Hearing technology can play an essential part in the education of deaf and hard-of-hearing children in inclusive schools. Few studies have examined these children’s experiences with this technology. This article explores factors pertaining to children’s use of and attitudes toward hearing technologies, such as hearing aids, cochlear implants, teacher-worn microphones, and student-worn microphones. The study included 153 deaf and hard-of-hearing students. All students communicated orally and were in inclusive schools from grades 5–10. The results suggest that males view hearing technology more positively than do females. Having severe hearing loss also promoted positive attitudes toward hearing aids and cochlear implants, but not toward microphones. The students with positive self-descriptions tended to be more satisfied with hearing aids or cochlear implants than the students with negative self-descriptions. The main factors promoting the use of hearing aids were severe hearing loss, positive attitudes toward hearing aids, and the sound quality of hearing aids.

Assistive technology can be a key factor that enables individuals with disabilities to participate in daily life and be included in society (Schneidert, Hurst, Miller, & Üstün, 2003). However, this technology has a double-edged nature in that it is both a tool for achieving independence and a visible sign of disability (Scherer, 2002). Assistive technology that is seen as a tool or as one way of achieving desired activity is more likely to be assimilated into the user’s life. Alternatively, technology seen as a visible sign of a disability can reinforce the stigma associated with the disability. Because individuals with the latter view of technology may avoid or resist using this technology, they may avoid meaningful activities and suffer both social and physical isolation (Polgar, 2010).

Hearing technologies for deaf and hard-of-hearing (DHH) individuals include personal amplifiers (e.g., hearing aids [HA] and cochlear implants [CI]), which are typically worn on the head or on the body and assistive listening devices that are not used on the head or body, such as classroom sound field amplification systems (Dillon, 2001). Specialized hearing technologies may reduce the impact of barriers that DHH students experience in schools, such as classroom noise, rapid rate of discussion, rapid change of topics, and large numbers of people engaged in conversation, all of which can prevent DHH students from participating in teacher–student and student–student communication (Luckner & Muir, 2001; Stinson & Antia, 1999). Although DHH students and their teachers report that the use of hearing technology is essential for ensuring effective inclusion (Eriks-Brophy et al., 2006; Luckner & Muir, 2001), the equipment is sometimes used irregularly because of the stigma associated with assistive technologies.

The majority of DHH children in the western part of the world attend inclusive schools, but few findings have examined how these children view their hearing technology or how the technology is utilized. The children are infrequently asked about their experiences...
with hearing technology and their views on using it; scholarly attention has mainly been concentrated on the impact of personal aids on speech perceptions (Anderson & Goldstein, 2004; Beadle et al., 2005; Iglehart, 2004; Loy, Warner-Czyz, Tong, Tobey, & Roland, 2010; Odelius, 2010; Yoshinaga-Itano, 1999). Qualitative studies on the subject have focused more on personal amplifiers and less often on assistive listening devices (Kent & Smith, 2006; Preisler & Tvingstedt, 2005; Wheeler, Archbold, Gregory, & Skipp, 2007). In research on the use and nonuse of HA among children and the sense of stigma associated with HA, the respondents group have included teachers, parents, and hearing peers but not the DHH children themselves (Blood, Blood, & Danhauer, 1978; Brimacombe, Danhauer, & Mulac, 1983; Clarke & Horvath, 1979; Cox, Cooper, & McDade, 1989; Dengerink & Porter, 1984; Haley Stephen & Donna, 1986; Ryan, Johnson, Strange, & Yonovitz, 2006; Silverman & Klees, 1989; Strange, Johnson, Ryan, & Yonovitz, 2008; Vesterager & Parving, 1995). In contrast, numerous studies have examined adults with hearing disabilities and their attitudes, feelings of stigma and qualities of life in terms of using or not using HA (Arnold & MacKenzie, 1998; Bertoli et al., 2009; Bisgaard, 2008; Cameron et al., 2008; Cohen, Labadie, Dietrich, & Haynes, 2004; Laplante-Levesque, Hickson, & Worrall, 2010; Oberg, 2008; Wong, Hickson, & McPherson, 2009). Children who are fitted with HA or CI in early childhood may integrate such aids into their daily lives (Preisler & Tvingstedt, 2005). If so, this trend might explain why there is less focus on children’s use of HA and CI compared with adults who have acquired hearing loss.

The hearing technology offered to DHH children in inclusive schools can consist of assistive listening devices, including teacher-worn microphones and student-worn microphones used by hearing classmates. Teachers and students must make daily use of the equipment. Their attitudes toward hearing technologies may affect the degree of usage and, accordingly, the level of participation in school. This article presents DHH children’s attitudes toward the different hearing technologies offered and explores predictors that can affect the children’s attitudes toward these technologies and their utilization. A comprehensive understanding of the factors affecting the utilization of HA can improve rehabilitation interventions provided by health personnel and itinerant educators both at school and at home.

**Barriers to and Facilitators of the Use of Hearing Technology**

Factors that can improve attitudes toward and the use of hearing technology have been related to DHH individuals themselves, the environments, and the technology (Coniavitis-Gellerstedt, 2006; Craddock, 2006; Eriks-Brophy et al., 2006; Vesterager & Parving, 1995; Wennnergren, 2008; Winn, 2006).

Personal factors, such as psychosocial factors, gender, age, and degree of hearing loss, are highlighted as important issues. Several research projects have pointed to stigma as an essential factor affecting DHH persons’ refusals to wear HA (Bisgaard, 2008; Blood, Blood, & Danhauer, 1977; Hetu, 1996; Hetu, Jones, & Getty, 1993; Oberg, 2008). Individuals with HA are evaluated more negatively by teachers, parents, and hearing peers on dimensions such as intelligence, achievement, and personality through a phenomenon known as “the hearing aid effect,” which has been confirmed by a number of research studies (Blood et al., 1978; Brimacombe et al., 1983; Cameron et al., 2008; Cienkowski & Pimentel, 2001; Cox et al., 1989; Dengerink & Porter, 1984; Haley Stephen & Donna, 1986; Johnson et al., 2005; Ryan et al., 2006; Silverman & Klees, 1989). The feelings of shame and guilt attached to hearing loss can lead to a fear of disclosing one’s hearing impairment (Hetu, 1996).

In line with the stigma concept, Kent and Smith (2006) argue that the feeling of “being normal” is fundamental. Students who are able to perceive their use of HA in a given context as a normal phenomenon are likely to use them more frequently. Conversely, if HA use is perceived as abnormal, usage is often disguised or negated. Consequently, DHH students who express high levels of personal adjustment and willingness to use assistive hearing devices are found to have a strong sense of “being normal.” Students who struggle to participate and are reluctant users of HA, tend to view themselves as “not normal.” The study comprised 16 hearing-impaired children, between 12 and 17 years of age (Kent & Smith,
The normality aspect also appears in studies of children’s views of CI; Preisler and Tvingstedt (2005) concluded that the majority of the children in the study considered their CI to be natural parts of their lives. Wheeler et al. (2007) produced similar results and described the children as being completely depended on CI to hear; the researchers reported that the children would feel bereft if the CI could not be used.

Other psychosocial characteristics of successful hearing aid users include self-confidence, self-esteem, extroversion, and locus of control (Brooks & Hallam, 1998; Cienkowski & Pimentel, 2001; Garstecki, 1996; Garstecki & Erler, 1998; A. S. Helvik et al., 2006; Humes, Wilson, & Humes, 2003; Kricos, Erdman, Bratt, & Williams, 2007; Lockey, Jennings, & Shaw, 2010). DHH individuals with high self-confidence, self-esteem, or extroversion are more likely to be constant HA users.

Studies have also pointed to gender as a central factor but the results have been divergent. According to Garstecki and Earler (1998), females seem more likely than males to acknowledge their hearing loss and to use personal amplification devices. Similar conclusions were produced by studies undertaken in Switzerland and in the United Kingdom; women tended to use HA more regularly (Bertoli et al., 2009; Smeeth et al., 2002). A Swedish study also found that, in a sample population of 595 students, girls seemed to use HA to a greater extent than boys (Coniavitis-Gellerstedt, 2006). In contrast, a Norwegian study concluded that elderly males tended to experience fewer barriers to HA use than elderly females (Solheim, 2011).

The degree of hearing loss has been found to predict use or nonuse of HA (Bertoli et al., 2009; Clarke & Horvath, 1979; Kochkin, 2009; Smeeth et al., 2002; Solheim, 2011). According to two older studies, children with profound or mild hearing loss make less use of HA than children who have moderate or severe hearing loss (Clarke & Horvath, 1979; Vesterager & Parving, 1995). Vesterager and Parving’s study included children with profound hearing loss who were using HA. A newer study by Kochkin (2009) drew a similar conclusion; based on a sample of 5000 DHH adults and children, moderate or severe hearing loss was a common characteristic of the HA users.

In addition, older DHH students seem to be less willing to use HA (Clarke & Horvath, 1979; Coniavitis-Gellerstedt, 2006; Wennegren, 2008; Winn, 2006). Wennegren’s (2008) study concluded that nonuse of HA appeared only among the oldest students, who comprised 165 members of the sample. Winn (2006) found that among the 60 participants in his study, there was a progressive decline in the use of HA starting from elementary school and continuing through high school. In a research project involving students ranging from 13 to 19 years old, few HA users were found in high schools, whereas a higher number of HA users were seen in elementary schools (Coniavitis-Gellerstedt, 2006). Older students also tended to use assistive listening devices less frequently than their younger counterparts (Kent & Smith, 2006; Wennegren, 2008; Odelius, 2010). According to Kent and Smith (2006), older students have developed enhanced listening strategies and no longer need microphones.

The age of onset is also claimed to influence the utilization of HA. Early intervention is said to promote more frequent wearing of HA later in life (Gillies, 1997). Another finding supports this claim, which suggests that students fitted with HA early in life appreciated their use more than those who were fitted with HA later on (Rekkedal, 2007). A study of adolescents using CI showed that 38% of those implanted with CI later in life did not wish to be implanted again if their systems failed. None of the adolescent undergoing early intervention with CI shared this view (Wheeler et al., 2007). In contrast, Vesterager and Parving (1995) did not find a relationship between early interventions with HA and use of HA, among the 76 children who participated in their study where the maximum age of onset was 10 years.

Environmental factors such as type of school attended have been associated with the utilization of HA (Clarke & Horvath, 1979; Vesterager & Parving, 1995). Students attending special schools for DHH children use HA more irregularly than DHH children in ordinary schools (Clarke & Horvath, 1979). The form of communication preferred by DHH children,
such as sign or oral language, has also been related to the utilization of HA (Cameron et al., 2008). Another factor reported by Kent and Smith (2006) is the level of support provided by friends and families. Those who perceived affirming or accepting attitudes in their relationships with family and friends were more comfortable with wearing hearing aids.

Technological factors, such as outdated technology or technology in poor working order, seem to hinder utilization (Eriks-Brophy et al., 2006; Luckner & Muir, 2001; Wennergren, 2008). A Swedish study reported that 14% of inductive loop controls did not function properly (Björklund & Sundelin, 2010). Similar results were found in a Norwegian study; approximately 14% of the listening devices were either out of order or used incorrectly (Rekkedal, 2007).

The type of technology and sound quality are also discussed. The past decade has brought tremendous advances in hearing technology (Lockey et al., 2010). As analogue technology has given way to the digital revolution, the arrival of digital HA makes it possible to individually tailor hearing devices to meet individual needs (Banerjee & Garstecki, 2003). Multiple programs are available for diverse listening situations and offer advanced noise reduction strategies as well as reduction of acoustic feedback. CI have also benefited from this technology. However, studies indicate that sound quality still poses a problem. An Australian study, using a sample of 57 young adults with severe to profound hearing loss, revealed that the degree of contentment with the sound quality of HA was significantly related to the utilization of HA (Cameron et al., 2008). Approximately 50% of the nonwearers were dissatisfied with the sound quality, whereas only 13.8% of regular hearing aid wearers felt the same. Bertoli et al. (2008) also found that noisy and disturbing sounds were the most frequently reported problems by adults. This finding indicates that despite advances in digital hearing aid technology and noise suppression algorithms, amplification may fail in a subgroup of HA users.

The option of a direct audio input in new digital HA/CI makes it possible to connect miniature FMs (called MLx receivers) to HA and CI via an audio shoe. Using general induction loops connected to the telecoil in HA and CI, FM technology (with use of MLx receivers) has become a more common practice. In addition to these two sound transmission systems, sound field amplification in which the entire classroom is amplified through the use of one, two, or four wall- or ceiling-mounted loudspeakers (Crandell, Flexer, & Smaldino, 2005) is now offered to DHH students. According to Crandell et al. (2005) sound field amplification improves the learning environment for all students by enhancing the listening conditions. In addition, it can lead to improved student attention spans during teaching sessions (Rosenberg et al., 1999). Because sound field systems improve the learning environment for all students, they may also lessen the embarrassment for DHH users.

Critical technological aspects also include cosmetic issues such as visibility and design. Invisible assistive hearing technologies appear to be preferred over visible ones, both in the case of personal amplifiers and assistive listening devices (Cameron et al., 2008; Kent & Smith, 2006; Luckner & Muir, 2001; Preisler & Tvingstedt, 2005). In particular, older girls preferred less noticeable head-worn CI processors over those worn on the body (Preisler & Tvingstedt, 2005). The potential spotlighting effect of body-worn FM receivers has been seen as a barrier; they were not stylish and singled out hearing-impaired students from their hearing classmates (Luckner & Muir, 2001). Even miniature FM devices have been considered conspicuous and unattractive (Kent & Smith, 2006).

**Analysis Model**

The aim of this study was twofold. The main purpose was to explore predictors that could explain the differences in the dependent variable (i.e., students’ “uses of HA and CI”). The second purpose was to explore predictors that could impact students’ attitudes toward the following: (a) the sound quality of HA and CI, (b) the use of HA and CI, (c) the use of student-worn microphones, and (d) the use of teacher-worn microphones. Because the students’ attitudes toward the personal amplifiers were expected to be related to their use (or nonuse) of HA or CI, their attitudes toward the aides were investigated. The intention was to examine how different independent variables simultaneously affect attitudes toward hearing technology and the use of personal amplifiers.
among DHH children. Use of microphones was not explored, as this factor also depends on the teacher’s utilization of the equipment.

Three categories of independent variables including personal, technological, and environmental aspects were analyzed. Some variables were common to all of the hearing technologies, whereas others were specific to personal amplifiers or to assistive listening devices. The personal variables: (a) gender, (b) age, (c) hearing loss, and (d) students’ self-description were the common variables measured for the users of all hearing technologies. “Age of intervention with HA/CI” was only measured for the HA and CI users because not all students using microphones wore HA or CI. The personal variable “students’ view of the school” was explored for those with assistive listening devices but not to personal amplifiers because the latter are used during the entire day and are not limited to the school environment.

The technological variable that measured the attitudes toward “the sound quality” of the personal amplifiers were based on the type of equipment used (HA or CI). It was expected that the use of either an HA or CI could affect the perception of sound quality. The technological variables tested in terms of the assistive listening devices were the following: (a) technical problems with the microphones and (b) use of a sound field system. Often, technical problems with the microphones negatively impacted the attitudes toward microphones, whereas the use of a sound field system was assumed to be a positive influence, as this system can improve the listening environment for all students, not just for the DHH student (Crandell et al., 2005). Unfortunately, technological aspects, such as the design and visibility of the hearing technologies, were not included in this study, even though several studies have shown that visible technology is more preferable over visible forms (Cameron et al., 2008; Kent & Smith, 2006; Preisler & Tvingstedt, 2005).

The variable related to the environmental aspects was primarily students’ interaction with other DHH children, which was measured among the users of each hearing technology. The support experienced by DHH students from their families and friends is reportedly important (Kent & Smith, 2006), but is not measured here. However, this study assumed that frequent contact with other DHH children could provide support leading to positive acceptance of one’s own hearing loss and bringing about positive attitudes toward the use of hearing technology.

In addition, the study investigated the factors influencing students’ reported use of HAs in terms of frequency. This analysis included two independent variables, attitudes toward HA/CI and sound quality in HA/CI, as well as the six previously listed independent variables related to attitudes toward HA/CI.

**Materials and Methods**

**Subjects and Procedures**

The participants in this study were children with mild to profound hearing loss between 10 and 16 years old. The participants had no intellectual impairments and were educated in inclusive schools. Most DHH students in Norway are in inclusive schools because of the “one school for all” principle. All students, including those with learning difficulties or exceptional abilities in certain areas, are supposed to meet challenges corresponding to their abilities; individual adaptation is regarded as essential targets to providing schooling of equal value, as specified by Norway’s educational authorities.

The participants were recruited from the Assistive Technology Centers (ATCs) and the National Resource Centers for hearing disabilities (NRCH). In each of Norway’s 19 counties there is one ATC that provides assistive technologies free of charge to people of all ages whose functioning in everyday life is considerably and persistently reduced. The associated costs are funded by social security. A different system operates in the case of HA and CI, as these provisions are the responsibility of hospitals (Ravneberg, 2009). Six NRCHs take on the task of helping families, local schools, and municipal authorities to include DHH students in local schools. These centers offer supervision and guidance to individual children and their families as well as programs for municipalities, local schools, and child guidance services (Simonsen, Kristoffersen, Hyde, & Hjulstad, 2009).

Twelve of the 19 ATCs contributed. Because five did not have the capacity to contribute four NRCHs replaced them. Two counties were omitted because they had taken part in a pilot project. In 2009, the ATCs
and NRCHs were asked to list all DHH children born between 1992 and 1998 who had been supplied with assistive listening devices. The centers did not have the ability to identify the DHH students who attended special classes or those with concurrent intellectual disabilities. In all, 557 children were identified, which is fewer than the 790 children estimated to have hearing loss in those counties. Estimates suggest that 0.25% of all children and young people under 20 years old have hearing disabilities, with 10% of those suffering from profound hearing loss (Kunnskapsdepartementet, 2001).

In spring 2009, invitations were sent to the 557 parents. The invitation gave details about the survey and the criteria for participation: (a) no intellectual impairment, (b) use of oral language, and (c) inclusive class enrollment. The subjects could respond with a paper questionnaire, with an Internet-based questionnaire, or in face-to-face interviews with the author. In addition, to information regarding the confidentiality of the research findings, the parents were informed that one child participant could win 130 € and that two children could win 65 €. Of the 557 parents only 187 replied to the informational letters and permitted their children to participate. Ten parents responded that their child did not meet the participation criteria. The author contacted all 187 families, to determine the preferred participation method (i.e., paper questionnaire, Internet-based questionnaire, or face-to-face interview). The study also obtained additional information such as the type of hearing loss (e.g., unilateral deafness) and the age at which the hearing loss was ascertained.

Data were collected from May to December of 2009, and 153 children completed the questionnaire. The distribution of the responses was as follows: 46.8% by paper questionnaire survey, 34.4% by Internet-based questionnaire, and 18.8% through face-to-face interviews. Approximately 65% of the students who had completed the questionnaire online or in paper form stated that they had received help with filling out the form, whereas 35% responded independently. No significant differences (in terms of school grade or degree of hearing loss) were found between those who were assisted versus those who were unassisted. However, fewer students in the Internet group (51%) reported receiving help from their parents, whereas 68% of the students in the paper group were assisted by their parents. The chi-squared test for independence indicated significant associations ($\chi^2 = 9.466$, $p = .009$) between the groups. The majority of the students in the 5th and 6th grades responded either by paper or through face-to-face interviews, whereas the students in the 7th–10th grades more often answered via the Internet. The chi-squared test for independence indicated significant associations ($\chi^2 = 10.955$, $p = .004$) between the students in grades 5 and 6 compared with the students in the upper grades. In addition, slightly more students with severe hearing loss tended to be in the paper and face-to-face groups than found in the Internet group, however, the chi-squared test for independence revealed no significant differences ($\chi^2 = 8.705$, $p = .069$).

The final participation rate was low (28.1%). Information on gender, school grade, degree of hearing loss and family conditions was collected to identify potential biases. Table 1 shows the distributions for school grade, gender, and degree of hearing loss. Fewer students were in secondary schools than in primary schools, and slightly more boys than girls took part in the study. The majority of the students reported being able to hear speech from a distance of 1 m without using an HA, and none of the students selected the fourth category (cannot hear speech from a distance of 1 m while using an HA or CI). A smaller group of students characterized themselves as unable to always hear speech from a distance of 1 m while using an HA or CI, as seen in Table 1. The number of CI users represented approximately 10% of all respondents.

A total of 76.2% of the students lived with both of their parents and 23.8% lived with one parent. According to Norwegian statistics, 75% of all children aged between 0 and 17 years old live in two-parent households (Statistics Norway, 2010b). Research on children with disabilities and family structures found that a slightly higher number of such children live with both parents compared with the general population (Lundeby & Tøssebro, 2008). Of the students, 8.5% reported using a second oral language (in addition to Norwegian), and 6.5% reported using both sign language and spoken Norwegian. The remaining 85% communicated orally and in Norwegian
only. First-generation immigrant children and Norwegian-born children with immigrant parents account for 9% of the population between the ages of 0 and 17 in the participating counties (Statistics Norway, 2010a).

The respondents represented 16 counties in Norway, including both rural and urban areas. The majority of the students (61.8%) were located in the eastern region and in the west coast of Norway. Others resided in southern Norway (14.5%), central Norway (13.9%), and northern Norway (9.8%). When compared with Norwegian statistics on the demographics of the general population, the findings were broadly similar, with the exception of northern Norway (slightly fewer students) and southern Norway (slightly more students).

All data were collected by the author. A pilot trial was first conducted with 2 hearing educators and 12 students (one student was in 2nd grade and the other students were in the 5th, 6th, or 7th grade). The paper questionnaire was expected to take approximately 30–60 min for each participant to complete. The durations of the face-to-face interviews ranged from 30 to 90 min, including short breaks for the youngest cohort of students. All face-to-face interviews took place in the home environment, with the exception of two sessions that were conducted at school.

The Respondents’ Hearing Technologies

Three types of sound transmission systems are provided to DHH students in Norway: (a) microphones combined with an inductive loop system, (b) microphones combined with an FM system, and (c) microphones connected to a sound field system. Each DHH student can be provided with one of the following: (a) a teacher microphone only, (b) a teacher microphone and a limited number of student microphones (1 microphone for every 3–7 classmates), or (c) teacher microphone and a high number of student microphones (1 microphone for every 1–2 classmates). During conversations classmates must press the microphone switch; handheld microphones are most commonly used, but desk microphones are used as well. Both teacher and student microphones must be regularly charged.

Table 2 presents the distribution of assistive technologies used by the children. The number of CI users was low (18). From 1988 to 1998, only 41 children received CI in Norway, in contrast, from 1999 to 2009, this figure reached 382 (Bunne, 2009). The participants in this

Table 1 The distribution of the students (%, N = 153)

<table>
<thead>
<tr>
<th>Boys</th>
<th>52.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>47.1</td>
</tr>
<tr>
<td>Grade 5</td>
<td>21.7</td>
</tr>
<tr>
<td>Grade 6</td>
<td>13.8</td>
</tr>
<tr>
<td>Grade 7</td>
<td>21.7</td>
</tr>
<tr>
<td>Grade 8</td>
<td>15.8</td>
</tr>
<tr>
<td>Grade 9</td>
<td>13.8</td>
</tr>
<tr>
<td>Grade 10</td>
<td>13.2</td>
</tr>
</tbody>
</table>

Degree of hearing loss
- Can without HA hear speech at a distance of 1 m: 58.8%
- Can with HA/CI hear speech at a distance of 1 m: 32.4%
- Cannot always with HA/CI hear speech at a distance of 1 m: 8.8%
- Cannot with HA/CI hear speech at a distance of 1 m: 0%

Note. CI, cochlear implants; HA, hearing aids.

Table 2 Use of assistive hearing technology (%, N = 153)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HA</td>
<td>58.8</td>
</tr>
<tr>
<td>CI</td>
<td>11.8</td>
</tr>
<tr>
<td>No personal amplifiers</td>
<td>29.4</td>
</tr>
<tr>
<td>Teacher microphone</td>
<td>Yes</td>
</tr>
<tr>
<td>No, have never used it</td>
<td>3.3</td>
</tr>
<tr>
<td>No, but have used it before</td>
<td>11.8</td>
</tr>
<tr>
<td>Student microphone</td>
<td>Yes</td>
</tr>
<tr>
<td>No, have never used it</td>
<td>15.4</td>
</tr>
<tr>
<td>No, but have used it before</td>
<td>19.1</td>
</tr>
<tr>
<td>Allocation of student microphones</td>
<td>One microphone per 1–2 students</td>
</tr>
<tr>
<td>One microphone per 3–7 students</td>
<td>38.7</td>
</tr>
<tr>
<td>Sound transmission system</td>
<td>Loudspeaker only</td>
</tr>
<tr>
<td>FM with or without loudspeaker</td>
<td>24.6</td>
</tr>
<tr>
<td>Inductive loop with or without loudspeaker</td>
<td>28.5</td>
</tr>
</tbody>
</table>

Note. CI, cochlear implants; HA, hearing aids.
The majority of the students were supplied with teacher microphones (cf. in Table 2). Most students used loudspeakers as the only sound transmitters, whereas the others used either inductive loops or FM systems both with and without loudspeakers. Approximately 31.3% used only FM or inductive loop systems. These numbers were in line with what the ATC had reported in telephone interviews regarding the systems delivered. Approximately 42% of the ATC reported delivering a sound field system only, an inductive loop, or an FM system only, whereas 23% of the centers could combine sound field amplification with an inductive loop or FM system. Because a relatively high number of centers (35%) had not started to distribute sound field systems either an inductive loop or FM system was the only system utilized. Most students were also supplied with student microphones; whereas the majority had one microphone per one or two classmates, others had one microphone per three to seven classmates (cf. in Table 2).

Table 3 presents the distribution of ages of intervention with HA or CI. Most children received their first HA between 3 and 5 years of age, but a relatively large percentage received their first HA after school age. Of these children 65% characterized themselves as having mild to moderate hearing loss, and 35% reported severe hearing loss. The modal age range for receiving CI was also between 3 and 5 years of age. The age for CI fitting has been reduced during the last 10 years, and the modal age range is now between 1 and 2 years old (Bunne, 2009).

Measures
The survey questions were developed following a review of the relevant literature and information gathered from a pilot project. The dependent variables were the attitudes toward the following: (a) the sound quality of HA and CI, (b) use of HA and CI, (c) use of teacher-worn microphones, (d) use of student-worn microphones, and (e) students’ utilization of HA and CI. The independent variables were organized into the following areas: (a) student-related, (b) environmentally related, and (c) technically related.

Dependent Variables

Satisfaction with the sound quality of HA/CI. The sound quality of HA/CI was measured using the statement I like the sound in my HA/CI. The students responded using a 5-point Likert scale (totally agree, agree, neither disagree/nor agree, disagree, and totally disagree).

Satisfaction with HA/CI. Three attitudinal statements regarding the use of HA/CI were formulated. The statements were as follows: (a) I feel embarrassed when using HA/CI, (b) I am so used to my HA/CI that I do not mind what others think, and (c) I try to hide my HA/CI as much as possible. The rankings for the response options were the same as those for “satisfaction with the sound quality of HA/CI.” Item 2 was recorded with a positive rank. The three items were added to one variable (Cronbach’s $\alpha = .84$).

Satisfaction with student microphones. The respondents experiences with student microphones were measured with five attitudinal statements: (a) I hear my classmates more clearly when using the microphones, (b) I feel embarrassed when my classmates use the microphones, (c) I like that my classmates use the microphones, (d) It is easy for my classmates to use the microphones correctly, and (e) I think that my classmates often joke around with the microphones. The response categories were the same as those for “satisfaction with the sound quality of HA/CI.” Principal component analysis (PCA) based on Kaiser’s criterion was implemented. The KMO did not reach the recommended value .60, but did reach .59. The Bartlett test result was significant. The PCA suggested two factors (eigenvalue = 2.39; 1.03; percent of variance = 47.91; 20.64). The first three items were suggested as one factor with a Cronbach’s $\alpha$ of .73, and...
represent the dependent variable analyzed here (items 1 and 3 were recorded as a positively ranked value). Items 4 and 5 were suggested as the second factor, but Cronbach’s α proved unsatisfactory. Thus, the items were treated as single independent variables that could affect “satisfaction with student microphones.”

**Satisfaction with teacher microphones.** The scales for measuring attitudes toward teacher microphones were similar to the first three statements used in the student microphones category, but the teachers were referred to instead of classmates. The response options were the same as those for “satisfaction with the sound quality of HA/CI.” A PCA suggested only one significant factor (eigenvalue = 2.07; percent of variance = 50.68). The Cronbach’s α of .73 was acceptable for the three statements.

**Utilization of HA/CI.** The utilization of HA and CI was assessed through two variables: How often do you use the HA or CI in the class? and How often do you use the HA or CI during the school breaks? The answer choices included never, seldom, sometimes, almost always and always. The two variables were added together and treated as one variable (Cronbach’s α = .84).

**Independent Variables**

**Gender.** 0 = males and 1 = females.

**Age.** Age was measured through school grade and transformed into a dichotomous variable (0 = secondary school, including grades 8–10, and 1 = primary school, including grades 5–7).

**Hearing loss.** The degree of hearing loss was recorded based on the student self-assessments. Table 1 presents the four response categories. The variable was transformed into a dichotomous variable. The first response category formed one group, and the second and third response categories formed the other group. No students selected the fourth response category.

**Age of onset with HA/CI.** Age of HA/CI fitting was split into six discrete categories: (a) 0–2 years, (b) 3–5 years, (c) 6–7 years, (d) 8–9 years, (e) 10–11 years, and (f) more than 12 years. The variable was transformed into a dichotomous variable (0 = more than 6 years and 1 = 0–5 years).

**Self-description.** The “Self-description Questionnaire” (SDQ II; Marsh, 1990), which was adapted and translated into Norwegian by Skaalvik in 1997, was used in this study (Kvello, 2006). The scale consists of eight items with a Cronbach’s α of .81. An example item is I like myself as I am. The response alternatives were true, slightly true, slightly untrue and untrue.

**Views of school.** A scale developed by Rutter et al. (1979) was adapted and translated into Norwegian by Ogden (1995). It contains 10 items and represents three dimensions: (a) views of schools, (b) social well-being, and (c) further education (Nordahl, 2000; Ogden, 1995). An example of an item on this scale is I usually like to go to school, which measured on a Likert scale with five response alternatives (totally disagree, disagree, neither disagree/nor agree, agree, totally agree). Only one dimension was included in the survey (views of school). The Cronbach’s α of .56 on view of school suggests unsatisfactory reliability and is also lower than the .63 score produced in Nordahl’s study. Nevertheless, the dimension was incorporated into the analysis.

**Quality of teaching.** This variable contains 4 items and has a Cronbach’s α of .71, it was adopted from the Quality of School Life scale developed by Karatzias, Power, and Swanson (Väge, 2007). The scale consists of 14 dimensions, but only the Quality of Teaching dimension was included. An example item is I like the way I am being taught. The response categories were similar to those used for “the views of school” variable.

**Interaction with other DHH children.** Interaction with other DHH children was measured with two variables. The first was How often have you participated in student courses with other DHH children? This variable had response alternatives of never, once, 2–3 times, and 4–5 times. This variable was transformed into a dichotomous variable (never/once = 0 more than 2 = 1), and labeled “participated in courses.” The second variable asked the respondents How often are you together with other DHH children? The response options were seldom or never, once a year, several times a year, several times a month, several times a week, and daily. The variable was renamed “contact with DHH children.”

**Technical problems with teacher microphones.** Technical problems were measured using the statement There is often something wrong with the teacher microphone. The response categories were arranged on a 5-point Likert scale (totally agree, agree, neither disagree/nor agree, disagree, and totally disagree).
Technical problems with student microphones. These problems were assessed using the teacher microphone questions, but “student microphones” was used in place of “teacher microphone.”

Sound field system. 0 = no sound field system, 1 = sound field system.

Use of HA or CI. 0 = HA, 1 = CI.

Analysis

All of the statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 18.0 for Windows (SPSS Inc., Chicago, IL, USA, 2003). The statistical significance level was set at 0.05. Principal component analysis and reliability testing were conducted to evaluate data reduction for the two dependent variables (satisfaction with teacher and student microphones) and the composed independent variables. Cronbach’s α was computed to estimate the internal consistency of all instruments used.

Descriptive statistics, including means and standard deviations, were calculated for the continuous variables. Hierarchical multiple regression analyses enabled the study to explore the variables affecting all of the dependent variables (satisfaction with teacher and student microphones) and the composed independent variables. Prior to the multiple regressions analyses, bivariate regression analyses were performed and only the predictors with significant effects on the dependent variables were included in the multiple regression analyses. Missing data were treated using pairwise exclusions.

Data Screening and Collinearity Diagnostics

Data screening revealed negatively skewed distributions on all of the dependent variables, but this study decided not to transform the variables. The use of collinearity diagnostics in the multiple regression analyses indicated no collinearity on “satisfaction with sound quality of HA/CI” also fell within acceptable boundaries (Durbin–Watson test: 2.12; tolerance: 0.60–0.86; VIF: 1.09–1.64; Cook’s distance <1). The following scores on the variable “satisfaction with teacher microphones” were obtained: Durbin–Watson test: 2.21; tolerance: 0.77–0.99; VIF: 1.00–1.29; Cook’s distance <1. The scores for the variable “satisfaction with student microphones” were as follows: Durbin–Watson test: 2.19; tolerance: 0.72–0.97; VIF: 1.02–1.38; Cook’s distance <1. The figures also lay within the boundaries of acceptance for the variable “utilization of HA” (Durbin–Watson test: 1.82; tolerance: 0.75–0.92; VIF: 1.10–1.32; Cook’s distance <1).

Results

The independent variables were related to personal, environmental, and technological aspects. Some of the personal variables, such as “age of onset with HA/CI” were evaluated only in terms of satisfaction with HA/CI. Similarly “views of schools” were investigated in terms of satisfaction with microphones.

Hierarchal multiple regressions were used to assess the effectiveness of the measures in predicting levels of satisfaction with assistive hearing technologies. Table 4 analyzes the respondents’ satisfaction with the hearing technologies, and Table 5 analyzes utilization of HA. The predictors with insignificant effects on the dependent variables in a preliminary bivariate regression analysis were not included in the multiple regression analyses; in these cases, the cells appear blank, as seen in the tables. Differences emerged with regard to the predictors that had significant effects on particular dependent variables. Finally, the analysis of “utilization of HA” is presented.

Satisfaction With the Sound Quality of HA/CI

The independent variables assumed to affect satisfaction with the sound quality were gender, age, use of HA or CI, hearing loss, age of onset with HA/CI, self-description, contact with DHH children, and participation in courses. In the bivariate regression analyses age of onset with an HA/CI, hearing loss, use of HA or CI, contact with DHH children, and participation in courses appeared to be significant predictors and were implemented in the multiple regression analysis.
With regard to the multiple regression control model for the other variables as seen in column 1 of Table 4, the significant predictors were use of HA or CI (β = .185, \( p < .05 \)), hearing loss (β = .201, \( p < .05 \)), and age of onset with an HA/CI (β = .290, \( p < .01 \)). The students who used a CI tended to be more satisfied with the sound quality and contributed to distributions of 3%. In addition, the students with severe hearing loss or who started using HA before school age were more likely to be satisfied with the sound quality than the students with mild to moderate hearing loss or who were fitted after school age. This unique distribution corresponded to 3% and 7%, respectively, of the total adjusted \( R^2 \). “Participation in courses” and “contact with other DHHH children” was insignificant in the multiple regression analysis.

Almost all 18 students wearing CI were satisfied with the sound quality, except for one who stated “both” because of a new CI in the other ear. Figure 1 illustrates the students’ respective satisfaction levels with the sound quality of CI and HA. A small subset of the students who used HA did not agree with the statement I like the sound in HA, whereas a relatively large group stated “both/or” and the majority agreed. An independent sample \( t \) test was conducted and showed

### Table 4  Multiple regression analysis predicting attitudes to assistive hearing technologies

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Satisfaction with the sound quality of HA/CI</th>
<th>Satisfaction with HA/CI</th>
<th>Satisfaction with teacher microphone</th>
<th>Satisfaction with student microphones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( B ), ( SE ), ( \beta )</td>
<td>( B ), ( SE ), ( \beta )</td>
<td>( B ), ( SE ), ( \beta )</td>
<td>( B ), ( SE ), ( \beta )</td>
</tr>
<tr>
<td>Use of HA or CI</td>
<td>.595 , .297 , .185*</td>
<td>.102 , .060 , .158</td>
<td>.695 , .210 , .290**</td>
<td>.145 , .298 , .048</td>
</tr>
<tr>
<td>Contact with DHHH children</td>
<td>.066 , .235 , .027</td>
<td>.477 , .222 , .201*</td>
<td>.660 , .664 , 231*</td>
<td></td>
</tr>
<tr>
<td>Participated in courses</td>
<td>.066 , .235 , .027</td>
<td>.477 , .222 , .201*</td>
<td>.660 , .664 , 231*</td>
<td></td>
</tr>
<tr>
<td>Hearing loss</td>
<td>.707 , .242 , .390*</td>
<td>.198 , .089 , .028</td>
<td>.265 , .084 , .304**</td>
<td></td>
</tr>
<tr>
<td>Age of onset HA</td>
<td>.695 , .210 , .290**</td>
<td>.168 , .112 , .137</td>
<td>.154 , .108 , .140</td>
<td></td>
</tr>
<tr>
<td>Satisfaction with the sound quality of HA/CI</td>
<td>1.967 , .617 , .278**</td>
<td>.180 , .069 , .227*</td>
<td>.049 , .054 , .084</td>
<td>.084 , .053 , .164</td>
</tr>
<tr>
<td>Gender</td>
<td>.180 , .069 , .227*</td>
<td>.049 , .054 , .084</td>
<td>.084 , .053 , .164</td>
<td></td>
</tr>
<tr>
<td>Self-description</td>
<td>.168 , .112 , .137</td>
<td>.154 , .108 , .140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Views of school</td>
<td>.366 , .182 , .169*</td>
<td>.495 , .187 , .246**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality of teaching</td>
<td>.366 , .182 , .169*</td>
<td>.495 , .187 , .246**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical problems with teacher microphones</td>
<td>.169 , .191 , .083</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical problems with student microphones</td>
<td>.169 , .191 , .083</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classmates often joke around with the student microphones</td>
<td>.169 , .191 , .083</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 )</td>
<td>28.9 (( n = 108 ))</td>
<td>25.6 (( n = 105 ))</td>
<td>16.4 (( n = 123 ))</td>
<td>30.1 (( n = 90 ))</td>
</tr>
</tbody>
</table>

Note. \( B \), unstandardized beta coefficients; CI, cochlear implants; DHH, deaf and hard-of-hearing; HA, hearing aids; \( SE \), standard error. Predictors lacking statistical significance in the bivariate analyses on dependent variables are not given.

\* \( p < .05 \), ** \( p < .01 \).

### Table 5  Multiple regression analysis predicting utilization of hearing aids (HA)

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Utilization of HA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( B ), ( SE ), ( \beta )</td>
</tr>
<tr>
<td>Satisfaction with HA</td>
<td>.417 , .122 , .404*</td>
</tr>
<tr>
<td>Satisfaction with the sound in HA</td>
<td>1.202 , .318 , .445**</td>
</tr>
<tr>
<td>Self-description</td>
<td>−.258 , .102 , −.315*</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>44.8 (( n = 46 ))</td>
</tr>
</tbody>
</table>

Note. \* \( p < .01 \), ** \( p < .01 \).
significant differences in the sound quality scores of the users of CI ($M = 4.72$, $SD = 0.57$) and HA ($M = 3.64$, $SD = 1.11$, $t(104) = −4.01$, $p = .01$). High scores indicate positive attitudes.

Satisfaction With HA/CI

The independent variables measured in the bivariate regression analyses for “satisfaction with the sound quality of HA/CI” were also used in the bivariate regression analyses for “satisfaction with HA.” In addition, “satisfaction with the sound quality of HA/CI” was assumed to explain the differences in satisfaction HA/CI. The bivariate analyses showed that gender, hearing loss, age of onset with HA/CI, self-description, and satisfaction with the sound quality of HA/CI were all significant. These factors were all included in the multiple regression analysis.

Column 2 of Table 4 shows that three predictors hearing loss ($β = .231$, $p < .05$), gender ($β = .278$, $p < 0.001$), and self-descriptions ($β = .227$, $p < .05$) were found to be significant when each factor was controlled for in the analysis. The students with more severe hearing loss appeared to feel more positively towards HA/CI than the students with mild to moderate hearing loss, and contributed to 4% of the adjusted $R^2$. The boys also tended to be more satisfied with HA/CI than the girls, and the distribution for gender was 7% of the total adjusted $R^2$. In addition, the students with positive self-descriptions seemed more satisfied than the students with negative self-descriptions, and comprised 4% of the adjusted $R^2$. No associations were found between this dependent variable and the degree of “satisfaction with sound quality of HA/CI” or “age of onset with HA.”

Satisfaction With Teacher Microphones

The regression analyses using “satisfaction with teacher microphones” as a dependent variable included the same independent variables as the analyses using “satisfaction with HA/CI” as a dependent variable, except that “age of onset with HA/CI” was not included. In addition, the analysis of “satisfaction with teacher microphones” included the independent variables of “views of school,” “quality of teaching,” “technical problems with teacher microphones,” and “use of a sound field system.” The preliminary bivariate regression analyses showed that gender, self-description, views of school, quality of teaching, and technical problems with teacher microphones were significant predictors. Thus, these factors were incorporated into the multiple regression analysis.

For the multiple regression analysis, three variables were significant, as shown in column 3 of Table 4. These variables were gender ($β = .212$, $p < .05$), views of school ($β = .202$, $p < .05$), and technical problems with the microphones ($β = .169$, $p < .05$). The boys tended to be more satisfied with teacher microphones than the girls. The distribution of gender was 4% of the total adjusted $R^2$. The students who had more positive views of school and who had experienced few problems with the equipment indicated greater satisfaction with teacher microphones. These two variables contributed to a unique explanation on 3.5% and 3%, respectively, of the total adjusted $R^2$. The two other variables “self-description” and “quality of teaching” became insignificant when the study controlled for the other predictors.

Satisfaction With Student Microphones

The variables assumed to impact the students’ satisfaction with student microphones were parallel to those affecting teacher microphones satisfaction. In addition,
the independent variable “I think that classmates often joke around with the microphones” was measured. The predictors with significant effects, as shown in the bivariate regression analyses, included gender, self-description, views of school, quality of teaching, errors with the student microphones, and “classmates often joke.” Hence, these predictors were included in the multiple regression analysis.

Column 4 of Table 4 shows the multiple regression analysis for “satisfaction with student microphones.” Significant predictors were gender, views of school, and technical problems with the microphones. In terms of teacher microphone and HA/CI, the boys (β = 196, p < .05) appeared to feel more positively toward student microphones than the girls and comprised 3.3% of the variance in the dependent variable. Similar to satisfaction with teacher microphones “views of school” (β = .305, p < .001) was a central predictor that corresponded to approximately 8% of the adjusted R². Technical problems with the student microphones (β = .246, p < .001) also impacted the students’ satisfaction. Fewer technical problems with the microphones led to higher satisfaction with the student microphones and explained 5.5% of the adjusted R². When these predictors were controlled for the “self-description,” “classmates often joke around . . .” and “quality of teaching” variables became insignificant.

Utilization of HA/CI

Almost all of the students with severe hearing loss and the CI users constantly wore their personal amplifiers in school; consequently, only the students with mild to moderate hearing loss were evaluated with regard to utilization of HA. The mild to moderate hearing loss group using HA comprised 46 students. Approximately 44% of them irregularly or never wore HA during lessons and breaks, whereas 56% almost always or always used them. The main predictors anticipated to affect utilization of HA were satisfaction with HA and satisfaction with the sound quality of the HA. In addition, the independent variables of gender, age, age of onset with HA, self-description, contact with other DHH children, and participation in courses were presumed to have direct effects. Although the preliminary bivariate analyses showed that the girls used HA more regularly than the boys, this difference was not significant. Aside from the students’ satisfaction with HA and their sound quality, only the variable of “self-description” appeared significant in the bivariate regression analyses.

Table 5 shows the multivariate linear regression model, which predicts the outcomes of the dependent variable. All of the variables appeared significant (“satisfaction with wearing HA,” β = .404, p < .01, “satisfaction with the sound quality of HA,” β = .445, p < .001, and “self-description,” β = −.315, p < .05). The students satisfied with wearing HA and with the sound quality seemed more willing to use HA constantly. The prevalence of the two variables was 14% and 17%, respectively, of the adjusted R². The analyses showed that self-description had the opposite effect compared with the students’ satisfaction with HA, low self-description led to greater use of HA whereas high self-description promoted greater satisfaction with HA. This variable explained approximately 7% of the total adjusted R².

Discussion

The present investigation of DHH children’s opinions of hearing technology aimed to explore the factors influencing students’ satisfaction with hearing technologies and utilization of HA. On the basis of findings from other studies, it was assumed that personal, environmental, and technological factors could explain the variations in the dependent variables.

The findings here indicated that all students who wore CI were satisfied with the sound quality of their CI. The students with HA who had severe hearing loss or who were fitted with an HA/CI prior to school age tended to be more satisfied with the sound quality of the HA than the students who had mild to moderate hearing loss or who were fitted after school age. According to several studies, students with CI have integrated them as natural parts of their lives (Preisler & Tvingstedt, 2005; Wheeler et al., 2007). In addition, students with severe hearing loss may be strongly dependent on their HA, which can explain why both groups tended to be more satisfied with the sound quality. The reasons explaining why the students
who are introduced to HA later on became unsatisfied may be connected to the information provided by their parents; for many of the students the hearing loss was first discovered after school age. Hearing loss diagnosed later can have particular implications; sound signals that do not reach the brain will be forgotten over time and can only be reproduced through conscious effort. Furthermore, within the first year, infants experience a reduced ability to perceive differences among phonetic contrasts that are not used or heard in their linguistic environment (Bisgaard, 2008; Olaussen, 2010). Consequently, children who are diagnosed late may not adapt as easily to the sound provided in the HA compared with children who are diagnosed early. Although newborns can now be screened for hearing loss, universal newborn screening protocols do not target hearing loss in the minimal to mild ranges (Johnson et al., 2005), and children with minimal to mild degrees of hearing loss are still not likely to be identified until approximately 5 to 6 years of age (Tharpe, 2007).

The students’ satisfaction with the HA/CI appeared to be related to hearing loss, gender, and psychosocial dimensions. Having severe hearing loss seemed to make students more content with their HA/CI, as other studies have revealed (Bertoli et al., 2009; Clarke & Horvath, 1979; Smeeth et al., 2002; Vesterager & Parving, 1995). In addition, the boys tended to be more positively oriented toward personal amplifiers than the girls. These results contradict those of other studies, where females are reported to accept their hearing loss and to use HA to a greater extent than males (Bertoli et al., 2009; Coniavitis-Gellerstedt, 2006; Smeeth et al., 2002). However, the results of this study are in line with Solheim’s (2011) findings, which found more positive attitudes toward HA among elderly males than among elderly females. Nevertheless, the male effect here may be specific to the young group of children. Furthermore, consistent with other studies that have pointed to psychosocial dimensions as central explanations for attitudes and the use or nonuse of hearing technology, high levels of positive self-description was positively related to the students’ satisfaction with their HA/CI (Cienkowski & Pimentel, 2001; Garstecki, 1996; A. Helvik, Jacobsen, & Hallberg, 2006; Kent & Smith, 2006).

The boys also tended to be more satisfied with both teacher and student microphones than the girls. In addition, the psychosocial dimension measuring the students’ “views of school” was related to satisfaction with the microphones. Interestingly, the students with positive attitudes toward the school were more content with the microphones than the students with negative views. Although hearing loss was related to satisfaction with HA/CI, no differences were found between the students with mild to moderate hearing loss and the students with severe hearing loss in terms of the students’ satisfaction with the microphones. Both teacher and student microphones seemed to be valued by both groups of students. Self-description was not related to satisfaction with the microphones or the “classmates often joke around with the microphones” variable when the other variables were controlled for, even though it would be reasonable to presume that the latter one would have a negative effect on satisfaction with the student microphones. The technical equipment such as sound field systems was thought to promote satisfaction with the assistive listening devices because it may feel less embarrassing for DHH students. However, it did not appear to be associated with the students’ satisfaction with the microphones. Use of the microphones is limited to classrooms, where the students’ hearing loss is probably well known, whereas personal amplifiers are commonly used in daily life, including settings where the students’ hearing loss is unknown; in such situations, the HA/CI may be commented upon by the students’ peers. Kent and Smith (2005) describe two different strategies for handling comments; by ignoring the comments (which would have a constructive effect) or by perceiving the situation as an unwanted and stigmatizing teasing episode. Inherent in stigmatization is a perceived risk of being identified as abnormal, which may impact children’s self-descriptions, as the current study demonstrates; low self-descriptions impacted the students’ satisfaction with the personal amplifiers, but not toward the microphones. Consequently, the type of environment in which the hearing technology is used seems to be essential. However, the assumption that frequent contact with other DHH children could be supportive and lead to positive attitudes toward hearing technologies was not associated with the students’ satisfaction. Accordingly, because the students seemed
to appreciate the microphones frequent technical problems with the microphones contributed negatively to the students’ satisfaction. In total, 30% of the respondents stated that there were often technical problems with the teacher microphones, and 20% stated the same for student microphones. The frequency of technical problems is challenging and should be further explored.

This study revealed that only the students with mild to moderate hearing loss were infrequent HA wearers. Consistent with the findings of other studies, all students with CI used them constantly, and nearly all students with severe hearing loss used their HA regularly at school (Clarke & Horvath, 1979; Vesterager & Parving, 1995). The students with severe hearing loss clearly have less choice concerning the use of their HA. The students in the group with mild to moderate hearing loss who were comfortable with wearing HA (in the sense that they felt less embarrassed or cared less about what other people thought about their HA) were more likely to use them. According to Polgar (2010), individuals who see technology as a visible sign of disability reinforce the stigma associated with disability. Consequently, they avoid using the technology, as these results indicate.

The students satisfied with the sound quality also tended to be consistent wearers of HA. This study revealed that several HA users were more dissatisfied with the sound quality than the CI users, nearly all of whom were satisfied with the sound quality. Cameron et al. (2008) reported similar findings and found that approximately 16% of 57 young adults were dissatisfied with the sound quality of their HA, 30% were unsure, and 53% were satisfied. Others have also pointed to sound quality as the most frequently reported problem by adults (Bertoli et al., 2009). This study seems to support Bertoli et al., who claim that, despite the advances in digital hearing aid technology and noise suppression algorithms, amplification may fail in a subgroup of HA users. In Heeney’s (2007) study, the young participants proposed two recommendations that could improve their satisfaction with personal amplification systems: better access to information regarding hearing aid options and better sound quality in HA. In line with this finding, 43% of the students in the pilot study reported being unfamiliar with their HA options, including the number of applications and what they represented (Rekkedal, 2007). In addition, Heeney reported that several of the adolescents had negative attitudes toward the hearing service providers, with only 64.9% of the respondents feeling that their audiologists cared about their hearing. These issues were not touched upon in this study, but because the sound quality posed a problem for DHH children and impacted their uses of HA, this issue would also benefit from further consideration and investigation.

Surprisingly, although the boys were more positive toward the use of HA, this perception did not seem to have any bearing on their use of HA. Instead, the girls appeared to use HA more regularly, even though they did not appreciate using them. Consequently, the effect resulting from the boys’ satisfaction with the use of HA became unimportant. Although, positive attitudes toward HA influence their use, the psychosocial aspect of self-description had the opposite impact, whereas positive self-descriptions indicated positive attitudes toward HA, a negative self-description predicted constant use in this case. The cause for this relationship is unclear but may be related to gender. The girls generally appeared to have significantly lower self-descriptions that the boys, who rated their self-descriptions higher. Other studies concerning self-esteem and self-descriptions among adolescents describe parallel differences in gender; girls generally rank themselves lower than boys (Gadbois & Bowker, 2007; Moksnes, Moljord, Espnes, & Byrne, 2010). Because the girls in this group tended to use HA more frequently, a lower self-description may be related to constant use; thus, gender can be an underlying factor in understanding DHH students’ uses of HA. The group also differed from the total sample regarding independent variables with impacts on “satisfaction with HA”; gender did not predict any significant differences, whereas “age of onset with HA” appeared to be significantly related in this group. In addition, the number of respondents was low and therefore more difficult to analyze.

A relatively large portion of the students (i.e., approximately 38%) received their first HA after starting their compulsory education. Still, the findings here did not support the argument that having students fitted early on with HA directly influenced their utilizations of HA: rather to a certain degree, the results supported the findings of Vesterager and Parving (1995), who did
not find differences between students fitted early and those fitted late, which may disprove Gillies’s (1997) findings that implicate age of intervention as a main factor. However, age of intervention seemed to have an indirect effect on the utilization of HA in this group; the students who received later interventions with HA tended to feel more negatively about the sound quality of their HA and less satisfied with the HA. This finding indicates that children fitted later with HA may be a group at risk that requires follow-up by professionals.

Students with mild hearing loss are reportedly more often ignored by teachers because they are believed to function more easily and have less need for support services than students with severe hearing loss (Convertino, Marschark, Sapere, Sarchet, & Zupan, 2009). However, poor listening conditions in classrooms can create considerable difficulties for students with mild hearing as well (Antia, Jones, Reed, & Kreimeyer, 2009). In addition, previous findings indicate that these students’ academic levels lag behind their hearing peers’ academic performance (Daud, Noor, Abd Rahman, Sidek, & Mohamad, 2010). Accordingly, professionals should be attentive to this group, as these students use HA more irregularly at school, which may further reduce their abilities to understand classroom communications.

Several studies have pointed to children’s ages as an explanation for the differences in students’ views of and willingness to use HA (Clarke & Horvath, 1979; Coniavitis-Gellerstedt, 2006; Wennergren, 2008; Winn, 2006). The findings here did not show any differences between students in primary and secondary school on students’ satisfaction with assistive hearing technologies or the use of HA. Some studies have shown that the main decrease in use of HA occurs after the transition from elementary to high school (Gellerstedt, 2006; Winn, 2006). In this study, no students at the high school level participated, which may explain the absence of similar findings.

Limitations

Because the study had a low response rate, care should be exercised in the generalizing these findings to the total population of hearing-impaired children. There was a particular focus on the following set of dimensions: (a) personal factors, such as age, and self-description; and (b) technical factors, such as type of equipments, sound quality, and technical problems. These may offer likely explanations for the variances seen in the respondents’ attitudes towards the hearing technologies. If the study had included data on specific audiograms, design, visibility, types of HA and microphones, fuller explanations could have been obtained. Because the effects and causes of the students’ utilizations of HA were difficult to construe care should be exercised in the generalization of these findings. Access to the audiograms may perhaps have improved the explanation of the predictors of students’ utilizations of HA.

Conflicts of Interest

No conflicts of interest were reported.

References


Assistive Hearing Technologies Among Students With Hearing Impairment


