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Raising students' performance in music composition through the use of information and communications technology (ICT): a survey of secondary schools in England

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This paper is based on research carried out into the effects of ICT on musical composition in secondary schools.[1] It is based on a series of interviews with students and teachers, and classroom observations in eight schools following questionnaire responses from 18 secondary schools in south-eastern England. The strategies suggested for effective use of ICT in composing in the classroom resulting from the research include differentiation and classroom management. In addition to teachers' subject knowledge, and resources and their deployment, it appears that the physical learning environment is another crucial factor.

Introduction

'Music technology' can be usefully defined as any 'situation in which electronic technology is used to control, manipulate or communicate musical information …' (Murray, 1997). The development and proliferation of music technology and the use of ICT in the music classroom has developed out of all recognition in the last ten years, with ever-tantalising possibilities for music teachers. The distinction between teachers of *music* and teachers of *technology* can be seen as separate issues. Only recently have people considered the *music technology* teacher as a type of unique specialism in the same sense as a specialist violin teacher. There is a tension between those who believe computers should help teachers do their jobs as they do them *now* and those who see computers as redefining teachers' roles in the future. Teaching music with ICT seems to be either optimistic and supported (naturally) by the major hardware companies, or bound up with the 'pressure' of acquiring technical mastery and the non-musical aspects of ICT.

In England, the latest version of the Music National Curriculum includes the statement 'using ICT to create, manipulate and refine sounds' as an adjunct to the breadth of musical study (DfEE/QCA, 1999: 21), putting ICT more at the heart of musical activities than previously. In post-16 teaching, new AS/A-level specifications allow for a more technological view of music teaching and learning (e.g. cf. http://www.edexcel.org.uk).

The developments of the 1960s and 1970s included the use of tape recorders and the physical editing of sound, supported by a 'Schools Council' project (e.g., see Paynter & Aston, 1970). In class music lessons now, these would probably equate with the sampling of small sections of pre-recorded CDs into the rhythmic patterns so beloved of rap and hip-hop music artists. This illustrates a comment by Middleton that 'technology and musical technique, content and meaning generally develop together, dialectically' (Middleton,

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1990). The electric guitar is a good case in point. Amplification (technology) began in response to guitarists' demands to be heard over the big bands of the 1930s. Electrification then facilitated an expansion of guitar techniques and bigger and better amplifiers.

The development of microtechnology in the 1980s affected not only the production of electronic instruments but also their application. Electronic instruments that could now 'talk' to each other using MIDI (Musical Instrument Digital Interface), linking computers directly with a musical sound source, was a defining moment in music education. It was not until 1983 that Casio produced their first digital electronic calculator which also had as a 'game' some musical sounds. It was essentially the first electronic keyboard in mass production. The electronic keyboard from both Casio and Yamaha followed shortly afterwards, becoming a valuable sound source capable of MIDI links.

According to Wright (1992), 'there is evidence to suggest that the latter [music technology] may have tended, despite its best efforts, to widen the gulf between music making with electronic instruments and [traditional] acoustic sound sources'. He argues that the use of some software packages such as Cubase will 'have a tendency to draw children away from group music making into the virtual reality' of the computer environment.

The use of music technology as a *resource* seems to be connected to its use as an *object* requiring mastery (cf. Rogers, 1997). Scafe & Wellington (1993: 45) suggest that successful classroom practice should be '*shaped* by IT rather than considered *prior* to it'. ICT can be used as a support to 'encourage, develop and guide students to achieve their expectations and take the necessary shortcuts where there might have otherwise be [*sic*] delay' (Hulbert, 1997). Busen-Smith's (1999) research shows that *students* have fewer concerns about using the *objects* of ICT than their teachers do. She finds that students are generally keen to acquire autonomy with the technology, although Armstrong (1999) highlights gender aspects to this.

According to Crook (1994: 11–24), the three main 'pressures' that influence how teachers perceive the use of ICT in the classroom are *sociological* (e.g. computers being mainly used for individual private work), *economic* (such as expensive hardware outlay) and *pedagogical* (e.g. the perception by teachers of the need for a strong degree of technical mastery). Crook also identifies the following four principal modes of interaction with IT:

1. the computer as tutor (drill and skill);
2. the discovery/constructivist paradigm (employing programs such as LOGO);
3. the computer as simulator (for testing hypotheses);
4. the computer as toolbox (features to do with manipulating and organising self-generated data).

Close interaction in Crook's four modes can have a downside where group working is concerned. But this might not necessarily apply in situations where individualised work is encouraged, such as in composing, particularly at GCSE (General Certificate of Secondary Education) and post-16 levels.

Some relevant issues have been highlighted by Odam (2000) and Patterson (1999), with specific reference to composition employing music technology in the classroom. Patterson reports that teachers were observed 'teaching techniques which enabled pupils to understand the building blocks they need in order to compose', and further that:

> Where the computer is used extensively, there may not be a culture of performing what they have written – pupils can hear everything they write much more easily and frequently than when playing live . . . . (Patterson, 1999: 25)

An emergent role of 'music technology teacher' seems to have required a sea change in the behaviour and attitudes of teachers. Teachers commented that they switched modes 'all the time from performer, to director, to composer on [the] feet, to manager, to quiet support, to galvaniser, to planner, to IT specialist' (ibid.: 24). It appears then that a delicate balancing act needs to be made between teaching *music* and teaching *technology*, with the teacher's role being central to the task. Furthermore, it seems there is a wide variety of solutions to particular problems in the teaching of music using ICT. With these points in mind, an investigation was carried out to explore the tension between teachers who believe computers should help them do their jobs as they do them now and those who see computers as redefining teachers' roles. After outlining the aims and research methodology, the present report analyses and discusses the results of the investigation. It concludes with a summary.

Aims

Busen-Smith (1999) notes the use of headphones, a potential source of social isolation, as affording improved concentration; and that the use of video, DAT or cassette recordings and electronic keyboards supports independent creative work. The extent to which these aspects are commonplace in secondary schools was a research objective. Murray (1997)[2] lists CD-ROMs, recording, electronic keyboards, synthesis, drill and practice software, the Internet, MIDI sequencing and presentation software as having the potential to be used by music teachers in a variety of classroom contexts. Our second objective was to find out the extent to which these resources and applications were used.

The extent to which the following items relating to the effectiveness of the teacher in the learning process, drawn from the work of Odam (2000) and Murray (1997), are evident in classrooms was another objective of the research:

- demonstrating own musical and technical skills;
- being able to compose and improvise 'on the hoof';
- showing technical skills in mending equipment (such as headphones);
- being a good listener;
- having extension materials for moving some pupils on faster;
- being able to deal with constant requests, queries and interruptions;
- being able to refine students' work;
- being able to get students to show what they mean to ensure understanding;
- having good class management skills to ensure equality of access;
- structuring pupils' learning;
- giving pupils choices about how to proceed;
- reminding pupils about saving work.

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Methodology

Questionnaire

A questionnaire was sent to a sample of 30 secondary schools representing a wide variety of classifications: from the maintained and private sectors; independent, comprehensive and technology schools; single sex grammar schools; and a sixth form college. The questionnaire was designed to provide data on teaching resources in schools and how schools used ICT in composing activities. The questionnaire asked teachers to outline their use of ICT in their teaching and to give details of tasks and teaching methods from Key Stage 3 to A-level (pupils aged between 11 and 18), and to mention any factors that were seen as important for the teaching and learning of composition through ICT. The teachers were also asked to provide data on available hardware and software, on technical support, and on their use of the Internet.

Observations and interviews

After analysing questionnaires from 18 schools, observations and interviews were conducted in eight of the schools during the summer term of the 1999/2000 academic year. Classes involving students in Years 7, 8 and 9, 10 and 12 (so aged between 11 and 17) were observed. The classes were taught in a variety of mixed ability groups including single and mixed sex groupings. The types of school included 11–18 and 11–16 comprehensives, selective and independent schools, and a sixth form college. The observations focused on the use of software as a composing tool, and how ICT supported composition, and these were followed up by short, structured interviews with pupils and teachers.

Analysis

The following analysis, based on data collected from the 18 schools, draws a clear picture of what works in the classroom and what skills are needed to teach composition with the support of ICT. It looks at the environment for teaching and learning and the use of resources, as well as pupil and teacher perceptions of the use of ICT.

All 18 schools plan musical activities supported in some way by ICT, from recording and appraisal to a stand-alone unit of work for a whole year group. Several schools remarked on the limitations of their hardware/software, which had adversely affected their desire to use ICT for music composition. In all cases, lack of teacher expertise in technical aspects was noted as a drawback. Training of teaching staff was an issue in 4 cases, ranging from the actual provision of effective programmes to the on-costs of bringing a department up to speed in ICT.

Four teachers were concerned about the cost of ICT systems, some feeling that this factor would preclude them from integrating ICT work on a large scale. Several teachers reported single stand-alone machines for whole class use in their departments. One school commented on the prohibitive cost of replacing equipment simply in order to maintain the present provision. In a number of cases, developmental work was seriously hampered by the cost of new equipment.

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Key Stage 3 teaching programmes were said to be impoverished because of lack of resources to enable effective use of composing software. Suggestions for dealing with shortages by having smaller classes were made, but it was quite common for larger groups of pupils to have to share a computer workstation. Adequate specialist hardware provision was a rarity, with some schools having to adapt general ICT rooms for music use or having to use small numbers of workstations in the music department. One teacher commented:

> [the Senior Management Team] fail to realise that Music is different! Particularly in terms of ICT requirements to other subjects.

Classroom observations gave an insight into unexpected learning outcomes, which seemed to be encouraged by most music teachers within a variety of learning frameworks, from the highly prescriptive to the open-ended. Two of the schools visited relied heavily on pupils' freedom of creative choices, while most reflected traditional training with its accustomed order and hierarchical discipline.

All three of Crook's (1994) 'pressures' were observed in a variety of classroom contexts. The *sociological* pressures of working alone were ostensibly seen to a lesser degree, although small groups of three or four pupils were common. *Economic* pressures were evident where programs and systems had been allowed to fall into disuse and disrepair – plenty of headphones was a rarity. Conversely, a well-resourced classroom was seen, supported by European Union money, but this was not the norm even in the two technology schools included in the survey. *Pedagogical* pressures were seen from a number of perspectives, as the 'mastery' element was definitely a factor in pupil interviews.

In 7 lessons, pupils engaged in composition involving the handling of musical layers. 'Programme Music' was a topic in 2 schools, while more pop-based topics such as 'Funky Song' and 'Pop Song' were also evident. In 2 cases there was an exploration into 'ambient' or 'atmospheric' music using MIDI keyboards as sound sources. In the observed lessons, similar assignments were approached in different ways, with the teacher's perspective seeming significant as the balance shifted between teaching *music* and teaching *technology*.

Use of resources

The most popular computer platform was the PC, with the number of workstations ranging from 1 to 31. Regarding software, over 13 respondents used Cubase or a derivative, and over 7 used Sibelius. Cakewalk and Logic were also used. Teachers observed using Cubase found it effective as a graphical notation package that enabled pupils of all abilities to manipulate musical structures relatively easily.

Most schools made good use of *Hutchinson's Music Encyclopedia* and *Microsoft Musical Instruments*, but in 2 schools CD-ROMs were used for sampling and sequencing.

The initial questionnaire seemed to confirm the centrality of keyboards as a classroom resource, and all teachers visited used electronic keyboards. Recording equipment was also in use, with some schools having Minidisc recording facilities linked to their computer software.

Over 15 teachers had access to the Internet at departmental level, but not all schools had on-line facilities. Twelve teachers had Internet access at home but did not use it to

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download teaching materials. The main issue appeared to be lack of time, with some teachers intending to search for materials during the summer vacation.

Patterns of use were interesting, as it appeared that ICT was most often used to support composing in Key Stage 4, with over 11 teachers using it on a weekly basis to support pupils' musical learning. Just over 33 per cent of weekly classes in Key Stage 3 used ICT.

Despite the growth of music technology as an examination option, only 7 schools used ICT weekly at post-16. One school reported its use for composing Bach chorales via a sequencing program, while others used it for supporting aural work and historical research. Evidence from observations suggests that through the use of ICT pupils with limited instrumental skills were partially successful in realising their musical ideas without being able to play their compositions.

We wanted to explore the questionnaire responses further and, if possible, find out why Cubase was such a strong leader in the survey. Like other computer sequencing programs, Cubase provides the opportunity to create, edit and manipulate arrangements and compositions. Three of the schools visited used a Cubase program of some sort.

We also wanted to explore the reasons why music teachers had adopted ICT as a solution to composing. Does music technology open up the subject to pupils who might not normally be interested in it? A head of music commented that he had 'been using computers ... for the past three years and ... been bowled over by the results'. He continued:

> I would say to anyone just 'try it'. No one could have been more sceptical than I was. I'm a very traditional musician. I'm over 40 and I thought I'd probably never need to touch a computer in my life. But the results are so much better than I ever could have anticipated. They are amazing.

His lesson involved getting a whole class to compose a short piece of pop-based music with four possible outcomes. All 30 of his Year 9 pupils worked well, with no sign of the antipathy expected in the light of Armstrong's (1999) research. Only a few pupils chose to exploit the more disruptive aspects of electronic sound! Pupils were genuinely proud of their work and did not seem phased by the *technology* aspects of the music lesson.

One girls' school was observed with a Year 9 class recording tracks of a minuet as a unit of work on the 'classical' period. They worked in pairs and could choose to record either in real time via the MIDI keyboard or in step time via the score option on Cubase. The highly sectional nature of the activity, with its emphasis on structure, led to some highly individual outcomes. The teacher interacted with each pair of students to solve their ICT problems. Generally the girls observed seemed to be more apprehensive using the technology in comparison with the two boys' classes and mixed lessons seen. Results were shared at the end of this lesson, and refinements suggested. This would seem to support Armstrong's (1999) assertion that girls need more help on the technical side, particularly in the early stages.

An East London technology college Year 9 boys' class was engaged in a similar topic of writing a layered piece involving a melody, bass, drums and chords. The boys were encouraged to use existing tunes. The pupils worked with enthusiasm, but some groups preferred to experiment with 'cut and paste' in long sections rather than in shorter units. Pupils liked the immediacy of their work and the 'professional' sound when it was played back. Many chose to imitate their musical idols to quite a sophisticated level.

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Cubase seemed to provide support for Key Stage 3 and 4 work as pupils could instantly hear what they had composed. Yet, unlike science lessons, where technical support is commonplace, there was no dedicated support time in any of the schools. Teachers often spent a third of lesson time sorting out problems with programs and MIDI links; sometimes the incidence was higher. Resource problems such as network 'crashes' and lost work seemed to contribute to pupils' lack of progress. Two groups lost all their saved work due to a computer 'bug'.

Two observed teachers used a student network to save work, with sub-directories enabling access to the work for assessment purposes. Only 1 teacher used student floppy discs for work storage; several teachers instructed pupils to save work onto the hard disk. The latter made the use of the same workstation a prerequisite in subsequent lessons. Only 1 school, a technology college, had a small, dedicated music network.

In over half of the classroom environments seen, headphones were used, and in 1 case rationed. Pupils sat faced away from the teacher in an inadequate physical space. In some cases teachers struggled valiantly, but in the most effective rooms observed, pupils were grouped facing the teacher with each workstation enabling sight of the main board and, where applicable, the main sound system.

Student perceptions

Pupils of all abilities seemed eager to hear what they were doing and get it right. It seemed a natural support for pupils who do not have the performance skills necessary to achieve their aims with more traditional music activities. One said:

> It's encouraging. You can write songs easily and hear them as soon as you have made them. (Year 10)

Another pupil in a mixed ability class saw the benefits of a unit of work thus:

> We can write stuff like [*sic*] we listen to. Our *Eastenders* theme sounds like a great dance track. (Year 9)

These pupils, who continued to hang around the technology facilities at break time, were obviously highly motivated.

Sound technology can be threatening, particularly if seen as a complex new skill to be learned. One pupil working in a girls' selective school was particularly disillusioned with the ICT process, preferring the immediacy of the piano and its almost physical contact with the player to the virtual world of the MIDI keyboard.

Pupils observed appeared to have a clear outline of the sound they wanted, although it was not always clear how this was helped or hindered by their use of ICT equipment. In an open-ended lesson on 'ambient music' by a Year 12 class,[3] students preferred sound samples of other musical themes to recordings of sound effects and other environmental sounds. The teacher tried to lead them towards hearing the potential of environmental sounds, but the students liked overlaying other theme tunes such as 'The X Files' with a held pedal note or chord sequence.

In most of the lessons observed pupils were asked to use prior learning such as chord theory or ICT procedures. Some pupils interviewed felt that the ICT work did not connect with their other musical learning, as is borne out by the following statements:

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> All practical [work] is done on keyboards here. I'm never asked to bring my violin in. (Year 8)
>
> We use the keyboard to select sounds, but I wouldn't say it was much of a skill. (Year 8)
>
> I can write it all out in my manuscript book already, this program [Sibelius] makes it look nice but it doesn't help me compose. (Year 7)

When using sequencing programs, pupils who could read conventional notation seemed to prefer the 'score edit' rather than dealing with the more abstract sound manipulation in the 'arrange window'.

Technical development was an important part of pupil progress. In one school the teacher used Class Link to put his own workstation screen onto every computer in the room. Pupils could see exactly how he manipulated the music and program features. Complex editing commands were often introduced on a need-to-know basis, although in several cases this was performed by the teacher (cf. Odam, 2000).

Teachers' methodologies

In the classes observed, there was a mixture of whole class, group and paired work. Half of the classrooms were sufficiently well resourced to enable some individual work. This was achieved with up to four pupils working at each workstation.

Some teachers were concerned that some pupils would only ever experience composition in groups (cf. Odam, 2000). It can be argued that group composing can be better than the sum of its parts in the sense that pupils can work to their strengths to create a composition which is better in quality than is possible for an individual to compose. At least one group of musically inexperienced boys observed was able to construct a complex five-part arrangement of the *Eastenders* theme, complete with counter-melody, walking bass and varied drum track, in one lesson.

Six teachers observed actively demonstrated their own skills in class, although some commented on their inexperience in music technology. One said he brought his own equipment into school to use, as he was more familiar with it. The teachers also worked around the classroom composing and improvising in an interaction with the work pupils had done. The use of templates in several lessons also helped pupils make quicker progress, as they could see what was expected, and then edit and manipulate the musical tracks to make their own piece.

In all 8 lessons observed the teacher had to mend equipment or act as technician. Busen-Smith (1999) notes 'persistent equipment failure' and 'equipment failure detracted from learning' as having major consequences for learning. The loss of the entire work of 3 groups was due to a formatting error by a teacher when transferring data between two programs. Problems with MIDI connections were also widespread.

Another general issue was the time teachers spent resetting equipment, program defaults and MIDI voices. Systems that did not use a network for storing work were prone to accidental alteration by pupils. Retrieval of work was another problem, particularly where pupils had not noted down keyboard settings or the location of their files.

Teachers were actively involved in listening to their pupils in lessons, moving them on where appropriate. One mixed ability class was carefully structured to include new instructions later in the lesson, and one small group in an independent school was set

regular challenges to 'move the piece' on and for them to develop ICT skills. Teachers observed were constantly responding to pupils' requests, queries and interruptions. Even in a single sex selective classroom where there were guidesheets to follow, pupils still demanded a great deal of attention from the teacher. Most of the pupils' queries were to do with the *technology* aspects of the activity.

One teacher saw the use of ICT in music composition as essentially three lessons in one, thus:

> The boys are really learning to play the piano on one level, dealing with musical theory on another, and learning ICT skills as well. It relies on student motivation to succeed.

Some pupils were able to quantify their work systematically; others were shown how to use some of the graphical note editing screens. Only one teacher went on to show how the global settings of the Cakewalk program could be used to affect the expressiveness of the piece.

Summary

From this study we can see that secondary school teachers are making use of ICT creatively to raise their pupils' performance in composing tasks. Significantly, the mass production of keyboards has brought a technological resource into the music classroom. Pupils were observed to be engaging in Crook's (1994) four modes in many varieties of encounter, from pop-based song composition to classical minuet. Most effective progress was observed when the unit of work linked into prior musical learning of chord or song structure. All teachers observed related the task back to pupils' music knowledge in some way.

Teachers seemed to be most concerned about the 'pressures' in music technology work. Most influential in a teacher's decision whether or not to work with ICT in music was the economic pressure of the sheer expense of workstations and consumables.

In the lessons observed, pupils worked quickly to input their ideas, supporting Rogers's (1997) observations regarding the group dynamic and influence of peer performance. They worked with MIDI sounds that they were incapable of manipulating 'live', and they were able to 'model' their piece by playing back what they had sequenced.

In some lessons the pupils did not use ICT equipment to its full potential, particularly when they were expected to use theoretical concepts they had forgotten. Pupils achieved the highest standards when they were given musical and technological information as they needed it. There were clear benefits to the whole class being able to see on their screens what technical operations were required and what would be the musical result.

In all but one observation, pupils worked as composers controlling the input of data, bringing to bear quite complex planning and refining skills. One sixth form college tapped into the students' interest in contemporary music by allowing CDs to be sampled into a piece as a collage technique. An outcome of the work was to be the production of a CD of the finished piece as an example for assessment and a keepsake for the students.

This study reveals that very few teachers had time to develop fully study opportunities on the Internet. Where teachers record any views, they mention pupils having access to it as a 'search' for materials. Only one school had resource materials to support

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individualised learning, with websites identified in much the same way as a booklist or sources list in history.

BECTA's (1998) ideals for the teaching of music using ICT are quite well embedded in schemes of work in the schools investigated. Further training of staff under the New Opportunities Fund (NOF) and other courses will be needed if staff are to perceive the real potentials of ICT in musical composition outlined by Hulbert (1997).

The musical content observed varied from school to school, but there was a danger of using up valuable curriculum time without extending pupils' musical skills. Clare (2000) sees the use of ICT as an e-panacea, recommending that ICT use be limited to areas where phenomena are hard to reproduce or simulate. Teachers who wanted to avoid this problem structured lessons carefully and balanced experimentation with musical recreation in much the same way that a traditional music teacher would do. The ICT solution allowed pupils a highly relevant and immediate resource to manipulate layers of sound in a wide variety of styles, bringing together musical forces that could not be assembled in a normal music classroom.

From this study, the skills needed for successful teaching of music composition supported by ICT would seem to reflect Odam's (2000) conclusion, but there remain serious doubts about the reliability of equipment used in schools that can seriously undermine even the most dedicated teacher. The music composing observed supported by ICT *did* require 'mastery' of three elements: *music* knowledge, *instrumental* skills and *technology* handling. Musical success was possible in all or none of these areas, but where pupils were really 'fired up' they were comfortable with all three. At its best ICT did enable attainment in music by opening up avenues of exploration: composing music pupils could not play reliably themselves, performing music with a control of detail not possible in 'live' music, and listening to the merits of live and sequenced versions of a song. It enhanced pupils' progress most obviously in areas such as listening to where a track can be muted or enhanced to isolate musical features usually hidden in a complex texture. The classes seen were, in the main, enthusiastic, with pupils wanting to improve their composing skills.

In conclusion, as the present report represents a snapshot of a small selection of schools, its results cannot be generalised. The investigation, following Mills & Murray's (2000) more extensive work, preceded recent curricular developments which suggest that music technology may be getting a stronger profile in English schools and that it will become a more prevalent feature of the work of music teachers (cf. Kwami, 2001). But the extent to which music teachers can balance the increasing tensions of their role as teachers of music *and* technology remains to be seen.

Notes

1 A research grant was funded to the first named author by the Teacher Training Agency (TTA). The second named author contributed to the project as a consultant.

2 Andy Murray has been attached to the British Educational and Technical Authority (BECTA), which was formerly named the National Council for Educational Technology (NCET). Both the NCET and BECTA have done a lot to develop exemplar materials for teachers, such as the Curriculum Information Technology Support (CITS) initiative and the Music Technology in Action Pack.

3 On a Business and Technical Education Council (BTEC) course.

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