Audio for Dummies : Primary School Halls

Designing a primary school hall PA system is not an easy task. Everyone expects performance to match that that of a professional theatre or concert. But unlike with the pro shows, the system is expected to perform with no testing or maintenance whatsoever for years on end and be used primarily by people who have no idea how to use it.

All professional productions employ a trained and talented engineer to sit at a mixing desk with hundreds of knobs on it. He tweaks, turns and makes constant adjustments in order to ensure sound quality and strength is optimised while at the same time, ensuring the system does not feed back on itself or distort the sound.

Every PA system installed in a school hall is a compromise. It can be used for the annual school concert or musical, as well as daily assembly. But first, a quick theory lesson:

Feedback:

This is the screeching noise that happens when the microphone gets too close to the speakers or when you turn the volume up too loud. What's happening here is that sound from the speakers is getting back in to the microphone. We can control it by moving the speakers and microphones further apart or by getting the talent to talk louder and closer to the microphone and then turning the system volume down.

Number of "open" microphones:

A PA system might have dozens of microphones connected to it at the same time. However in a professional application, very few of these are in use at the same time. If you want your school hall PA to sound as good as the professional ones do, then you need to use the same operating methodology : **LESS is BETTER**.

For every extra microphone you have active in a PA system, the system gain needs to be reduced by 3dB in order to prevent the system from feeding back. For example, this means if you have one microphone on and then switch on two more, you then need to *reduce the system master volume by HALF* in order to stop the system feeding back on itself.

This in turn means that in order for three people to be heard as loud as one, all three people will now need to speak twice as loud or reduce the distance between them and the microphone by half.

Professional sound engineers deal with this by constantly "riding the levels." They sit there and pay attention to who is speaking closest to each microphone. They then boost the gain on that microphone while cutting the others. When somebody else speaks, they adjust it again. And again, and again, and again.

Unless you're willing to pay a trained audio person to sit in your hall and do this for you all day long, your hall PA system is never going to be able to keep up.

Hand Held Cordless Microphones

The key to good school hall PA is to **use as few microphones as possible** and to get your talent as close as possible to them at all times. The simplest way to do this is in a school situation is to use hand held cordless microphones which are handed between each person as they speak.

Two microphones are best. That way if one fails, you can immediately use the other one as a fallback. If you have more than two switched on at a time, the unused ones will inevitably pick up handling noise which will make your situation worse.

Make sure your cordless microphones operate in the 520MHz band. It's the only band currently in Australia which can be guaranteed to be interference free, anywhere in the country.

Do NOT use "consumer grade" 2.4GHz microphones, or anything above 690MHz. These might appear to work fine during your rehearsal. At show time, when your hall fills up with an audience full of people with mobile phones in their hands, these frequency bands will suddenly become crowded with RF noise and your microphones will become less than useless!

Headset and Lapel microphones

For situations like drama productions where hand held microphones are inappropriate, the best option is to use a couple *of headset style* cordless microphones and belt packs. Sometimes called "Madonna" microphones (made famous by her use of them in the early 1990's on stage), these are small and light headsets which clip on to the head of your talent and position a tiny microphone near the mouth.

The benefit of headsets is that they can be used to pick up several people, not just the person wearing the headset. For example in a simple stage play, you can put a headset on your two key talent kids who have the most speaking parts. This effectively becomes two omni directional microphones on legs who will generally position themselves as close as possible to whoever is actually speaking at any given moment.

You don't need or even want a dozen mics on a dozen different kids. A single pair of mics on two heads on stage with sufficient gain, will be enough to pick up everyone and be heard. The result will be a lot less noise and clearer speech as a result. Most importantly, a lot less can go wrong!

Lectern Microphone

It's probably one of the most used microphones in your hall PA system, so make sure you don't skimp on quality. Cheap and nasty dynamic gooseneck microphones can pick up lots of noise transmitted through the floor and the lectern into the microphone. They are also not very sensitive at kids' higher voice frequencies.

Be sure to insist on a good quality, electret, high sensitivity super cardioid lectern microphone. **Make sure it has an on off switch** so users can easily turn it off when it is not needed or when the lectern has to be moved. ***These are delicate microphones,*** best kept safely in the administration office, not left on the lecturn or kicked around on the floor of your hall sound cupboard.

Corded microphones

Good quality cordless microphones cost north of $500. Good cord microphones? Around $50.

Don't throw your pearls before pigs. **Keep your valuable cordless mics in the front office.** Get them out only when your school has a special assembly or event. For all other uses (and especially if you're hiring the hall out to community groups or you let your kids set up and use your system), *get them to use the cord microphones.*

Cord microphones will do most jobs just fine. Lets not mince words here, **they WILL be dropped, lost and broken**. When they are, it's only $50 for a new one instead of $500+. If hall hirers want to use cordless microphones.. then *let them bring their own!* They can easily plug their receivers in to the same plugs where your corded mics plug in. There is no need for anyone to go diving behind your PA system rack and messing with the wiring.

Don't skimp on microphone leads either. What's the point in spending north of $10k on a whiz bang PA system for your hall, if it can be bought to its knees by a faulty $15 lead or plug?

Buy spare microphone leads and keep them in your office stores. Plan to change your microphone leads at least every year because they WILL break often. A school hall can be a punishing environment for leads which are rarely wound up properly and are regularly yanked, tugged and trodden on.

Also: *be wary of stage microphone plugs located on the front of your stage* if you have stairs there. These floors and stair areas are regularly polished by your cleaners using floor polish. Over the years, the plugs will become clogged with this dust and floor polish - making them noisy and unreliable. Make sure you *have them replaced* with new plugs every time you upgrade your PA system.

Speakers and Amplification

One of the most common problems with school hall PA systems is not just the choice of speaker but *where to put them.*

Whatever you choose, you should always make sure your "Front of House" (FOH) speakers are located **well away and forward from the front of your stage.** Your aim should be to ensure as little sound as possible can get from your speakers back in to your microphones as this is what causes feedback. Don't worry too much about the first few rows of your audience – they'll pick up sound direct from the stage.

Whilst we're not going to get too tied up in the pros and cons of speaker design and choice here, we will say that over the decades we have found that "horn loaded" speakers are best avoided in school hall situations. From a manufacturers' point of view, horn loaded speakers are a good way of packing a lot of punch into a small speaker box that's cheap to build and doesn't need much amplifier power to drive it to high sound pressure levels (i.e. they have high efficiency).

However the horns in them are also very delicate. *They are very easily damaged by short passages of loud feedback or system misuse,* which is very common in hall PA systems used by inexperienced operators. Horn loaded boxes also tend to direct higher vocal frequencies in tight patterns. This "directed sound" bounces around the reflective wall and floor surfaces of a typical school hall. It greatly reduces the vocal intelligibility of speech, as well as making the system sound very harsh and unbalanced with music.

Wherever possible, avoid horn loaded designs in these spaces altogether. Instead, try and use boxes with traditional drivers such as traditional PA columns, line array solutions or full range cone speaker point source systems.

Amplification should be matched to the speakers by your installer. Wherever possible include digital equalisation and processing, which should be "pre set" by the installing contractor and then "locked out" so regular users can't alter the settings. This should include a "compression algorithm" which will automatically limit the power output of the system so your speakers will be protected from abuse.

System Size and Complexity

A typical school hall PA system should be able to fit within the capabilities of a 12 channel mixer. Any larger than this and your system will become too difficult for your staff to understand or trouble shoot when things go wrong.

If your school has an annual "extravaganza" event like a musical or drama evening with more demanding and complex arrangements, **consider hiring in a complete production PA system for this** instead of just buying your own equipment. The advantage of doing this is that a hired system generally comes with a very valuable asset attached: a trained OPERATOR!

The *operator* will know how to get the most out of the system, hall and situation. They will then look after all the boring but important bits you might not get time for: Things like making sure cordless microphones have fresh batteries and work properly, ensuring that all your various music playback sources and files work properly and are in order, all the way to equalising the system to get maximum performance without feedback. All the while, you can get on with the job that you're actually there to do – put on your show.

No doubt about it – **hiring a production audio professional for your show will be worth the money!**

A modern hall PA system typically has the following inputs;

Inputs 1,2 ,3 = Cord Microphone inlets at the stage (left, centre, right)
Inputs 4,5 = Hand held cordless microphones
Inputs 6,7,8 = Headset cordless microphones
Inputs 9+10 (Stereo) = Computer audio input
Inputs 11+12 (Stereo) = Mobile Device audio input

“Foldback speakers” (or speakers pointed back at the stage) should be avoided if possible. They just add another level of complexity to your system that is likely to be ignored, misused and misunderstood. They will end up hobbling the effectiveness of the rest of your system, causing acute feedback and intelligibility problems unless they are professionally set up and operated.

If you must include some kind of “foldback” capacity in your system, ensure that the only sound that can be physically sent to these speakers is sound from music playback sources, not the microphones.

Video & Data Projectors, Computers and Mobile Devices

The biggest challenge integrating audio from the many consumer grade sources now in use in schools is how to get sound out of the device and in to your PA system. Because they are all “consumer” electronic items they are not designed to couple with sound systems, rather they are designed to be used by a single person, generally listening through headphones.

Because of this, all these items invariably have only the ubiquitous unbalanced 3.5mm headphone plug as a source of audio that can be used to send audio to a PA system. These connectors are notoriously unreliable and easily damaged, so even the slightest abuse can render your expensive PA system useless.

Hand held mobile devices such as tablets and smartphones are generally operated without being connected to any other device or power supply. They’re also generally used close to your PA system rack, so connecting these devices is usually as simple as using an adaptor lead. A modern PA system will always provide a set of stereo “line in” RCA connectors on the front panel for easy connection of mobile devices, eliminating the need for anyone to go diving into the back of your PA rack and messing around with plugs, potentially wrecking your system.

Computers and projectors introduce another level of complexity to the problem of getting professional sound from consumer grade products. This is because projectors are earthed to the power mains. That long VGA or HDMI cable which is used to get the picture from your laptop to the projector is therefore also earthed.

This in turn means your laptop or computer is now also earthed. That means when you connect your el cheapo, consumer grade 3.5mm unbalanced “headphone jack” sound lead between your computer and the PA system, which is also earthed to the power mains, you have just set up a gigantic version of what electronics engineers like to call an **earth loop**. It’s reaching all the way from your computer, through the VGA lead, through the projector and into the power mains, back to the building switchboard, back through the mains again to your PA system, then through the audio lead and back to your computer.

This “earth loop” usually manifests itself in the form of a huge hum and noise in your PA speakers. It will stay there until you unplug the lead again and break the loop. The only way to get rid of this annoyance is to break the loop permanently. This is usually done by the installer inserting a special “isolating transformer” in the line between your computer and the PA system. If this method is used, it is important to make sure that the transformer is located in exactly the right position.

Another common source of trouble with computers, projectors and audio is the need to be able to send audio from a computer which might be located on the stage (next to the performers) rather than at the PA rack. Many installers use dedicated digital devices from the likes of Extron or Crestron to control these functions. However these rarely solve the earth loop problem. In fact in some cases (particularly with poorly installed

systems) it can make things even worse, adding a whole plethora of unwanted noises. Worst of all, results can be totally inconsistent depending on which computer is used.

Wherever possible, it is best to try and keep your video and audio completely separate. If you have integrated input systems installed alongside a video projector, be sure to thoroughly test the system in all configurations before accepting it from the installer, to make sure that it works properly and quietly.

Bluetooth Connectivity

Another increasingly common request from schools is to include Bluetooth connectivity to hall PA systems. While this may seem like an ideal way to solve the problem of "getting sound out of a consumer grade mobile device and in to a professional PA system," it is one which we do not recommend – particularly for larger schools and in particular, high schools.

This is because kids are tech savvy. You're likely to have a whole hall filled with otherwise bored people playing with their phones. It's only a matter of time until someone discovers an open Bluetooth tether in the hall.. then tethers their phone to it.

Now they not only have absolute control over your PA system and can play whatever they like over it whenever they like, they have also just locked you out of tethering to your own device! These situations can become embarrassing to say the least. They can be extremely difficult to sort out, especially when you don't know who the culprit is.

Most modern PA system "Bluetooth adapters" have a button on the unit which you need to press and hold for a determined set time in order to "open the tether" and allow a phone to connect. Just remember that whatever you know – the kids know too!

Having Bluetooth in your school hall is like leaving the keys in the ignition of your car and the door wide open. It might be relatively safe to do at home, but not in a public space like a school.

Suddenly the idea of using the 'ole 3.5mm headphone jack and lead seems like a good idea after all…

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