

Academic Success Between Disabling Hearing Loss and Hearing Students in Upper-Secondary: An Inclusive Classroom

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Академичен успех при инвалидизирани със загуба на слух и чуващи от втора степен на средно образование: Една приобщаваща класна стая

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Abstract

Academic performance between disabling hearing loss (DHL) and hearing students is unclear when considering students in the same classroom. The main objective of this study is to identify significant differences in grade by semester between DHL students who study in the same classroom supported by sign language interpreters. Second, this study looks to identify what school subjects show significant differences between DHL and hearing students. $N= 35$ upper-secondary students from a Mexican school with an inclusive educational methodology (deaf and hearings share the same classroom supported by an interpreter) participated in the study ($M = 17$; $SD = 2.2$), $n = 21$ disabling hearing loss students (52% males) and $n = 14$ hearing students were followed during three years (six semesters). The first step was to obtain the previous grade earned in their low-secondary studies. Second, we got the overall rate by semester identifying grades by subject and comparing results between groups. Results indicated significant differences in academic performance, showing higher mastery for DHL students in the fourth and fifth semesters, particularly in computer-logical subjects and social subjects. In conclusion, this research provides evidence that supports the success of an inclusive methodology where DHL and hearing students share the same instructional design supported by a sign language interpreter. Additionally, DHL students performed better in the computer-logical subjects, an important skill daily but even more in the current COVID -19 crisis, as well as a social subject, an important factor suggested by prior evidence.

Keywords: disabling hearing loss, deaf, hearing, upper-secondary, academic performance.

Резюме

Академичните резултати между деактивните със загуба на слух (DHL) и чуващите учащи са неизяснени, когато са в една и съща класна стая. Основната цел на това проучване е да идентифицира значимите разлики в семестриалната оценка между обучаваните от DHL, които учат в една и съща стая, подкрепена от устни преводи на жестомимичен език. Второ, това проучване има за цел да идентифицира кои учебни предмети показват значителни разлики между DHL и слушащите обучаеми. $N = 35$ ученици от втора степен на средно образование от мексиканско учебно заведение с приобщаваща образователна методология (глухи и със слух споделят една и съща стая, подкрепена от преводач), участвали в проучването ($M = 17$; $SD = 2, 2$), $n = 21$ DHL обучавачи се със загуба на слуха (52% мъже) и $n = 14$ обучаеми със слух са били

проследявани през три години (шест семестъра). Първата стъпка бе да се получи предходната оценка, получена в по-ниското им средно образование. Второ, получихме обща семестриална оценка, идентифицирайки оценки по предмети и сравнявайки резултатите между групите. Резултатите разкриват значителни разлики в академичните постижения, показващи по-високо майсторство за обучавани от DHL през четвъртия и петия семестър, особено по компютърно-логически дисциплини, както и по социални дисциплини. В заключение, това изследване предоставя доказателства, които подкрепят успеха на една приобщаваща методология, ако DHL и чуващите споделят един и същ дизайн на обучението, подкрепен от преводач на жестомимичен език. Освен това обучаемите от DHL се представиха по-добре в компютърно-логическите дисциплини – умение, важно ежедневно, но още повече при настоящата криза COVID 19, както и в социална дисциплина, предложена на базата на предишни доказателства като важен фактор.

Ключови думи: DHL със загуба на слух, глухи, чуващи, втора степен на средно образование, академични постижения

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Disabling hearing loss (DHL) is a health disability where a person cannot hear and normal hearings, considering a hearing threshold of 25 dB. Hard of hearing refers to people with hearing loss ranging from mild to severe (World Health Organization (WHO), 2020). The etiology of hearing disorders includes multiple causes: hereditary and congenital malformations, infections during pregnancy, complications during the perinatal period, otitis, noise, trauma, Meniere's disease, tumors, cerebrovascular disease, aging, etc. (Garcia et al., 2013).

Besides, more work is needed to understand what is happening in low and middle-income countries because most people with DHL live in these countries (WHO, 2020). Particularly in Mexico, 7,877,805 persons (6.3%) of the population were reported with disabilities in 2018, showing an increase of 0.3% compared to 2014 (Instituto Nacional de Estadística y Geografía (INEGI), 2018), and people with DHL represent 18.4% of persons with disability. Although the highest percentage of people with some type of disability occurs in adults over 60 years, a significant increase in people between 10-19 years old has been reported recently (INEGI, 2018), showing inequalities for DHL people in the public or private education. It's worth mentioning that high-school serves as the final stage of learning and training for the university's graduate. Also, it is possible to be the last step before the insertion of young people into the labor force (Instituto Nacional para la Evaluación de la Educación (INEE), 2018).

However, the importance of studying more about DHL figures for attention in social and educational inclusion (Antia, 1996) should promote access to school learning on equal terms with their hearing peers. This means offering a similar curriculum considering the necessary adaptations, making it possible for the deaf student to truly understand and participate in classroom situations because some evidence refers that deaf individuals who attend special courses outside public schools perform even better than hearing students (i.e., previous studies about reading comprehension have not shown significant differences between deaf and hearing students who attend the same school) (Piper et al., 2019). Based on the beforehand mentioned, there is growing evidence suggesting the importance of social interaction between DHL and hearing students because this interaction promotes situations that foster the establishment of friendly relationships with other DHL and hearing companions

and promotes the harmonious development of their personality, helping to the students to grow in a bi-cultural (also bi-lingual) environment (Dominguez et al., 2009).

Certainly, considering an inclusive education in the same classroom for disabling hearing loss and hearing students draw important challenges because DHL students require special help in the educational environment (Fernandez & Villalba, 1996). One of the most important needs is sign language (SL) support in the classroom due prior evidence has demonstrated that in some cases, natives sign language can develop as well as hearing in the educational environments (Gaceta de la Cámara de Diputados, 2001). Especially in the classroom, sign language facilitated by interpreters is an essential support service in the learning process (Marschark et al., 2006). Sign language also appears to have important repercussions on language acquisition, including the relationship between deaf students and their environment (Corvera & Gonzalez, 2000).

Nonetheless, in Mexico, public policies do not reflect the inclusion of deaf students in the same environment as hearings. Historically, public and private education has been centered on oral education. Thus, deaf students have few or no possibilities to be included in the standard education system in addition to a lack of interest in sing languages (Gaceta de la Cámara de Diputados, 2001).

On the other hand, evidence about academic performance between deaf and hearing persons is unclear, but there is evidence that academic performance is a reliable measure to compare groups. Cascon (2000) considered that the mean of school grades is a reliable and valid value to measure academic performance, while Nivia and Valles (2014) mention that the act of evaluating deaf and hearing people should not be different, and grades is an impartial way to do that. Edel (2003) found that school grades are considered the predictive variable most used by teachers and researchers to approximate academic performance, likewise conceptualizes academic performance as a construct capable of adopting quantitative and qualitative values related to other variables such as knowledge, attitudes, and values developed by the student in the teaching-learning process.

Based on the beforehand mentioned, this study aims to identify significant differences in grade by semester between DHL (hard hearings) and hearing upper-secondary students who studied in the same classroom supported by sign language interpreters for DHL students. Second, this study looks to identify what subjects show significant differences between DHL and hearing students.

Finally, the hypothesis proposed for this study establishes that normal hearings will not perform significantly better than deaf students in any semester, considering just as much disabling hearing loss and hearing students share the same classroom.

Method and materials

The present work is a longitudinal study considering two different groups. Students were taken for one of the few high-Schools in the whole state with an inclusive program in which DHL and hearing persons take courses in the same classroom, supported by Mexican Sign Language interpreters for the DHL students.

Participants

$N = 35$ students ($M = 17$; $SD = 2.2$), $n = 21$ DHL students (52% males) and 14 hearings (57% males, participated voluntarily in the study after signing an informed consent. Thirteen students who drop out was considered as missing values and they were not included in the final analysis ($48 - 13 = 35$ final sample).

Procedures

Students were followed up during six semesters from the first until the last course. The first step was to identify the students' previous grade in their lower-secondary studies to determine differences when starting upper-secondary. For the analysis, the independent t-test was calculated. We followed up the academic performance of all students obtaining the grade average by semester and the grade obtained in each subject for those semesters, which showed significant differences between groups. Afterward, we determine significant differences between DHL and hearing students calculating the Mann-Whitney U Test between grade averages. An additional Mann-Whitney U Test was calculated considering each subject (see Table 1).

Results

The grade obtained by DHL and hearings in their lower-secondary studies did not show significant differences ($p = 0.54$). This data was essential to discard significance due to prior grade values.

Looking for differences between groups in each semester, Table 1 shows significant differences for the 4th ($M_1 = 81.27$; $M_2 = 72.17$; $p = 0.00$) and 5th semester ($M_1 = 80.98$; $M_2 = 64.76$; $p = 0.04$).

Table 1

Descriptive and differences between deaf and hearing groups

Semester	Deaf		Hearing		Mann-Whitney <i>U</i> Test	
	M	SD	M	SD		
1st	83.76	6.74	78.52	10.23	38.00	0.80
2nd	85.19	9.06	86.86	8.32	115.00	0.46
3rd	83.22	11.48	80.48	12.92	60.00	0.26
4th	81.27	9.98	72.17	11.62	33.00	0.00
5th	80.98	7.81	64.76	11.26	41.00	0.04
6th	78.20	12.05	79.07	11.53	84.00	0.66

Particularly, for the 4th semester (Table 3) DHL students obtained higher significant scores than hearings in COFE ($M_1 = 82.43$; $M_2 = 63.23$; $p = 0.00$), COBD ($M_1 = 75.42$; $M_2 = 70.93$; $p = 0.02$), and AFEO ($M_1 = 85.36$; $M_2 = 74.56$; $p = 0.00$). While higher significant scores were found between DHL students and hearings in INSO ($M_1 = 80.43$; $M_2 = 54.40$; $p = 0.00$), IRLO ($M_1 = 78.77$; $M_2 = 46.89$; $p = 0.01$), PSGB ($M_1 = 79.01$; $M_2 = 52.21$; $p = 0.00$), and ADSI ($M_1 = 79.89$; $M_2 = 52.70$; $p = 0.00$) (See Table 4). For more details about each subject and the code used see Table 2.

Table 2

Subjects in 4th and 5th semester with code

	4 th semester
CIIN	Independent communication in English
COFE	Contextualization of social, political, and economic topics
TADA	Processing of data and random events
COBD	Database development
PROO	Object-oriented programming
AFEO	Analysis of electrical, electromagnetically and analysis of optic topics
PROS	Software planning

	5 th semester
CPIN	Productive communication in English
INSO	Interpretation of norms for social interaction
FEMP	Entrepreneurship education
IRLO	Installation of local area networks
MPAD	Administrative process management
PSGB	Coding with database management systems
AIND	Derivative análisis of functions
ADSI	Analysis and design of information systems

Table 3

Descriptive and significant differences by subjects in 4th semester

	Deaf		Hearing		Mann-Whitney <i>U</i> Test	<i>P</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
CIIN	79.24	8.48	69.54	14.72	65.00	0.10
COFE	82.43	10.01	63.23	23.58	38.00	0.00
TADA	74.19	10.29	66.45	24.48	87.50	0.47
COBD	75.42	10.74	70.93	5.58	50.50	0.02
PROO	93.96	6.47	87.88	11.69	73.50	0.19
AFE0	85.36	10.34	74.56	3.08	39.50	0.00
PROS	78.32	6.93	72.60	9.44	65.00	0.10

Table 4

Descriptive and significant differences by subjects in the 5th semester

	Deaf	Hearing	<i>M</i>	<i>SD</i>	Mann-Whitney <i>U</i> Test	<i>P</i>
	<i>M</i>	<i>SD</i>				
CPIN	83.41	11.26	76.11	33.99	92.00	0.93
INSO	80.43	9.73	54.40	31.46	28.00	0.00
FEMP	87.51	5.09	61.73	36.52	35.00	0.01

	Deaf	Hearing				
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	Mann-Whitney <i>U</i> Test	<i>P</i>
IRLO	78.77	11.26	46.89	35.28	35.00	0.01
MPAD	81.03	8.13	62.39	35.42	74.00	0.37
PSGB	79.01	13.55	52.21	29.81	29.00	0.00
AIND	77.82	8.73	59.89	34.51	91.00	0.89
ADSI	79.89	7.44	52.70	27.11	15.50	0.00

Discussion

Results from our study propose that scores in performance between DHL students and hearing ones do not necessarily indicate lower mastery for the first group differing from previous studies (i.e., Andin et al., 2014). On the contrary, our results appear to confirm Moreno-Pérez et al. (2015) confirm that there is a minority of deaf persons who achieve equivalently (or even better) than hearings. It is important to note that based on the results, DHL students performed better than hearings in computer-based and logical thinking courses (database development, installation of local area networks, coding with database management systems, analysis and design of information systems, analysis of electrical, electromagnetically and analysis optic). This point is relevant because, precisely, a great majority of digital information remains inaccessible to deaf individuals (Harkins & Bakke, 2011). Our results support the evidence by Maiorana-Basas and Pagliaro (2014). They indicate that the DHL community could be more closely aligned to the general population. Also, evidence about the ability of DHL people in digital skills is a relevant finding in the current health situation we are living consistent with Adam (2020). He mentioned that DHL people around the world had found communication quite challenging during COVID-19 because what successfully was accessible before COVID-19 has been brought with it access restrictions.

Our analysis indicated that DHL also performed better than hearings in social-learning courses (contextualization of social, political, and economic topics, and norms for social interaction, and entrepreneurship education) a very relevant topic in the personal and professional life of the DHL students, especially, the social interaction and the social acceptance in good agreement with Antia and Kreimeyer (2019).

Due we did not measure the feeling of inclusion or the interpreter's role directly in the learning processes, we only can assume that the integration of DHL students in the same classroom as hearings could result in a positive practice. Prior evidence has demonstrated that when individuals with disabling hearing loss who are enrolled in an oral deaf education since childhood may benefit from a meaningful educational experience (Noll, 2007). It appears applicable to the high-school where integrative DHL students reveal the importance of socializing with friends and participation in after-school activities in addition to the importance of the teacher understanding of sign language (Mertens, 1989), and the benefits of a sign language interpreter in the classroom (Marschark et al., 2006). Finally, this study reveals the importance of introducing inclusive methodologies for DHL students in the classroom in line with Cawthon (2001) even more than the consideration of segregated education for persons with DHL, which is the preponderant model in Mexico.

Conclusions

In conclusion, this study provides evidence indicating that DHL students can gain mastery better than hearing in diverse school subjects in contradiction with some previous research. Especially, results showed that an educational model that promotes the integration between DHL and hearing students could help DHL to perform well. It could lead to developing social skills in DHL students in contradiction to the current educational exclusion policies considered by the government named as "special education," which probably are not the way to solve the educational inequality in the DHL population. Finally, results showed that DHL students performed higher in computational-logical subjects and social subjects, which need more attention in the DHL population's educational curricula. Particularly, accepting that DHL persons are technology skilled could help in challenges such as the current health crisis imposed by the COVID-19 providing more digital resources to the DHL persons. Nonetheless, more research is necessary to identify the valuable use of an educational model that considers the effectiveness of the integration of disabling hearing loss and hearing students in the same classroom with the same instructional design as well as to understand the role of the sign language interpreters in the classroom.

References

Adam, R. (2020). *Sign languages and deaf people during Covid-19: How you can help in the classroom*. Cambridge University Press.

- <https://www.cambridge.org/elt/blog/2020/09/22/sign-languages-and-deaf-people-during-covid-19-how-you-can-help-in-the-classroom/>
- Andin, J., Rönnerberg, J., & Rudner, M. (2014). Deaf signers use phonology to do arithmetic. *Learning and Individual Differences*, 32, 246-253.
<https://doi.org/10.1016/j.lindif.2014.03.015>
- Antia, S. D., & Kreimeyer, K. H. (1996). Social interaction and acceptance of deaf or hard-of-hearing children and their peers: A comparison of social-skills and familiarity-based interventions. *Volta Review*, 98(4), 157-180.
- Cascón, I. V. (2000). Análisis de las calificaciones escolares como criterio de rendimiento académico [Analysis of grades as academic performance]. <https://goo.gl/fxPAGs>
- Cawthon, S. W. (2001). Teaching strategies in inclusive classrooms with deaf students. *Journal of Deaf Studies and Deaf Education*, 6(3), 212-225.
<https://doi.org/10.1093/deafed/6.3.212>
- Corvera, J., & González, B. (2000). Psicodinamia de la sordera [Psicodinamia of deaf]. *Gaceta Médica de México*, 136(2), 139-152.
- Domínguez, A.-B., Pérez, I., & Alegría, J. (2012). La lectura en los alumnos sordos: Aportación del implante coclear. *Infancia y Aprendizaje* [Reading ind deaf students: Contribution of cochlear implant]. 35(3), 327-341.
<https://doi.org/10.1174/021037012802238993>
- Edel, R. (2003). El rendimiento académico: concepto, investigación y desarrollo [Academic performance: concept, research and development]. *REICE Revista Electrónica Iberoamericana sobre Calidad, Eficacia y Cambio en Educación*, 1(2).
<http://goo.gl/Qy3d90>
- Fernández, J. A., & Villalba P.A., (1996). *Atención educativa de los alumnos con necesidades educativas especiales derivadas de una deficiencia auditiva* [Educational attention of students with educational special needs releases from hearing impairment]. Generalitat Valenciana.
- Gaceta de la Cámara de Diputados (2001, November 14). *De ley federal de la cultura del sordo* [Of Federal Law of deaf culture].
http://sil.gobernacion.gob.mx/Archivos/Documentos/2001/11/asun_986_20011113_831294.pdf

- García, F., Penaloza, Y. R., & Poblano, A. (2003). Los trastornos auditivos como problema de salud pública en México [Hearing disorders as a public health problem in Mexico]. *Anales de Otorrinolaringología Mexicana*, 48(1), 20-29.
<https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=20328>
- Mendelsberg-Fishbein, P., Márquez-Ávila, C.S., García-Delgado, C., Sánchez-Boiso, A., Rodríguez-Espino, B.A., Vázquez-Martínez, E.R., Roque-Lee, G., Ortiz-Rodríguez, S., Fierro-Evans, M.Á., Castillo-Castillo, S., López-Mosqueda, R., García-Rivera, P., Flores-Venegas, A.L., Aguirre-Hernández, J., Cervantes-Peredo, A., Morán-Barroso, V. F. (2013). Importancia del diagnóstico de mutaciones en el gen de la conexina 26 en el manejo integral de la sordera congénita no sindrómica [Congenital deafness in Mexico]. *Boletín Médico del Hospital Infantil de México*, 70(2), 89-97.
<https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=40573>
- Harkins, J. E., & Bakke, M. (2011). Technologies for communication: Status and trends. In M. Marschark & P. E. Spencer (Eds.), *Oxford handbook of deaf studies, language, and education* (2nd ed., Vol. 1, pp. 425– 438). Oxford University Press.
- Instituto Nacional de Estadística y Geografía (2018). Encuesta Nacional de la Dinámica Demográfica ENADID 2018 [National Survey of of Demographic Dynamic ENADID 2018].
https://www.inegi.org.mx/contenidos/programas/enadid/2018/doc/resultados_enadid18.pdf
- Instituto Nacional para la Evaluación de la Educación (2018). La educación obligatoria en México: Informe 2018 [The mandatory education in Mexico: Inform 2018].
<https://www.inee.edu.mx/wp-content/uploads/2018/12/P1I243.pdf>
- Maiorana-Basas, M., & Pagliaro, C. M. (2014). Technology use among adults who are deaf and hard of hearing: A national survey. *Journal of Deaf Studies and Deaf Education*, 19(3), 400-410. <https://doi.org/10.1093/deafed/enu005>
- Marschark, M. Leigh, G., Sapere, P., Burnham, D., Stinson C., Knoors, H., Vervload, M. P. J., and Noble, W. (2006). Benefits of sign language interpreting and text alternatives for deaf students' classroom learning. *Journal of Deaf Studies and Deaf Education*, 11(4), 421-437. <https://doi.org/10.1093/deafed/enl013>
- Mertens, D. M. (1989). Social experiences of hearing-impaired high school youth. *American Annals of the Deaf*, 134(1), 15-19. <https://doi.org/10.1353/aad.2012.0633>

- Moreno-Pérez, F. J., Saldana, D., & Rodríguez-Ortiz, I. R. (2015). Reading efficiency of deaf and hearing people in Spanish. *Journal of deaf studies and deaf education*, 20(4), 1-11. doi: 10.1093/deafed/env030
- Noll, D. L. (2007). Activities for social skills development in deaf children preparing to enter the mainstream. *Independent Studies and Capstones*, Paper 256. Program in Audiology and Communication Sciences, Washington University School of Medicine. http://digitalcommons.wustl.edu/pacs_capstones/256
- Noll, Dorie L., "Activities for social skills development in deaf children preparing to enter the mainstream" (2007). *Independent Studies and Capstones*. Paper 256. Program in Audiology and Communication Sciences, Washington University School of Medicine. http://digitalcommons.wustl.edu/pacs_capstones/256
- Nivia, D. & Valles, B. (2014). Una aproximación a los fundamentos de la evaluación de la comprensión de la lectura en sordos [An approach to the fundamentals of the evaluation of the reading comprehension in deaf persons]. *Lenguaje*, 42(2). <http://www.scielo.org.co/pdf/leng/v42n2/v42n2a03.pdf>
- Piper, B., Bulat, J., Kwayumba, D., Oketch, J., & Gangla, L. (2019). Measuring literacy outcomes for the blind and for the deaf: Nationally representative results from Kenya. *International Journal of Educational Development*, 69, 1-8. <https://doi.org/10.1016/j.ijedudev.2019.05.002>
- World Health Organization (2020, March 1). *Deafness and hearing loss*. <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>