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The group synergetic effect: some observations in relation to design with relevance to schools

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Abstract
This paper examines some aspects of synergy in relation to the activity of designing by pupils. Firstly the concept of synergy is considered by reference to the literature on the subject. Secondly observations are made from fieldwork completed by the author. This fieldwork consisted of a series of case studies of pupils designing in teams. It had been hypothesized that the performance of such teams would be enhanced by synergetic effects in comparison with design work done individually. The limitations of these observations, due to the specific conditions of these case studies, are made clear.

The fieldwork demonstrated a positive effect on endeavour in these situations; but it was not possible to demonstrate a positive effect on the quality of design work completed. Pupils tended not to adopt a competitive approach but did respond to deadlines. Pupils preferred to establish cooperative team management structures rather than establish leaders, who were not seen as relevant. Endeavour was maximised in teams which were selected so that they were heterogeneous in terms of gender, friendship groupings, subject expertise and ability.

The findings from the fieldwork are then interpreted in relation to the theoretic literature. Certain conclusions are drawn in relation to the teaching of design in schools and suggestions are made for further research.

Introduction
Groupwork in schools is an accepted practice for a variety of reasons ranging from vocational and social growth through to simple lack of resources. The literature on groupwork often refers optimistically to synergetic effects which hold the possibility of greatly improved results, yet both in industry and in schools, this does not always occur. Design and Technology teachers have an interest in understanding synergy and ensuring that it is positive in an identifiable manner such as the range and quality of design ideas generated.

This paper compares aspects from the literature and findings from a programme of fieldwork in schools. Synergy is defined, the literature is visited and then the fieldwork findings considered. These are then juxtaposed and discussed.

What is synergy?

In the social sciences writers on synergy tend to polarise into two camps:

* The positivists see synergy producing effects greater than the sum of individual effects, though these effects are rarely defined. Moulton (1984 p11) saw synergy as: the concept that under certain conditions the whole can be more than the sum of the parts. Hampden-Turner (1971 p 55) stated that Synergy — consists of an affective or intellectual synthesis which is more than the sum of its parts.

* Others define synergy neutrally. Hackman (1983) stated that synergy refers to group phenomena which emerge from interaction and affect how a group is able to deal with a situation. Similarly Shaw (1971), referring to Cattell (1948) used the term syntality - the personality of the group, more precisely, as any effect that the group has a totality. (sic)

Experience of the groupwork discussed below, tends to show that synergy is variable in relation to the effect of individual work. Because of this the second, neutral, definitions seem more appropriate: they allow variation in synergetic effects at any given time and do not assume group synergy to produce effects greater than the individual.

A synergetic function may be indicated in a number of ways. Hoerr (1989) looked at 'output' in industrial group work settings. He reported gains of as much as 250%. Buchanan (1989) looked at employee self confidence, tolerance and flexibility; seeing improvements in these areas with the adoption of group work. These results are clouded as the introduction of group work coincided with changes to 'flatter' management structures, giving workers greater personal responsibility and autonomy. There is evidence of some industrial innovation based on group work resulting in diminished results in relation...
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to previous systems (Buchanan); group members do not always accept the new practices involved.

Explanations of synergetic processes are difficult to find. Shaw (1971) assumed that there would be a loss of ‘effective synergy’ due to interpersonal relations, termed maintenance energy’. Driskell et al (1987) showed gains could be made via an ‘assembly bonus effect’ when pooling resources to minimise errors. This would appear reasonable when the task is simply assessing factors, but those who have used ‘brainstorming’ techniques effectively would probably feel that it does not explain the improved flow and breadth of ideas in more creative group tasks.

What do authors suggest?

Little has been done directly in the area of synergy and designing. Most work has been in the area of group effectiveness in general education, only indirectly describing synergy. The balance of evidence is that if given a good understanding of the effects involved it is possible to ensure that the overall effects of synergy are ‘positive’, though the form of this can be varied. Relevant points are:

a. Yeoman (1983) concluded that when children learned in groups results was significantly ‘better’ than individual learning and at the very least no worse. Bennett and Cass (1988) found that lower ability children achieved better when working cooperatively with higher ability children. High ability children did not appear to suffer.

b. There are strong indications that heterogeneous groups develop better understanding and empathy in the cases of gender and cultural differences (Cowie and Rudduck 1988).

c. Competition is often associated with groupwork, even if informal. This may aid performance via an increased task focus (Miller and Davidson-Podgornay 1987). There are dangers as competition builds anxiety. If this rises beyond an indefinable point performance is then inhibited. The optimal level of arousal/anxiety built by competition will depend on individual group members and will be difficult for staff to predict.

Hackman (1983) and Hampden-Turner (1971) observed that competition may build esprit-de-corps within a group. They also noted that interpersonal relations may degrade together with a rise in pressure to conform and a fall in creative thinking; an important point in relation to design.

d. Groups may be established by self-selection or on criteria decided by staff. Self-selected groups may be more cohesive initially as members are likely to share common mores and friendship. Perry and Euler (1988) found that high cohesion groups out-performed low cohesion groups; however self-selected groups did not out-perform teacher selected groups. These results appear to contradict each other. Time scale is an important factor here. Teacher selected groups may, initially, lack cohesion and suffer a ‘process loss’ as they establish new relationships; interaction between members may use more energy than it generates. However, such groups will probably have a broader range of resources than a self-selected group and, therefore, have a better assembly bonus (Driskell et al 1987). Often groups plagued with conflict perform better than those which appear cohesive (Hackman 1983) possibly because they have a range of perspectives and prevent the group settling down to an easily agreed direction.

This limited review of some of the literature, indicates that whether in industry or education the function of management in establishing the group composition, environment and focus can be an important factor in influencing group synergy. Problems can be caused by poor understanding of groupwork by management (Buchanan 1989) or teachers (Cowie and Rudduck 1989).

The indications are that groups should be established with a spread of perspectives. Gender, ethnicity and ability should be considered. A group cannot work effectively without careful preparation and ‘warming up’ (Van Ments 1978). The task should be challenging and offer appropriate work for all (Hackman 1983). The group should have an appropriate base to work from which aids effective communications. The teacher or manager should be prepared to stand back and offer groups more autonomy (Jones 1989).

Up to this point the potential of synergy has been discussed in relation to the general development of ideas and performance rather than designing. The positive synergy realised by effective brainstorming aspects of design work should lead to improved flow and number of ideas together with the ability to improve the quality of accepted ideas. Where research has concentrated specifically on designing there has been a tendency to use experienced designers or design students as subjects, making findings less valid to designing in schools. Tovey (1986) looked at designing by individual industrial design students but used retrospective evidence such as drawings and models. He failed to acknowledge that there may have been informal groupwork during the development of these
designs. This is an important point; design in schools or higher education is rarely carried out in examination like conditions.

Scrivener and Palmen (1991) looked at designing in pairs. Unlike Tovey, they concentrated on observing the process as much as the outcomes. Whilst based on a small sample the indications are worth considering. Pairs tended to establish two roles, the synthesizer and the appraiser. The synthesizer produced the majority of ideas and drawings. These ideas were both self started and those built on ideas started by the partner. The appraiser was more involved in the evaluation of ideas and drawings produced by the synthesizer. It was noted that the process was parallel rather than being a period of synthesis followed by appraisal. There was little verbal discussion; communications centred on drawing.

Scrivener and Palmen noted that the roles distributed work by process rather than specific areas of the task. Effectively the pair honed ideas as the potential for synergy was maintained by working together. If the pair had delegated different parts of the task to be worked on independently the synergy potential would have been reduced. It is probable that non-specialist designers would be less able to recognise the importance of the process and would be less skilled in applying it than the undergraduates used by Scrivener and Palmen.

Observations from the fieldwork
The fieldwork was based on a series of case studies of groups of pupils designing products. The perspective was a general one looking at the way in which each ‘event’ ran rather than focussing specifically on synergetic effects on design.

Group members were not specialist designers but normal populations including samples from years 7, 8, 9, 10 and 12. The groups were set up in various ways including peer groups and teacher set groups with heterogeneous mixes of gender, culture, ability and subject expertise. The groups operated within commercial simulations and so effectively were intended to be in competition. Time scales varied from hours to one week of a residential course.

It was apparent that these groups went through three basic stages of maturation. There was an initial phase of ‘meeting and clarifying’. This was characterised by poor group coordination. The minimal structure of the events, intended to offer groups autonomy and responsibility, may have contributed to this slow initial response by not giving an operating framework.

The second phase of ‘forming and accelerating’ was characterised by the development of working relationships and movement on the task. The third phase, of ‘intense group activity’, was characterised by very high levels of endeavour. By this time group relationships and organization were established and deadlines were close enough to ensure urgency. Whilst children were showing a strong level of application to task there was no evidence of an improvement in the quality or range of design ideas generated, contrary to expectations.

It was apparent that given freedom to establish their own management structures groups almost invariably aimed for a cooperative model. In fact leaders did emerge during the course of the various case studies but the groups appeared either not to recognise this or ignore it, preferring a cooperative ideal. It was apparent that those groups in which effective leaders emerged were more effective on task. The levels of endeavour and achievement appeared highest in groups selected by staff on a heterogeneous basis.

The physical layout of the group base did influence the work done. The best group bases allowed all members to gather around a table in direct eye contact. It was important that all members could contribute to drawing or other modelling on that table in full sight of all members. Groups performed better when there was a degree of separation from other groups. This enhanced intra group focus and prevented members being diverted by peers in other groups. Low screens were very successful in that staff could survey a whole room and yet by sitting down a group was much less aware of others.

Discussion
Whilst the fieldwork indicated a positive effect in terms of endeavour which may have partly arisen as a function of synergy, (assisted by recognition of the approaching deadlines), there was no apparent improvement in the quality or range of design ideas as had been expected. The following observations are of interest.

a. Work was frequently delegated within the groups on the basis of aspects of the task, unlike the experienced designers described by Scrivener and Palmen. There would be reduced potential for synergy within that sub task as the work was individually based; this removed even the possibility of error cancellation as described above. Good communication and effective review meetings could possibly counter this but the accounts show that in these areas groups were ineffective at least initially.
This may, to some degree, explain why positive synergy, in design terms, was not evident.

b. The early phases of design work were done when groups were in the first phase of 'meeting and clarifying'. This was characterised by confusion and poor coordination. This represents a phase of negative synergy where most energy is being used to build new relationships and clarify the task. Design work done in this phase was evidently limited and of poor quality and yet had to provide the basis for subsequent design work.

c. Design work, including final modelling done in the later phases may have been negatively influenced by levels of arousal and anxiety which exceeded optimal levels. Urgency may have caused a more 'economic' approach to design, with teams ready to accept ideas sooner rather than explore more fully. The data are not detailed enough to draw firm conclusions and so further work is necessary. In itself an 'economic' approach to design is not necessarily bad if looked at in terms of a long term teaching scheme for Technology. Certainly professional designers have to be economical in the amount of time they give to a project and cannot afford to explore in an entirely open ended manner. It is important that at appropriate times pupils be allowed and encouraged to explore ideas and develop them under more relaxed conditions without commercial conditions such as deadlines, costings or competition. In this way, whether working individually or in groups it is possible to develop appropriate skills and importantly, positive attitudes - a love of design and designing.

Conclusions

These conclusions must be viewed with caution. They are drawn from the fieldwork on a specific type of design situation. However, juxtaposed with findings from the literature it is possible to enable certain limited conclusions to be drawn.

The fieldwork focused on groups within a competitive scenario and with specific deadlines. The literature (Hackman, 1983 and Hampden-Turner 1971) indicates that excessive pressure may have caused group synergy to be negative in relation to that possible with reduced pressure. This may explain the evident high levels of endeavour in the fieldwork, reflecting pressure, but the lack of positive synergy in terms of design thinking. This need not be the case in other group design situations.

Deadlines and competition can be used positively, but staff should be very sensitive to levels of arousal exceeding optimal levels. Only staff close to the groups can be aware of what these levels may be. Such pressures could be used positively if the intention was to generate opportunities to discuss the effect of working under pressure.

There is evidence that most groupwork in schools is working in groups rather than as groups (Bennett and Cass 1988). Such groups typically only share resources and effectively work independently. Staff should select design tasks which suit groupwork and encourage children to work together as indicated above by Scrivener and Palmen rather than delegating aspects of the task to individuals and so eliminating the potential for positive synergy. The literature and fieldwork also indicated that groups need time, and possibly support, to establish positive synergy. It may be hypothesized that experience of working cooperatively would enable children to more quickly go through the stages of groupwork described above and may then generate positive synergy quickly.

Similarly, if a new group is established it should be warmed up until it is working in phase 2 or 3 before the main task is introduced. Group brainstorming exercises used regularly need only take a few minutes but can be used to help a group to integrate and also realise how they can generate more ideas as a group than when working independently.

Groups should be given a base to work from which maximises communications between members, following the principle described above.

Staff should recognise the advantages of heterogeneous groups which besides offering better perspectives on a task also have social benefits as described above. However, such groups do have a lower initial cohesion and require more warming up before they are working with positive synergy.

References


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