollwitzer, is a key factor in making the identity feel like a real part of the self. This might explain why participation is an important mediator of group identification.

The importance of active participation in online communities as a mediator for positive outcomes was also shown within other virtual groups. Barak and Colev-Dohen [1] studied the effects of participating in an online support network for suicidal and severely distressed adolescents in Israel. On average, the emotional distress of the community members did not lessen because of group membership. The degree of active group involvement (number of posted and received messages) however affected the level of emotional distress significantly. Members who participated more actively in the first month of the study reported significantly less emotional distress by month three than members who participated less. The level of emotional distress of those who participated less actively remained the same over the course of the study. Similar results were reported by Cummings, Sproull, & Kiesler [5] who studied active participation in an online community for people with hearing loss. More active participation in the group was associated with more benefits from the group and stronger reports of community orientation.

Although online communities might not always be beneficial for all members or might in some cases even be

problematic – for example when people with severe diseases rely more on virtual support groups than on doctors – they offer great opportunities for a lot of people. Especially for those, who lack adequate groups for specified interest in their established social networks, online communities might be an important additional source to be considered.

According to our findings, one can say that online communities definitely matter for girls' who are interested in science, technology, engineering, and mathematics. Implementing an online mentoring program such as CyberMentor, one should thus consider (1) offering an online community platform as a virtual meeting place as well as supplementary offline activities and (2) getting the members to actively engage in online and offline activities. Whereas the first requirement – offering a community platform and supplementary offline activities – can be implemented fairly easy, the second requirement – getting members actively involved – is a harder challenge. Finding strategies for motivating participants to take part in those activities could be an interesting topic for future research. Besides motivation strategies, it would also be interesting to find out if specific personal or environmental attributes exist that predict whether community members engage in online participation or not. Since we found that the relationship to the personal mentor is also an important predictor of group identification, it would be desirable to explore factors predicting good mentoring relationships. These could be personal characteristics as well as communication styles or frequency of contact. Knowing which factors predict a good mentoring relationship could be helpful for choosing specific mentors and for developing training sections for mentors.

Summarizing our research, we are positive that carefully planned and well organized online communities for girls are one way to strengthen their participation in science, technology, engineering, and mathematics. Such communities offer girls who are interested in STEM a group to identify with and the possibility to get actively involved in STEM discussions and activities. In order to enhance positive effects of such online communities, more research is needed. With our future research we will try to answer some of the open questions that came up, aiming to create a best-practice online community which can be transferred to other countries facing similar problems in attracting girls for STEM study courses and careers as well as for other target groups.

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