Girls’ Engagement in Technology Education: A Systematic Review of the Literature

Ulrika Sultan, Cecilia Axell and Jonas Hallström

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Girls’ Engagement in Technology Education: A Systematic Review of the Literature

Ulrika N. Sultan  
*Linköping University, Linköping, Sweden*

Cecilia Axell  
*Linköping University, Linköping, Sweden*

Jonas Hallström  
*Linköping University, Linköping, Sweden*

The aim of this study is to review international published scientific literature on the subject of girls’ engagement in technology education, in order to: (a) identify what is the most common descriptions of the relationship between girls and technology, (b) identify how girls’ engagement in technology education is described, and (c) identify the type of technology concerned. After systematically searching a bibliographic database, 21 articles were located and included in the study. For each article, we have analysed the purpose of the study, the content of the research done, the research method used, and the sample characteristics and the results observed. The results of the literature review are discussed in terms of their implications for future research and can be used as guidance for educators and researchers in the area. This could lead to further questions, such as if a negative discourse around girls’ relationship with technology may assist or hinder girls’ engagement in technology and technology education.

Key Words: Girls’ engagement, gender, systematic review.

1. INTRODUCTION

The close relationship between gender and technology, in structures, symbols, and identities, has long been acknowledged by feminists, although the feminine connection with technology has often been downplayed in public discourse. According to Cheryan, Ziegler, Montoya & Jiang (2016) factors including lack of confidence, lack of support at home, in the classroom or from other authority figures, and lack of peer support can explain why so few girls pursue a career in technology. Feminists scholars of technology (e.g. Harding, 1986; Cockburn & Örrom, 1993) argue that everyday discourses of technology culture are a prominent factor that cause stereotyping and gender norms in a negative form. These norms fuel ideas of what technological agency is, and whose interest in technology and what kind of technology are regarded as legitimate (Wajcman, 1991). There are thus deeply rooted structures in society that influence girls’ engagement in technology from an early age. Specific attitudes and roles hinder girls’ benefitting from the opportunities provided by technology education because technology is seen and presented as an exclusively male domain (Cheryan, Ziegler, Montoya & Jiang 2016; Turja, Endepohls-Ulpe, & Chatoney, 2009). Thus, there may also be a problem with the actual concept of a male, “nuts and bolts” technology and how it is taught in school. de Vries (2006) points out that girls are less confident than boys when handling so-called hard technology; computers, electronics and other similar artefacts. This lack of confidence extends to the use of what can be identified as hard technology even in the school (Kimbell, Stables, & Green 1996). Cheryan, Ziegler, Montoya & Jiang’s (2016) meta-study shows that certain teaching methods may favour boys over girls. Sadker and Sadker (1994) elaborate on teaching methods by showing that teachers may inadvertently favour boys, especially in areas that society considers to be in the male domain, by providing them with more and better instruction.

These two problematics – the construal of technology and technology education as male domains, and a corresponding narrow concept of technology – are highly relevant to address for the research field of
technological education, and attending to them can even be seen as a competence in teaching technology. In the end, knowledge about reasons for the existence of gender stereotypes can support girls' engagement in technology education. The aim of the study is to identify what is the most common descriptions of the relationship between girls and technology, how girls’ engagement in technology education is described, and what type of technology it concerns, by systematically reviewing the research literature in the area of girls and technology education. The study engages in a critical content analysis of the discourses about girls and technology within the existing literature on girls and technology education. We conclude by presenting a synthesis of the existing empirical evidence.

2. METHODS FOR COLLECTING AND ANALYSING DATA

A systematic literature review is a method that enables the evaluation and interpretation of all accessible research relevant to a research question, subject matter or event of interest (Kitchenham, 2004). This systematic literature review focuses on international studies researching girls’ engagement in technology education. The term “discourse” has become one of the key terms in the vocabulary of the humanities and the social sciences. It has been the subject of discussion and has different meanings in different contexts. In this study, however, we use Petrina’s (1998) description of the concept and hence discourse refers to “recurrent statements, themes and wordings across texts, which represent orientations to the world” (Petrina, 1998, p. 30). In the present context, “texts” refers to research articles.

To conduct this review, we followed a process for conducting systematic reviews based on Kitchenham (2004) and covering the following stages and activities:

Stage 1: Planning the review
  Activity 1.1: Identification of the need for a review
  Activity 1.2: Development of a review protocol

Stage 2: Conducting the review
  Activity 2.1: Identification of research
  Activity 2.2: Selection of primary studies
  Activity 2.3: Study quality assessment
  Activity 2.4: Snowball sampling

Stage 3: Reporting the review
  Activity 3.1: Communicating the results

2.1 Planning and conducting the review (Stages 1 and 2)

Initially, a search was conducted to identify the existence of research literature studying girls’ engagement in technology education. Within the context of this paper, we carried out a systematic literature review using the basic approach identified in Kitchenham (2004), in order to examine the state of research on girls’ engagement in technology education, based on the following research questions:

Question 1 (Q1): What is the most common descriptions of the relationship between girls and technology?
Question 2 (Q2): How is girls’ engagement in technology education described?
Question 3 (Q3): What type of technology is described?

Activity 2.1.1: Identification of research

For the purposes of this study, data was collected in January 2018, in the following international online bibliographic database: ERIC (Educational Resources Information Centre). Searches were limited to full texts in peer-reviewed international high-quality journals, written in English, and published between 2000 and 2017 (research over the last 18 years). The specific protocol executed in the ERIC database was: Find all my search terms: girl AND interest AND technology AND education. The results of the data collections were thus initially 117 articles. The articles were cross-referenced in Web of Science to guarantee the scientific quality of each article. The decision on using the temporal limitation of the period 1 January 2000 – 31 December 2017 was made to achieve a larger sample, but also because there may have been changes in discourse over time.
Activity 2.1.2: Selection of primary studies
The following criteria (inclusion criteria, IC) were used to determine which papers would be included in the review:
IC1: The article reports on research about girls’ engagement in technology education.
IC2: The article presents a discussion about girls’ engagement in technology education.
Articles were included only if both these criteria were met.

Five criteria for excluding (EC) articles were also identified:
EC1: Afterschool activities. We wanted to examine technology during the school day.
EC2: Science education. We wanted to look specifically at technology education studies.
EC3: ICT Education or use of ICT tools and educational technology. Excluded for being a tool for learning technology and not being the subject of technology specifically.
EC4: Computer science. Excluded when handling the computer was in focus, and not technology per se.
EC5: Age span outside 10-17-year-olds.

Initially the limitation “elementary” was included in the research. Applying this limitation resulted in only three articles. By excluding the word “elementary” from the search we got a larger scope of included articles and it resulted in a broader variation of technology education studies from a variation of countries. Furthermore, elementary does not entirely match the ages 10-17 because they also overlap with secondary education. To be able to include the age span we wanted to examine, we therefore manually excluded all articles fulfilling exclusion criterion EC5. Age span outside 10-17-year-olds. We wanted to look specifically into ages 10-17 because this is an age that research (e.g. Sinnes & Løken, 2014) has pointed out as particularly formative for girls’ engagement in technology education.

The initial search thus generated 117 international peer-reviewed research papers. In the first stage, we analysed titles and abstracts with regard to the inclusion (IC1-2) and exclusion criteria (EC1-5), and subsequently 21 studies finally matched our full search criteria based on the research questions.

Activity 2.3: Study quality assessment
The data is a fairly condensed assortment taken from a large number of publications published during eighteen years. As can be observed in Table 1, approximately 82% of the total number of research articles were excluded based on IC1-2 and EC1-5.

3 RESULTS (STAGE 3) AND DISCUSSION

Activity 3.1: Communicating the results
Table 1. Results of the final sampling, in relation to the research questions

<table>
<thead>
<tr>
<th>Article</th>
<th>Q1. What is the most common descriptions of the relationship between girls and technology?</th>
<th>Q2. How is girls' engagement in technology education described?</th>
<th>Q3. What type of technology is described?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ardies, J., De Maeyer, S., &amp; Gijbels, D. (2015).</td>
<td>Insufficient representation of girls and women in STEM fields; ‘[...] girls are needed in technical studies and professions, as the relative number of students in technology-related studies has been decreasing in most industrialised countries’ (p 366).</td>
<td>Not defined. But described as an attitudinal factor.</td>
<td>Not defined.</td>
</tr>
<tr>
<td>Article</td>
<td>Q1. What is the most common descriptions of the relationship between girls and technology?</td>
<td>Q2. How is girls' engagement in technology education described?</td>
<td>Q3. What type of technology is described?</td>
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<tr>
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<td>-----------------------------------------</td>
</tr>
<tr>
<td>Ardies, J., De Maeyer, S., Gijbels, D., &amp; van Keulen, H. (2015).</td>
<td>'girls are more negative toward technology' (p 46).</td>
<td>Interest in technology defined as a measure for one’s feeling of wanting to know or learn about technology.</td>
<td>Not defined.</td>
</tr>
<tr>
<td>Mammes, I. (2004).</td>
<td>'Women are clearly reluctant to participate in courses of studies for natural sciences or technology even though these subjects have gained greatly in importance since the beginning of the twentieth century' (p 89).</td>
<td>Defined as a person’s interest in technology.</td>
<td>Christmas tree - components of the electrical circuit.</td>
</tr>
<tr>
<td>Autio, O., &amp; Soobik, M. (2017).</td>
<td>'not a surprise that boys and girls differ in their interests, the difference is usually emotionally charged’ and ‘possible reason for this might be the different social expectations for boys and girls’ (p. 201).</td>
<td>Not defined but claims “boys’ and girls’ different interests and earlier experiences obviously have an impact on motivation for learning about technology” (p. 193).</td>
<td>Technology can be described by means of how humans modify the world around them in order to meet their needs and solve practical problems (p. 195).</td>
</tr>
<tr>
<td>Colette, A., &amp; Chatoney, M. (2017).</td>
<td>As a social construction. ‘Furthermore, the social and cultural distribution of activities between men and women can also lead to a gendered vision of technical objects according to their predominant users’ (p. 5).</td>
<td>Not defined.</td>
<td>Not defined but examines different artifacts. ‘Thus, we see that a certain number of typically male objects (crane, range servant boy, balloon...). The same applies to rare items typically feminine (tablecloth, pastry molds, pan...’ (p. 15).</td>
</tr>
<tr>
<td>Osagie, R. O., &amp; Alutu, A. N. (2016).</td>
<td>'This study shows that there is strong evidence that the culture discourages girls’ (p. 234).</td>
<td>Not defined.</td>
<td>Not defined.</td>
</tr>
<tr>
<td>Stevanovic, B. (2014).</td>
<td>As an insufficient representation of girls and women in STEM fields due to the effect of educational policy and information campaigns on parents, teachers, guidance staff and girls.</td>
<td>Not defined but presume that personal, contextual and social cognitive factors have an impact on the formation of interest (p. 553).</td>
<td>Not defined.</td>
</tr>
<tr>
<td>Chatoney, M., &amp; Andreucci, C. (2009).</td>
<td>‘certain contents, certain types of activities, certain forms of studies, certain gestures of education and scholastic shapes are better adapted to the girls than to the boys and conversely’ (p. 393).</td>
<td>Not defined.</td>
<td>The concept of technology is not defined but task performed in the study was a product improvement of a Mini football cage and a jewellery box.</td>
</tr>
</tbody>
</table>


Villas-Boas, V. (2010). Must awaken an interest in technological knowledge: ‘Unfortunately, most girls do not consider a career in these fields, in which females are under-represented. The problem starts early, with society stimulating girls to take an interest in subjects said to be ‘feminine’ rather than ‘masculine’ (p. 294).


<table>
<thead>
<tr>
<th>Article</th>
<th>Q1. What is the most common descriptions of the relationship between girls and technology?</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not defined.</td>
<td>Not defined.</td>
<td>Not defined.</td>
</tr>
<tr>
<td>Study is a German – Finnish curriculum analysis.</td>
<td>Not defined.</td>
<td>Not defined but electric circuits were used in the performed task.</td>
<td>Not defined. Article about science, technology, engineering, and mathematics (STEM).</td>
</tr>
<tr>
<td></td>
<td>Not defined but outcome expectations are described as important factors in the development of youth’s interests in and goals toward future careers.</td>
<td>Not defined. but task performed in study was building and programming a Lego Mindstorms robot.</td>
<td>Not defined.</td>
</tr>
<tr>
<td></td>
<td>Not defined. but are described as learning interests.</td>
<td>Not defined.</td>
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</tbody>
</table>
In this section, we discuss the results of the systematic review, in an attempt to answer the three research questions Q1 – Q3 (elaborated in Stage 2). Regarding Q1 – What is the most common descriptions of the relationship between girls and technology? – the analysis of the discourses shows that adjectives like “negative”, “reluctant”, “insufficient”, “discouraged”, “lacking”, etc. are connected to the female relationship with technology. Many studies couple these kinds of descriptions with the underrepresentation of girls and women in STEM fields, which also includes technology education. So, in a sense, in response to Q1 girls and women are seen as lacking in and disconnected from, but also desirable in, STEM fields. Most studies venture some kind of explanation for this but none give the personal preferences of women as the reason; these studies instead point to expectations and factors in the broader societal realm: teachers, schools, or education policy/curricula. It seems that one of the problems is a dominating male code, and that women are more interested in feelings, relationships, and connectedness. As regards Q2 - How is girls’ engagement in technology education described? – there are few if any descriptions of this in the reviewed articles, other than that boys’ and girls’ interest are different. Girls’ interest is, in fact, described in some studies, for example, the PATT studies by Ardies et al. (2015a, b). Girls are considered less interested in technology than boys, according to these studies. In response to Q3 – What type of technology is described? – few articles define the concept of or type of technology, although those studies that do define a type of technology either put forward a neutral, or male kind of “nuts and bolts” technology. Exceptions are Chatoney & Andreucci (2009), who refer to a jewellery box, and Colette & Chatoney (2017) who take up examples of both what can be considered as male and female artefacts.

Our analysis of the data about girls’ engagement in technology was aggravated by scarce information in the reviewed articles (see Table 1). However, by posing Q1, Q2 and Q3 and applying an analysis of these discourses we have yet revealed some structures, symbols, and identities prevalent in the research of gender and technology. To some extent, the research reveals a traditional view of what technology is – a concept of technology and empirical examples of types of technology with a typical male, nuts and bolts code. Questionnaires, for example, could contain questions that prompted the following remark: ‘Spends a lot of time with engineering-related hobby activities’ (Auto et al., 2016, p. 98) which can be seen as a male-coded form of technology. This might create misleading answers from girls that do not identify their engagement in technology as engineering. When revisiting the PATT questionnaire, Svenningsson et al. (2018) also discovered that the gender category cannot be used as intended since it might be gender-biased. There thus seems to be a mismatch between the image of girls as not engaged in technology and that of expecting them to be engaged in technology, although most of the studies in the sample acknowledge that the reasons for this...
disengagement are beyond girls’ and women’s control. However, gendering that takes place within a research discourse seems to be complex as well as conflicting, which invites further more detailed empirical research.

The study may contain limitations that can affect the ability to draw conclusions or infer results beyond the scope of the study. Use of other variables and samples can be found to affect the results in different directions. This study should only be seen in the context it is in, since the study only considers a few variables.

4. REFERENCES


