Original Article

http://doi.org/10.1590/2317-6431-2016-1766

Audiology Communication Research
ISSN 2317-6431

Classroom acoustical screening survey worksheet: translation and cultural adaptation into Brazilian Portuguese

Planilha de triagem acústica da sala de aula: tradução e adaptação cultural para o Português Brasileiro

Aline Duarte da Cruz[1], Thais Corina Said de Angelo[2], Andréa Cintra Lopes[3], Diego Martins Pinto Guedes[1], Tacianne Kriscia Machado Alves[1], Vanessa Luísa Destro Fidêncio[1], Adriane Lima Mortari Moret[3], Regina Tangerino de Souza Jacob[3]

ABSTRACT

Introduction: In the school environment, teachers feel uncomfortable when teaching in noisy classrooms and realize the difficulty of students in hearing the information, what makes the noise, not just an annoyance, but also an aggravating factor that interferes with school performance. Therefore, appropriate acoustic conditions to the educational environment are indispensable. Currently, there is no standardization of the methodology that should be used to measure the acoustic characteristics of classrooms. **Purpose:** Translating and adapting into Brazilian Portuguese the "Classroom Acoustical Screening Survey Worksheet" protocol. **Methods:** The translation and adaptation of the protocol have included the translation into Portuguese, linguistic adaptation, and grammar and idiomatic equivalences revision, as well as the content validation by means of two steps: individual evaluation and meeting of specialists. **Results:** The protocol was translated and adapted into Portuguese. The protocol presented content validity, and after the appreciation and consensus of the experts, it was showed that the cultural adaptation of content was evident and objective, making possible to apply it in Brazilian classrooms. **Conclusion:** "Classroom Acoustical Screening Survey Worksheet" protocol was translated and adapted into Brazilian Portuguese, and named "*Planilha de triagem acústica da sala de aula*." Further studies should investigate its applicability and effectiveness in observing the acoustic characteristics of the classroom in the national scenario.

Keywords: Schools; Noise; Signal-to-noise ratio; Acoustics; Protocols

RESUMO

Introdução: No ambiente escolar, os professores sentem-se incomodados em ministrar aulas em salas ruidosas e percebem a dificuldade dos alunos em ouvir a informação, constatando, assim, que o ruído não é apenas um incômodo, mas também um fator agravante, que interfere no rendimento escolar. Portanto, são imprescindíveis condições acústicas adequadas para o ambiente educacional. Atualmente, não há padronização da metodologia que deve ser utilizada para mensurações das características acústicas das salas de aula. **Objetivo:** Traduzir e adaptar para o Português Brasileiro o protocolo *"Classroom Acoustical Screening Survey Worksheet"*. **Métodos:** A tradução e a adaptação do protocolo incluiram tradução para o Português, adaptação linguística e revisão da equivalência gramatical e idiomática, assim como a validação de conteúdo, por meio de duas etapas: avaliação individual e reunião entre os especialistas. **Resultados:** O protocolo foi traduzido e adaptado para o Português, resultando no instrumento "Planilha de triagem acústica da sala de aula". O protocolo apresentou validade de conteúdo e, após apreciação e consenso dos especialistas, mostrou que a adaptação cultural do conteúdo foi clara e objetiva, sendo possível aplicá-la à realidade das salas de aula brasileiras. **Conclusão:** O protocolo "*Classroom Acoustical Screening Survey Worksheet*" foi trazido e adaptado para o Português Brasileiro, sendo nomeado "Planilha de triagem acústica da sala de aula". Estudos futuros deverão investigar sua aplicabilidade e efetividade na observação das características acústicas das salas de aula no cenário nacional.

Palavras-chave: Instituições acadêmicas; Ruído; Razão sinal-ruído; Acústica; Protocolos

This study was carried out at Department of Speech-Language Pathology and Audiology, Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.

(1) Program of Post-Graduation in Speech-Language Pathology and Audiology, Department of Speech-Language Pathology and Audiology, Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.

(2) Clinic of Speech-Language Pathology and Audiology, Department of Speech-Language Pathology and Audiology, Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.

(3) Department of Speech-Language Pathology and Audiology, Bauru School of Dentistry, Universidade de São Paulo – USP – Bauru (SP), Brazil.

Conflict of interests: No

Authors' contribution: *ADC*, *TCSA*, *ACL*, *DMPG*, *TKMA* and *VLDF* were responsible for the production and writing of the paper. *ALMM* was responsible for the writing and correction of the paper. *RTSJ* was the research supervisor and responsible for the correction of the paper. All authors participated in the writing and analysis of the paper.

Corresponding author: Regina Tangerino de Souza Jacob. Email: reginatangerino@usp.br

Received: 9/12/2016; **Accepted:** 11/23/2016

INTRODUCTION

Evaluating the acoustic characteristics in classrooms for students with hearing impairment is of extreme importance, once in the school environment, the noise is not only an annoyance but also interferes with the performance of teaching activities[1,2].

The noise and its effects on the human organism have been arousing interest in various areas related to education and health[3]. The audiologist has studied the noise, focusing on the hearing loss that may be caused by exposure and its consequences, acting in prevention, detection, and rehabilitation of such loss[4].

In the school environment, teachers feel uncomfortable teaching in noisy classrooms and realize the difficulty of students in hearing the information, as well as the dispersion of their attention. The most frequent reports of teachers concerning noise in the classroom are: feeling uncomfortable in teaching in noisy classrooms; presenting voice problems by intense vocal effort; students difficulty in hearing the teacher speech and their dispersion; all of them harming the learning and the welfare[5,6].

The noise may cause stress, difficulty of concentration, delay of neuropsychomotor development, aggressiveness, and low performance. The noise found in classrooms and schoolyard, if compared with the Brazilian Society of Otolaryngology data, present the same levels of noise caused by an intense traffic, a racing car or an underground train, which ranges between 80 and 110 dB, showing that certainly these values are neither appropriated to school environment, nor to children's physical and mental health in this learning phase, nor to the other professionals at the school[7].

A study that evaluated classrooms of nine public schools, in Belo Horizonte (Brazil), concerning the measurement of acoustic parameters of Leq, reverberation time (T30) and the Speech Transmission Index (STI), concluded that such parameters are out of the required standards by international rules for the appropriate acoustic condition in education[1].

The noise caused by internal sources (talking, furniture, equipment) and by external sources (traffic, people traffic, proximity to urban centers) stand over the recommended values by the Brazilian Association of Technical Standards (ABNT) and by the World Health Organization (WHO). Thus, the performance in the teaching-learning process suffers interference, once does not exist a favorable environment for concentration and speech understanding[8].

The Brazilian Association of Technical Standards, by means of the rule NBR 10152 of 1986[9], regulates the noise levels inside classrooms, considering the recommended values between 40 dB(A) and 50 dB(A). Regarding the appropriate reverberation time, there is no specific standardization for classrooms. In the rule NBR 10152, the required conditions for the evaluation of noise acceptability in communities are stated, and also the maximum levels of noise in diverse environments are established. Therefore, appropriate acoustic conditions for the educational environment are indispensable[10].

The American National Standard Institute (ANSI/ASA S12.60)[11] recommendations establish 35 dB(A) as the maximum value of noise level inside classrooms; the signal-to-noise ratio (SNR) must be of at least +15 dB, and the reverberation time must not exceed 0.6 seconds.

Nowadays, there is no standardization of methodology to be used for measurements of acoustic characteristics of classrooms[12]. It is important that schools are instructed about acoustic adequacy for classrooms, once the acoustics characteristics may interfere with the learning process.

It is fundamental that the Audiologist knows the school reality of the student for the instrumentation of the Audiologist in order to demonstrate the impact of hearing loss in the communication and learning processes[13,14].

In the international literature, the "Classroom Acoustical Screening Survey Worksheet"[14] is available; a screening instrument that may assist the professionals in the acoustic measurement of the educational environment, which is observed as a quick and easy tool to apply[13,14,15].

The instrument[14] is subdivided into topics. The first part is directed to observation and general information of the classroom, through questions that address: classroom dynamics (1A); background noise (1B); reverberation time (1C); and the presence of accessibility equipment (1D). The second part is related to information derived from the measurement, for example, item 2A, concerning the noise, which can be evaluated by means of a Sound Pressure Level Meter or by using the applications available for smartphones. Item 2B, concerning the reverberation, which suggests the use of applications available for smartphones or web programs that calculate the RT-60. Item 2C, concerning the Critical Distance estimate, which can be obtained through the values of the classroom volume and the reverberation time obtained in the previous measurements.

This study aimed to translate and cross-culturally adapt into Brazilian Portuguese the "Classroom Acoustical Screening Survey Worksheet" protocol[14].

METHODS

The translation and cross-cultural adaptation of the "Classroom Acoustical Screening Survey Worksheet" protocol[14] into Brazilian Portuguese were based on the steps indicated by other studies[16,17,18] as the following description.

Translation of the questionnaire into the Brazilian Portuguese language

The instrument, in the original version, was given to two translators, both fluent in English, who knew neither each other nor the protocol, aiming to elaborate individually and stealthily

the first version into Brazilian Portuguese. This procedure was performed in order to create two independent translations of the protocol.

Linguistic adaptation

The review group was composed by two Audiologists (both Brazilian and fluent in English), who analyzed the two resultant documents and minimized the differences between the translations, adapting the text to the Brazilian culture. Then, a new inventory was obtained, named, in Portuguese, *"Planilha de triagem acústica da sala de aula."*

Grammar and Idiomatic equivalences review (back-translations)

In order to examine the grammar and idiomatic equivalence, one copy of the protocol was sent to two other translators with the same cultural and linguistic conditions as those in the first phase. These – both unfamiliar with the original text – performed a new version of the instrument back into English language. The same review group completed a new assessment of both resultant versions, comparing them with the original one in English.

Cross-cultural adaptation

The purpose of this phase was to establish cultural equivalence between the English and the Portuguese versions of the protocol. Cultural equivalence is established when comprehension difficulties of the questions performed were not observed by, at least, 80% of the assessment researchers.

A script with the protocol items and the following evaluation criteria was used: organization, scope, objectivity, and relevance. In this process, the final version was sent to six Audiologists in order to verify the translation into Brazilian reality. After the evaluation feedback, the compilation of the responses and alterations suggested was realized, and each participant expressed their opinion due to the items, coming all to the consensus.

The "*Planilha de triagem acústica da sala de aula*" was divided into two parts and subdivided into topics. The first one collects general information from the classroom, such as classroom dynamics (1A); background noise (1B); reverberation time (1C); and the presence of accessibility equipment (1D).

Item 1A presents observational questions about the dynamics of classrooms. Items 1B and 1C are composed of questions with following answer options: "yes" or "no"; these are suggestive aspects of high levels of noise or reverberation time when an affirmative response is marked. Therefore, if there are many affirmative answers, the Audiologist may suggest modifications and preventive measures in classrooms in order to reduce noise and reverberation. Item 1D (auxiliary equipment) indicates the presence of students with hearing impairment, users of Frequency Modulation System (FM System), or even the indication of FM System use in soundfield for the school, through orientations to the principals, coordinators, and teachers.

The second part is related to information resulting from the specific measurement for items 2A (noise), 2B (reverberation) and 2C (critical distance), collected through measurements carried out by means of applications for smartphones or software quoted in the worksheet. It is indicated for the analysis of the results, the Brazilian standard for noise[9], and the international standard for reverberation time [11] since there is no national regulation.

The classroom acoustic screening worksheet provides a survey of the acoustic characteristics of the environment, which may assist the Audiologist, and also may be used as basis and guide for instructions and adjustments that may be necessary.

RESULTS

Content validation was carried out by means of the individual evaluation and meeting among six specialists, after approval and final consensus of the following evaluated items: organization, scope, objectivity, and relevance of the screening protocol. The protocol has presented validity of content and showed that content adaptation was evident and objective, reaching 100% of comprehension of the items in the protocol.

After evaluation and consensus of the participating specialists, only the item "Portable/Relocatable Classroom," included in the item "Classroom Style" (1A), was removed taking into consideration that Brazilian schools do not present this class modality. There was no suggestion of modification regarding this vocabulary for reaching cultural equivalence.

The translation and cross-cultural adaptation of the "Classroom Acoustical Screening Survey Worksheet" protocol[14] resulted in the instrument named "*Planilha de triagem acústica da sala de aula*" (Appendix 1) with the same number of questions in the original version.

DISCUSSION

The cross-cultural adaptation of the screening protocol aimed to establish cultural equivalence between the English and Brazilian Portuguese versions of the "Classroom Acoustical Screening Survey Worksheet".

According to the Brazilian Standards NBR 10152 of 1987[9] from the Brazilian Association of Technical Standards, the appropriate intensities for the level of noise inside classrooms may vary from 35 dB(A) to 45 dB(A). Unfortunately, many of the research carried out in classrooms show that acoustic conditions highly vary according to each school, and the values are far from the ideal standard[19,20].

Therefore, scientific interest in order to improve the listening situation of children, especially those with hearing loss,

is increasing. Through observation, behavioral assessment, and classroom acoustic measurement, it is possible to implement a plan that shall result in a school environment with a more satisfactory hearing situation for students[14].

Besides disturbing the communication between teacher and student, noise may also cause physical, emotional and educational prejudice such as hearing alterations or hearing loss, tinnitus, listening effort, stress, and learning gaps, as the student shall miss part of the content or even receive a distorted message. Noise is also considered as a risk factor for the alterations on the voice of teachers[3,5,6,20,21,22].

Based on the information gathered through the screening, the Audiologist may guide and make suggestions for structural adaptations in the classroom; since simple school environment accommodation, for example, suggesting the feet of the chairs and tables to be rubberized, requesting the use of curtains and carpets, among others, which do not depend on structural changes linked to major project budget; as well as using Assistive Technology (AT), for example, the Frequency Modulation System (FM System) in soundfield system to improve speech recognition in a noisy environment[23,24].

It is worth to highlight that in rooms with excessive reverberation times, the use of soundfield system may increase the reverberation and sound, creating additional problems[25]. The ASA/ANSI[11] affirms that the amplification systems should not be used in an attempt to replace good acoustics, and advocates that noise levels and reverberation times inside classroom should be documented prior to the installation of soundfield amplification for ensuring the success of this system.

The soundfield system is classified as a Classroom Audio Distribution System (CADS), and according to the regulation by ASA/ANSI S12.60[11], its main objective is to distribute the sound source in the educational environment. It is not idealized for providing warning alerts or signs. The standard also states that the CADS may also assist in cases of vocal amplitude difficulties of the teacher, and in certain conditions of students with hearing difficulties.

The benefits of using CADS for children with normal hearing are, thus, described in the literature: improvements in school performance and speech recognition[6,26]. The literature indicates a reduction of effort and vocal fatigue, and greater ease of teaching as benefits for teachers, with the use of this system[6,27,28].

It is expected that the "*Planilha de triagem acústica da sala de aula*" may be used by Audiologists in order to get information about the acoustic characteristics of the classroom, once it is important schools be instructed about the acoustic adaptation in classroom and the impact that may cause, since these acoustic characteristics can interfere with the learning process.

It is also worth noting the importance of further studies with the purpose of validating and verifying the applicability of the "*Planilha de triagem acústica da sala de aula*" in the reality of Brazilian schools.

It is important to emphasize that the Audiologist should work in partnership with the teacher in the application of the protocol, since classroom experiences are increasingly dynamic and interactive, with estimates that students are involved with their peers or in groups of discussion for up to 34% of the school day and not only in expository activities[29].

CONCLUSION

"Classroom Acoustical Screening Survey Worksheet" protocol was translated and cross-cultural adapted into Brazilian Portuguese, and named, in Portuguese, "*Planilha de triagem acústica da sala de aula*."

Further studies should investigate its applicability and effectiveness in the observation of acoustic characteristics of classrooms in the Brazilian scenario.

REFERENCES

1. Rabelo ATV, Santos JN, Oliveira RC, Magalhães MC. Efeito das características acústicas de salas de aula na inteligibilidade de fala dos estudantes. CoDAS. 2014;26(5):360-6. http://dx.doi.org/10.1590/2317-1782/20142014026
2. Shield B, Conetta R, Dockrell J, Connolly D, Cox T, Mydlarz C. A survey of acoustic conditions and noise levels in secondary school classrooms in England. J Acoust Soc Am. 2015;137(1):177-88. http://dx.doi.org/10.1121/1.4904528
3. Klodzinski D, Arnas F, Ribas A. O ruído em salas de aula de curitiba: como os alunos percebem este problema. Rev Psicopedagogia. 2005;22(68):105-10.
4. Lacerda ABM, Gonçalves CGO, Lacerda G, Lobato DCB, Santos L, Moreira AC et al. Childhood hearing health: educating for prevention of hearing loss. Int Arch Otorhinolaryngol. 2015;19(1):16-21. http://dx.doi.org/10.1055/s-0034-1387810
5. Libardi A, Gonçalves CGO, Vieira TPG, Silverio KCA, Rossi D, Penteado RZ. O ruído em sala de aula e a percepção dos professores de uma escola de ensino fundamental de Piracicaba. Distúrbios Comum. 2006;18(2):167-78.
6. Cruz AD, Silvério KCA, Costa AR, Moret AL, Lauris JR, Souza Jacob RT. Evaluating effectiveness of dynamic soundfield system in the classroom. Noise Health. 2016;18(80):42-9. http://dx.doi.org/10.4103/1463-1741.174386
7. Almeida Filho N, Filletti F, Guillaurmon HR, Serafini F. Intensidade do ruído produzido em sala de aula e análise de emissões acústicas em escolares. Arq Int Otorrinolaringol. 2012;16(1):91-5. http://dx.doi.org/10.7162/S1809-48722012000100013
8. Ribeiro MER, Oliveira RLS, Santos TMM, Scharlach RC. A percepção dos professores de uma escola particular de Viçosa sobre o ruído nas salas de aula. Rev Equilíbrio Corporal e Saúde. 2010;2(1):27-45. http://dx.doi.org/10.17921/2176-9524.2010v2n1p%25p

9. Associação Brasileira de Normas Técnicas. NBR 10152: Níveis de ruído para conforto acústico-procedimentos. Rio de Janeiro: Associação Brasileira de Normas Técnicas; 1987.
10. Dreossi RCF, Momensohn-Santos TM. A interferência do ruído na aprendizagem. Rev Psicopedagogia. 2004;21(64):38-47.
11. American National Standard Institute. ANSI S12.60.2010. Acoustical performance criteria, design requirements, and guidelines for schools, Part 1: Permanent Schools. Washington, DC: American National Standard Institute; 2010.
12. Fidêncio VL, Moret AL, Jacob RT. Mensuração do ruído em salas de aula: revisão sistemática. CoDAS. 2014;26(2):155-8. http://dx.doi.org/10.1590/2317-1782/2014029IN
13. Smaldino J, Ostergren D. Classroom acoustic measurements. In: Smaldino J, Flexer C. (Eds.). Handbook of Acoustic Accessibility. New York, NY: Thieme; 2012. p. 34-54.
14. Johnson CD. Classroom listening assessment: strategies for speech-language pathologists. Semin Speech Lang. 2012;33(4):322-39. http://dx.doi.org/10.1055/s-0032-1326920
15. Anderson KL. Access is the issue, not hearing loss: new policy clarification requires schools to ensure effective communication access. Perspect Hear Hear Disord Child. 2015;25(1):24-36. http://dx.doi.org/10.1044/hhdc25.1.24
16. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. J Clin Epidemiol. 1994;46(12):1417-32. http://dx.doi.org/10.1016/0895-4356(93)90142-N
17. Ferreira PEA, Cunha F, Onishi ET, Branco-Barreiro FCA, Ganança FF. Tinnitus handicap inventory: adaptação cultural para o português brasileiro. Pro Fono. 2005;17(3):303-10. http://dx.doi.org/10.1590/S0104-56872005000300004
18. Giusti E, Befi-Lopes DM. Tradução e adaptação transcultural de instrumentos estrangeiros para o Português Brasileiro (PB). Pro Fono. 2008;20(3):207-10. http://dx.doi.org/10.1590/S0104-56872008000300012
19. Guidini RF, Bertoncello F, Zanchetta S, Dragone ML. Correlações entre ruído ambiental em sala de aula e voz do professor. Rev Soc Bras Fonoaudiol. 2012;17(4):398-404. http://dx.doi.org/10.1590/S1516-80342012000400006
20. Dreossi RCF, Momensohn-Santos T. O ruído e sua interferência sobre estudantes em uma sala de aula: revisão de literatura. Pro Fono. 2005;17(2):251-8. http://dx.doi.org/10.1590/S0104-56872005000200014
21. Almeida AP. Trabalhando a voz do professor: prevenir, orientar e conscientizar. Rio de Janeiro: Centro de Especialização em Fonoaudiologia Clínica do Rio de Janeiro; 2000.
22. Silvério KC, Gonçalves CG, Penteado RZ, Vieira TP, Libardi A, Rossi D. Ações em saúde vocal: proposta de melhoria do perfil vocal de professores. Pro Fono. 2008;20(3):177-82. http://dx.doi.org/10.1590/S0104-56872008000300007
23. Jacob RTS, Zattoni MQ. Sistemas de frequência modulada. In: Boechat EM (Org.). Tratado de Audiologia. 2a ed. São Paulo: Santos; 2015. p. 298-310.
24. Wolfe J, Schafer EC. Candidacy and device options: personal amplification systems for school-aged children. Semin Hear. 2010;31(3):203-18. http://dx.doi.org/10.1055/s-0030-1262326
25. Ostergren D. 20Q: improving speech understanding in the classroom: today's solutions. AudiologyOnline. 2013 [citado 17 out 2016]. Disponível em: http://www.audiologyonline.com/articles/20q-classroom-acoustics-and-audio-12285
26. Dockrell JE, Shield B. The impact of sound-field systems on learning and attention in elementary school classrooms. J Speech Lang Hear Res. 2012;55(4):1163-76. http://dx.doi.org/10.1044/1092-4388(2011/11-0026)
27. Jónsdóttir VI. Cordless amplifying system in classrooms: A descriptive study of teachers' and students' opinions. Logoped Phoniatr Vocol. 2002;27(1):29-36.
28. Dyre L. Classroom solutions and modifications for children with listening challenges. AudiologyOnline. 2016 [citado 20 set 2016]. Disponível em: http://www.audiologyonline.com/articles/classroom-solutions-and-modifications-for-17364
29. Phonak. Roger™. Touchscreen Mic Small Group Mode. Changing the dynamics of group activities in the classroom. 2016 [citado 20 set 2016]. Disponível em: https://www.phonakpro.com/br/b2b/pt/evidence/publications/phonak-insight.html

Appendix 1. Planilha de triagem acústica da sala de aula

Planilha de triagem acústica da sala de aula[1]

Fonoaudiólogo(a):
Escola:
Nome do Estudante:
Ano:
Data:
Professor:

1 INFORMAÇÃO MEDIANTE OBSERVAÇÃO

A observação da sala de aula é uma etapa preparatória para a realização das medições acústicas da sala de aula. A observação fornece informações sobre parâmetros acústicos, distribuição das carteiras e acesso a fala. Verifique abaixo:

1 A Dinâmica da Sala de Aula

A Dinâmica da Sala de Aula

Tipo da Sala de Aula:
Tradicional ○
Aberta ○

Distância Professor-Aluno :
Aluno mais Próximo _____ metros
Aluno mais Distante _____ metros

Forma de Ensino:
Aula teórica ○ Grupo Grande ○ Grupo Pequeno ○
Individual ○ Outros _____

Distribuição das carteiras:
Grupo ○ Forma de U ou Círculo ○
Fileira ○ Outros _____

1 B Ruído de Fundo

Características da Sala de Aula	SIM *	NÃO
O ventilador ou o ar-condicionado são audíveis.		
O ruído do pátio é audível.		
O ruído do tráfego de carros é audível.		
O ruído do tráfego de aviões é audível.		
Os sons de outras salas de aula ou corredor são audíveis com o ventilador ou ar-condicionado desligados.		

* A opção "Sim" sugere níveis de ruído potencialmente excessivos.

1 *Adaptado de: Johnson, C.D. Classroom Listening Assessment: Strategies for Speech-Language Pathologists. SEMINARS IN SPEECH AND LANGUAGE 2012: 33(4): 322-39.*

Planilha de triagem acústica da sala de aula

Características da Sala de Aula[1]	SIM *	NÃO
A superfície é dura e plana, sem telhas e teto acústico.		
Altura do teto é maior do que 3,35 metros.		
As telhas do teto acústico são pintadas.		
As paredes são construídas de materiais refletores de som (por exemplo, placas de gesso, concreto, painéis de madeira).		
Os pisos são construídos de materiais refletores de som (por exemplo, concreto, telhas, madeira).		

* A opção "sim" sugere tempos de reverberação potencialmente elevados.

1 C

O tempo de reverberação é determinado pelo volume da classe e as características de absorção dos materiais que compõem as paredes, pisoeteto da sala de aula.

D Presença dos seguintes equipamentos de acessibilidade

- FM pessoal [Número de estudantes ____] Tipo _____
- ADS: Em toda sala de aula Tipo _____
- ADS: Área especifica Tipo _____

[1] Sistema de Distribuição de Som em Sala de Aula (ADS ou CADS, do inglês Classroom Audio Distribution System)

1 D

Presença dos seguintes equipamentos de acessibilidade

INFO. INFORMAÇÃO MEDIANTE MENSURAÇÃO

2 A

RUÍDO

2 A - Ruído

Medidor de nível de pressão sonora: Marca/Modelo_____

Método Usado: Média de uma hora Curto prazo_____

- Nível do Ruído Ambiente (dBA, dBC)
- Nível da Voz do Professor (dBA):
- Sala de Aula Desocupada ou Ocupada
- Sala de Aula Ocupada

Planilha de triagem acústica da sala de aula

2 A RUÍDO

Condição (circule o número correspondente)	1=desocupada, HVAC desligados; 2= desocupada, HVAC ligados; 3= ocupada, HVAC desligados; 4= ocupada, HVAC ligados								Sem ADS em sala de Aula		Com ADS em Sala de Aula	
	1 2 3 4		1 2 3 4		1 2 3 4		1 2 3 4		Nível	SNR	Nível	SNR
Circuito de ponderação (média)	A	C	A	C	A	C	A	C	A	A	A	A
Locais de Medição A*												
B												
C												
D												
E												
F												
Média -Nível dB												

*Estudante Alvo

HVAC :Sistemas de aquecimento, ventiladores e ar condicionado (Heating, ventilation and airconditioning)
ADS: Sistema de Distribuição de Som em Sala de Aula (ADS ou CADS do inglês Classroom Audio Distribution System)
SNR : Relação sinal-ruído (Signal-to-noise - ratio)

Comentários

Nota: Podem ser utilizados programas on-line ou aplicativos para calcular o ruído como, por exemplo, http://appcrawlr.com/ios/audio-tool.

2 B - Tempo de Reverberação

2 B TEMPO DE REVERBERAÇÃO

Cálculo:_____ Estímulo sonoro utilizado:_____

Fequência:	500 Hz	1000 Hz	2000 Hz
Locais de Medição A			
B			
C			
D			
Média			

Média RT-60 na Sala de Aula: _____segundos

2 B

TEMPO DE REVERBERAÇÃO

Planilha de triagem acústica da sala de aula

Estimativa:		
Volume da Sala (V) = _____metros cúbicos		
Área (A) chão	__x Coef. ABS*. ____=	A chão ____
Área teto	__x Coef. ABS. _____=	A teto ____
Área parede lado 1	__x Coef. ABS. _____=	A parede 1 ____
Área parede lado 2	__x Coef. ABS. _____=	A parede 2____
Área parede ponta 1	__x Coef. ABS. _____=	A ponta 1____
Área parede ponta 1	__x Coef. ABS. _____=	A ponta 2____
		Total A ____

* Coeficiente de absorção

Média estimada RT da Sala de Aula =0. 049 x _____ (V)/_____ (A) =_____ segundos

Nota: Podem ser utilizados programas on-line ou aplicativos para calcular RT-60 como, por exemplo:

www.sengpielaudio.com/calculator-RT60.htm;
www.mcsquared.com/homrteng.htm; http://wwwp.feb.unesp.br/jcandido/acustica/Calculos/Tempo_de_reverb.htm.
https://itunes.apple.com/us/app/revmeter-pro/id357421594?mt=8
http://www.studiosixdigital.com/audiotools/installing-files-using.html

Coeficientes de absorção sonora para materiais de sala de aula

Material	Média Coeficiente de Absorção	Material	Média Coeficiente de Absorção	Material	Média Coeficiente de Absorção
Paredes		Pisos		Teto	
Beira	0.04	Madeira	0.04	Gesso, cal ou em ripa	0.05
Concreto pintado	0.07	Linóleo	0.03	Telhas acústicas (5/8¨) – suspensas	0.68
Janela de vidro	0.12	Tapete em concreto	0.37	Telhas acústicas (1/2¨) – em suspensão	0.66
Gesso em concreto	0.06	Tapete em espuma	0.63	Telhas acústicas (1/2¨) – não suspensos	0.67
Madeira compensada	0.12			Painéis de alta absorção - suspensos	0.91
Bloco deconcreto	0.33				

Comentários :

Planilha de triagem acústica a sala de aula

2 C

Estimativa da Distância Crítica

2 C -Estimativa da Distância Crítica

Recomendação das Normas Acústicas para Sala de Aula para Espaços de Aprendizagem	
Sala de Aula Permanente:	**Nível do ruído: 35dBA/55dBC; Tempo de Reverberação: 0.6 segundos***

* Nota: Os espaços em salas de aula permanentes devem ser facilmente adaptáveis para permitir uma redução no tempo de reverberação de 0.3 segundos para acomodar as crianças com deficiência auditiva.

Volume da Sala (metros cúbicos)	Tempo de Reverberação (segundos)							
	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
56,6	1,58	1,37	1,22	1,13	1,04	0,98	0,91	0,85
113,3	2,23	1,92	1,74	1,58	1,46	1,37	1,28	1,22
169,9	2,71	2,35	2,10	1,92	1,80	1,68	1,58	1,49
226,5	3,14	2,71	2,44	2,23	2,07	1,92	1,83	1,74
283,2	3,51	3,05	2,71	2,50	2,32	2,16	2,04	1,92
339,8	3,84	3,35	2,99	2,71	2,53	2,35	2,23	2,10
396,4	4,18	3,60	3,23	2,96	2,71	2,56	2,41	2,29
453,1	4,45	3,84	3,44	3,14	2,93	2,71	2,56	2,44
509,7	4,72	4,08	3,66	3,35	3,08	2,90	2,71	2,59
566,3	4,97	4,30	3,84	3,51	3,26	3,05	2,87	2,71
	Distância Crítica (metros)							