Electronics In Teaching:

In my last article, I focused on how students could gain valuable, job-related skills by learning to work with the various components of an electronic studio. Programming drum machines, sculpting sounds on electronic drums, and using computer-based sequencing software are all new skills that today's students are anxious to learn. And by learning these skills, students are forced to examine their own playing styles in a new light. In this article, we will see how the electronic studio can be used to improve a player's technique and control of time, tempo, and rhythmic accuracy.

One of the qualities that turns a good player into a great player is control. By control, I mean that dynamics, tempo, phrasing, and a hundred other aspects are done in a certain way—not by chance, but because the player *meant* to do it. I'm not going to try to tell you that adding electronic drums to your teaching studio is going to transform your students into the next Steve Gadd, Keiko Abe, or Cloyd Duff. Electronic drums won't solve all your teaching problems, but they can be used to correct many common faults that arise from the student's lack of control. Some of these problems are dynamics, balance of hands, tone production, and rhythmic timing.

The Drum Machine As Metronome

If you could design the "ultimate metronome," what would you desire? Would you like it to make a different sound on each division of the beat and measure? Perhaps you would want it to click in less common meters than two, three, four, and six (just what the doctor ordered for those Boulez tunes)? How about a "reverse metronome" feature so that you could simply tap the tempo and have it tell you the speed you're going? Just let your ideas flow, and the drum machine will do all of this and more.

All drum machines have several different sounds built into them. The machine I am using, the E-Mu Systems *SP-12*, contains 24 different sounds that can be altered in pitch to create well over 100 separate colors. When using the drum machine as your ultimate metronome, you have the choice of different sounds, pitches, dynamics, or any combination of these contrasts to signify the various divisions of the measure.

Mixed meters and odd meters are two of the biggest drawbacks of a standard metronome. If you have ever tried to use one for a passage in 7/8, then you are well aware of the "first bar is on the beat, second bar is off the beat" problems that arise. With a drum machine, you can program just about any type of measure that you desire. A measure of 17/16 is just as easy to set up as a measure of 4/4 time.

Measures that have less common subdivisions can also be programmed into the drum machine. An 8/8 bar that is phrased 3+3+2 can be easily demonstrated by using one sound for the first beat of each division and another sound color for the weaker parts of the division. As you can see, the choices and possibilities are wide open. Most drum machines allow you to create many different patterns (in some machines, up to 100 or more) that are then saved into the memory of the machine. It's a great idea to program just about every type of measure that you can think of, assign all of them to different memory locations, and then save the entire memory onto tape or disk. Once they are offloaded, you can put them back into the memory in a very short time. A handy reference chart could be used so that you know where certain patterns are located. For example: 8/8 as 3+3+2 is pattern 20, 8/8 as 3+2+3 is pattern 21, 8/8 as 2+3+3 is pattern 22, and so on.

Some students have trouble dealing with the musical concepts of ritardando and accelerando. Either one can be an even metrical change over a certain period, a change in tempo that is more subtle at the beginning and more apparent toward the end, or any number of different variations. You can program the *SP-12* to change tempo up to plus or minus 99 beats per minute over a time span of up to 32 beats. Longer time spans and more drastic tempo changes are possible, but need to be programmed in two or more steps. Changing the tempo is a very simple matter, and allows students to hear how different types and degrees of tempo change affect the mood and style of the piece being performed. Again, the desired goal is to have students play what they feel is going to sound the best for the particular passage, not just change the tempo to whatever happens. ("I *meant* to do that! Yeah . . . sure . . . *that's* the ticket.")

Most drum machines permit the user to combine different patterns and save them into memory as songs. Mixed meters or combinations of different meters are then the very simple process of creating a song by "chaining" the different patterns together. These songs can be either programmed to repeat for a specified number of times, or to play one time through and then stop. Songs can be custom-designed for a specific etude or excerpt, and placed into memory along with the patterns. Song number 1 might be etude 21 from Cirone's *Portraits In Rhythm*, while song 46 might be the "Dance Sacrale" from *The Rite Of Spring*, and song 62 might be the glockenspiel part to Messiaen's *Exotic Birds*.

Other Drum Machine Applications

Obviously, you are not going to shell out several thousand dollars for a sophisticated drum machine simply to use it as a very fancy metronome. In order for the expense to be justified, there must be other uses for it as well. The most apparent one is to program not just the metronome for the particular passage or work, but to program the entire rhythm as well. In addition to programming the rhythm, you can add dynamics, accents, tempo changes, pitch, different instruments, or fermati. In essence, this will give you a "metronome" that will play the piece, note for note.

There are two situations when this might be useful. One is to have students simply listen to a "perfect" performance of the passage. The other—possibly more beneficial—is to have students play along with the programmed performance. This would allow them to compare (in real time) every stroke of the passage. We all know that, when playing with a metronome, it is possible to make adjustments so that the beats fall with the sound of the click while the subdivisions may still wobble around. With all of the strokes sounding on the "metronome," students will be able to hear any weakness in their sense of time at a much finer level.

I have had much success programming the drum machine to play a passage and then having students play the same passage on the electronic drumset while it was turned off. This lets them imagine that their own strokes are producing the sounds they are hearing. While this may appear rather weird, it seems that the students are not involved with a comparison of two different sounds, but instead are relating a body movement to the sound that that particular movement should be producing. Perhaps students have an easier time judg-

by Norman Weinberg

Part 2

ing the differences that occur between the stroke and the immediate sound that they have always expected. Whatever the reason might be, this has proven itself to be an extremely valuable aid for fixing rhythmic wobbles in complex passages.

Sometimes, you may not want the total "perfect" performance. Perhaps, just the accent patterns can be programmed to help students realize that all accents in a passage should be at the same level, or it might be helpful to leave the accented notes out of the program and let students listen to the inner rhythm of the non-accented notes. You can even create your own "music minus one" studies.

Adding A Computer

With the addition of a computer into the system, many more possibilities are created. Electronic instruments communicate with computers in a language called MIDI, which is short for Musical Instrument Digital Interface. An explanation of how it works might be useful at this point. When electronic instruments are played, their keys or pads send certain information to the machine's brain, which in turn produces the sound. With MIDI, these same commands can be recorded on a computer disk and then played back into the brain to achieve the exact sound. The brain really doesn't care whether the command came from a drumpad, a keyboard, or a toaster. It simply receives the command and acts upon it. Because of this, when you record with MIDI, you are not really recording sound; you're recording information. And that recorded information can be edited and altered by a computer with a great deal of accuracy.

The device that connects the instruments to the computer is a MIDI interface. One of the programs I work with is called *Total Music* by Southworth Music Systems. *Total Music* comes with its own interface that permits two MIDI inputs and four MIDI outputs. With this interface, it is possible to record the MIDI information from two sources at the same time. This makes it possible to record a student's performance while he or she is playing along with the drum machine. The student then has the opportunity to go back and listen to what was just played, and can compare the two versions, side by side.

While a simple tape recorder might be able to record the "perfect" performance along with the live performance, the com-

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Example #1

Track-3

Key→ Data→

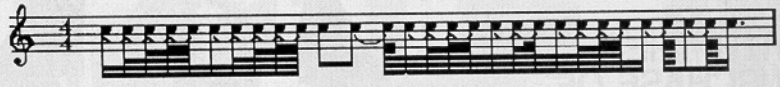
Time	Pitch	On	Off	Duration
1|1|000	♪C3	↓64	↑64	0|1|000
1|1|000	♪C4	↓55	↑64	0|0|088
1|1|088	♪C4	↓49	↑64	0|0|052
1|1|140	♪C4	↓41	↑64	0|0|068
1|1|208	♪C4	↓54	↑64	0|0|072
1|1|284	♪C4	↓47	↑64	0|0|052
1|1|336	♪C4	↓43	↑64	0|0|048
1|1|384	♪C4	↓61	↑64	0|0|092
1|1|476	♪C4	↓53	↑64	0|0|056
1|2|052	♪C4	↓42	↑64	0|0|036
1|2|088	♪C4	↓48	↑64	0|0|076
1|2|164	♪C4	↓46	↑64	0|0|052
1|2|220	♪C4	↓39	↑64	0|0|100
1|2|320	♪C4	↓78	↑64	0|0|160

Professional Performer, by Mark of the Unicorn, lists out the MIDI data of a nine-stroke closed roll. The data information is as follows: The first column (time) shows the exact time of the attack as bar/beat/tick. The second column (pitch) indicates what pitch is recorded. The third row of numbers is the "on" velocity (volumes from 1 to 128). The next number is the "off" velocity. (Drum machines do not send off velocity and use the standard number of 64 for all notes.) The last column is the duration of the event, also stated as bars/beats/ticks.

In this particular example, each hand movement produced three bounces. By looking at the "on" data, you can see that each stroke of the bounce is softer than the note before it. The velocity of 78 for the last stroke indicates the accent that ended the roll. With 128 different levels of dynamics available in MIDI, small differences of less than about six numbers are not too obvious to the ear.

This roll was recorded at quarter note equals 250, and at this speed, there are 2,000 divisions during each second of time. Again, small differences are not too obvious, but several things can be learned from this example. Notice how the stick takes longer to rebound back to the drum after the initial attack (88 ticks for the first note, versus 52 and 68 ticks for the bounced strokes). Another interesting aspect is the expanded length of time between the last bounce stroke and the accent that ends the roll. This space of 100 ticks is so much longer than the other durations that the ear will notice the difference. Once these problems are discovered, then specific exercises can be used to help correct them and improve the sound of the roll.

Example #2



This is the printout resulting from a simple rhythm that has not been quantized.

Example #3

This is the same rhythm as that shown in example #2, after the recording has been quantized. The end result is much closer to what is desired.

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puter can enhance that recording in several ways. The two individual instruments can be heard at the same time, or either part can be turned off or on again during the playback. The mix or volume of the two parts can be adjusted so that one is more prominent than the other. But the most exciting aspect of controlling the playback with the computer is that the tempo of the performance can be adjusted without affecting any of the other parameters.

Much can be learned about how something sounds by placing it under a type of "aural microscope." Some passages—which might sound pretty good, but not quite great—may contain rhythmic differences that are hard to hear as they happen but are quite obvious when replayed at a slower tempo. One of the best examples is the roll. A roll is the performance of many short attacks so close together that the ear is fooled into hearing the sound as a single, sustained tone. Any slight accent or difference in the volume of a stroke will cause the ear to pick it out of the texture and assign it a rhythm. Any slight deviation of time between attacks will also draw the ear away from the desired impression.

With the computer and the electronic drums, a student can play a roll and then listen to it at a much slower speed. In addition to hearing the roll, the student can see the various lengths between strokes and the various dynamics of each stroke. Example #1 shows the computer's recording of a pretty good (but not great) sounding roll in real time. Once a problem is discovered by the student, the solution is much easier to achieve.

Using Computer Graphics

Perhaps the biggest advantage of using electronics with the computer in the teaching field is that of automated notation. It is possible to play something on the drums and have the computer's program print it out in standard musical notation. This is probably the biggest single advance in music since the printing press. When you add notation to the system, the educational value is increased dramatically.

Students can actually *see* what they have just played! This is another type of feedback that students can use to analyze their performance. Not only did it feel right and sound right, but it also *looked* right. Unfortunately, the notation is not perfect. The complexity of the program and amount of memory that would be required for absolutely perfect notational transcription is beyond the scope of personal computers at this time. But even in its developmental stage, it is incredibly useful. A student can perform an etude and then see the printout of the notation. Problem areas can then be discovered by comparing the original written page to the performed written page.

So that you don't get the wrong impression, let's look at two limitations. First, the system will not add the proper dynamics to the printed page automatically. All dynamics will be reproduced during *playback*, just not in the *notation*. Dynamics can be added, but they must be added by the computer keyboard, not the musical instrument. The second limitation is that of resolution. Not a lack of resolution—instead, the computer is often more accurate than you would like it to be. The two different programs that I'm using with my system are *Professional Performer* by

Mark of the Unicorn and *Total Music*. These two programs use different "tick" rates, which are quite fast (480 beats to the quarter note in *Performer* and 96 in *Total Music*), and this highly accurate resolution can create some mind-boggling headaches.

Unless the recording is quantized (auto-corrected), the resulting notation will look like absolute garbage. If you want to see some very tricky rhythms, take a look at example #2! No player on earth has a strong enough control of time to play an 8th-note triplet exactly on division number 160. However, the computer will try its best to print that crazy rhythm even if you happen to play on tick 167. This is where the quantization of attacks is necessary. When you quantize, you are telling the computer to round off all attacks to the nearest specified note value. If the computer is told to quantize to the nearest 32nd-note triplet, then the resulting notation will look a little better and still give you a very fine line of resolution. Example #3 is what example #2 would really sound like to normal humans rather than to computers.

Once the art of quantizing is learned, you can teach such concepts as "laying back" on beats two and four, "leaning forward" into a syncopated accent, or even playing a very loose style of Dixieland. It is possible to really see the second and fourth beats delayed by a small amount. While these concepts may often be difficult to explain in words, they become easier to understand when they can be heard and seen.

This process can also be reversed. By using a program like *Professional Composer* by Mark of the Unicorn, the notation of the desired feel can be entered on the computer, and then read and played back by *Performer*. This can allow the student to first hear passages that might even be too tricky to create on the drum machine. Very complex polyrhythms, such as example #4, can be programmed and heard in just a few minutes.

By using these notational capabilities, the teacher can write exercises individually tailored to each student in about a quarter of the usual time, even during lessons. If the exercise is quite simple, it only needs to be played on the drums, quantized (which takes all of about eight seconds), and printed. If the exercise is more complex, then a certain amount of editing might be required. However, even the most complex notational problems can be solved in just a few minutes. With the addition of an inexpensive MIDI synthesizer, bar percussion exercises are just as easy to create.

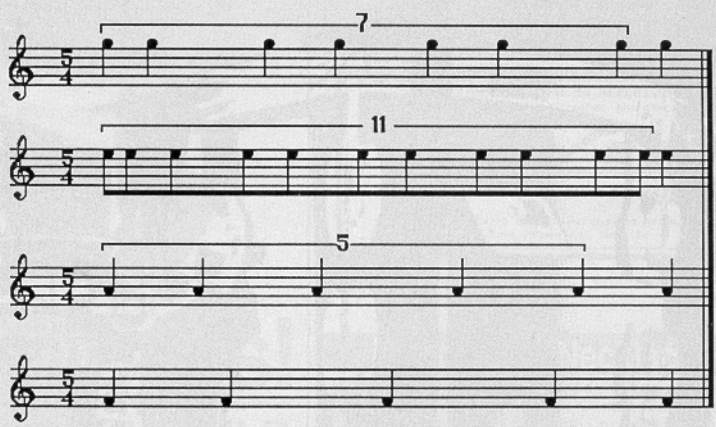
Additional Benefits

If all of these wonderful teaching aids do not convince you to "go electronic," don't forget that you will also have a very powerful computer in your office. Your productivity will increase in many areas. Word processing will help you write that article that you've been thinking about. Data base programs will help you control your inventory of music and instruments. Also, the notational capabilities of this system can make it easier for you to get your own musical ideas down on paper, performed, and maybe even published in much less time.

So what are you waiting for? Electronic percussion has much to offer you and your students. With electronics, there is a whole other world of information to explore and to learn from. On top of that, it's a great deal of fun, too! Really, isn't that what it's all about?

The Machine Shop Sidebar continued from page 69

Example #4



A complex polyrhythm like this can be programmed in a very short amount of time. This rhythm can be played back through the computer, the drum machine, or the electronic set. It can be played back as slow as 20 bpm or as fast as 400 bpm. Notice that all rhythms are automatically aligned to their proper position by the computer.